

**Governing invasive plants: policy and practice in managing the Gamba grass  
(*Andropogon gayanus*) - bushfire nexus in northern Australia**

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**Abstract**

Predicted nonlinear changes in the Anthropocene will challenge the extent to which environmental issues are governable. Climate change projections highlight positive feedbacks between invasive species spread and increased bushfire risk. We use empirical evidence of current practices of invasive plant management, and the case of Gamba grass (*Andropogon gayanus*), to illustrate what it means to live with invasive plants. Gamba is a significant threat to tropical savanna biodiversity through its influence on fire regimes across northern Australia. We analyse the practices of Gamba governance via policy analysis, interviews with over 50 managers and participant observation. Our results show the multiple ways in which Gamba exceeds and escapes governance, exposing the impossibility and risks of absolute control as a management framing. By attending to practice in this way, we show how an alternative framing, in which living with weeds is a more explicit part of the governance framework, can work. Our framing contribute to more effective management because political choices are made more transparent, valorises pragmatic knowledge about the messy reality of living with weeds, and mobilises a broader range of resources including land managers now resistant to the state. The Gamba-fire assemblage has mobilised political action by invoking fire policy rather than weed policy, but not necessarily in a way consistent with best practice weed management. Attention to these practices of vernacular governance not only shows the ideal of present control to be illusory, but will also provide important cultural resources in the form of networks and capacity, as the challenges of invasive species shift and intensify.

**Keywords:** Weeds, environmental governance, climate change, savanna land use, bushfire, *Andropogon gayanus*, qualitative methods

## **1.0 Introduction**

Invasive species are considered to one of the most significant environmental problems of the twenty-first century, becoming more severe under climate change (McGeoch et al. 2010; Barbour and Kueppers 2012; Driscoll et al. 2012). Evidence suggests that the Anthropocene – the period of human domination of earth surface processes - will increasingly be characterised by surprise, uncertainty and nonlinear change as different environmental thresholds are crossed (Steffen et al. 2011), challenging land use policy developed for conditions of predictability (Lorimer 2012). It is not only that the rate and scale of change has increased, but also that human activities have contributed to a situation that then spirals out of our control, in which different types of nonhuman agency are exerted. Extreme weather events, outbreaks and spread of invasive species, and sea level rises are all set to exceed the capacities of human societies to control them or even to respond effectively. In this context the question of what it means to ‘manage’ or ‘govern’ an environmental or land use issue must be rethought. Uncertainty, surprise shifts and potential catastrophe ‘challenge the steering capacity of governance at all political levels’ (Duit and Galaz 2008: 311; Lemieux et al. 2011; Schmidt et al. 2013; Merrie et al. 2014).

Scientific assessments of the reasons for failure to control invasive species draw attention to issues such as inadequate policy, lack of funding, gaps in scientific knowledge, and the complexity of managing across complex and increasingly fragmented land tenure landscapes (Simberloff et al. 2005; Epanchin-Niell et al. 2010; Driscoll et al. 2012). The rhetoric around such policy frameworks commonly uses a discourse of war and winnability (Larson 2011). There is increasing recognition of the importance of understanding socioecological factors

such as landholder motivations and incentives (Klepeis et al. 2009; Epanchin-Niell et al. 2010), but the overall tenor of most invasive species management literature is that the problem can be fixed if the right combination of science, policy and funding is directed towards the problematic species. The ‘knowing-doing’ gap, for example, has drawn attention to the extent to which research in invasion biology addresses the problems managers face (Esler et al. 2010). Invasive species management is not alone in this; it is echoed in other issues such as ocean (Crowder et al. 2006) and forest (Seymour and Forward 2010) governance. Others draw detailed attention to the politics embedded in the policy process itself (Mann and Absher 2014).

This paper addresses three related questions. Broadly we ask what actions are appropriate when the total context may be essentially ungovernable? Second, how well suited is a linear and instrumentalist policy process – even when well coordinated across spatial scales - to more mobile and distributed agencies, causations and changes? And specifically, what does it mean to live with invasive plants in ways that do not abandon all human responsibility? We use the case of Gamba grass (*Andropogon gayanus*) to examine how invasive plant governance needs to be reframed for increasingly uncertain conditions. A pasture grass introduced through government policies to assist the pastoral industry, Gamba grass is (in principle) one of the most ‘governed’ species in Australia, if by governing we refer to the legislation and policy that surrounds it. By attending to the practices of governance as well as to the plant itself as a key part of the governance assemblage, we argue for a broader understanding of what contributes to and constitutes governance. By illustrating the practices of living with Gamba, including in the context of challenges outlined above, we are able to demonstrate areas of traction and areas of friction. This indicates both how policy and governance might be improved and reframed for a more enduring relationship.

‘Living with’ rather than ‘completely removing’ is only just emerging as a theme in the invasive species literature, where aspirations to the pristine have remained deeply embedded (Atchison and Head 2013; Gibbs et al. 2014; Tassin and Kull 2015). In contrast, ‘living with’ (Aitken et al. 2009, Head et al. in press), or more flexible approaches, are a well-established theme in biosecurity discussions of various animal diseases (Hinchliffe, 2007; Hinchliffe and Bingham 2008; Mather and Marshall 2011; Phillips 2013; Barker 2014). Nevertheless, as Mather and Marshall (2011) note, the notion of ‘living with’ can be vague and ambiguous in terms of offering alternative management strategies. ‘It is not clear what living with disease means or how a loosely coherent program might translate into a workable approach to animal health’ (Mather and Marshall 2011:154). In invasive species management, any acknowledgement that underlying conditions have fundamentally changed, e.g. in the discussion of novel ecosystems, is often interpreted to mean giving up or ‘lowering the bar’ (Murcia et al. 2014: 551).

Issues with Gamba grass reflect the diversity of intersecting land use challenges being experienced globally. Climate change and invasive species are now interacting to ‘generally increase the risk and intensity of fire’ (IPCC 2014:18). Such interactions are being reported more frequently as a direct result of increased temperatures and increased invasive plant biomass, for example, in the case of invasive annual grasses (Abatzoglou and Kolden 2011). Ecologists are concerned that Gamba’s transformation of fire regimes is heading towards a threshold transformation of the tropical savannas of northern Australia, a key area of biodiversity conservation globally. The main threat posed is the potential of Gamba 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. The outcome

could be transformation of the savanna into grassland (Rossiter et al. 2003). The IPCC has also identified the ‘decoupling of relationships’ as another challenge to invasive species management under climate change. The implications of this are that increased invasive species biomass for example, may mean current control measures such as biocontrol or mechanical management, may not continue to be effective to the extent they are now (IPCC 2014).

The structure of the rest of the paper proceeds as follows. We next outline key trends in the environmental governance, land use and biosecurity literatures as they relate to the question of invasive plant management, before outlining the methods and presenting the results of the empirical study.

## **2.0 Environmental governance and the challenges of invasive plants**

A number of processes interact to create a challenging management and policy environment for invasive species, particularly plants. First, there is widespread recognition that invasive species interact with a diversity of other things happening in the landscape, including public perceptions and preferences (Boonman-Berson et al. 2014; Rolfe and Windle 2014), land-use patterns and changes (Waldner 2008; Klepeis et al. 2009), fire (Le Maitre et al. 2014) and climate change (Tassin and Kull 2015).

Second, governance - which takes place formally at national, state/territory and local levels in Australia, draws attention to the relationship between different scales, and the challenges of governing across scales from the international to the individual landholder. There is wide recognition in geography and the environmental governance literature that scale is socially and politically constructed rather than pre-given (Moore 2008; Bulkeley 2005). This means

that assumptions that governance can easily be ‘ “cascaded” down through national, and implicitly, subnational arenas of governance’ (Bulkeley 2005:879) must be contested. Climate change is seen to be the classic cross-scalar problem, partly because of the spatial disjunctions between the cause and effects of the problem (Lemos and Agrawal 2006; Bulkeley 2010; Reed and Bruyneel 2010; Hoppe et al. 2013). Invasive species research is also beginning to show how influential very small scale phenomena such as human bodies and seeds can be (Atchison and Head 2013).

Responding to these challenges effectively means acknowledging complexity. The environmental governance literature offers useful insights here in the attention it gives to the assemblages being governed. Rather than a linear relationship from science to policy to the problematic species, there is recognition of a less linear, complex network of actors and processes (Ogden et al. 2013). Indeed researchers draw attention to failure, as an inherent and fundamental aspect of governing, and a constitutive part of regulation itself (Higgins 2004; Law 2006; Enticott 2014). They also draw explicit attention to the influence of nonhuman actants, for example, Lockie’s (2004) analysis of Landcare organisations in a field characterised by distributed rather than unidirectional agency. Recognition of the complex ‘assemblages of governing’ (Lockie and Higgins 2007), including in climate change governance, is influenced by a large body of work seeking to go beyond the human-nature binary and consider relations between humans, plants, animals, bacteria and a host of others (Haraway 2008; Lorimer 2012). As we will show, policy frames itself as governing invasive plants as *species*, but to be effective this governance has to enrol a host of others: funding, machinery, chemicals and all sorts of human actors. In this paper we also draw attention to the agency of the plants themselves in the practices being undertaken (Head et al. in press). As Barker argues

For invasive plants and plant diseases, the inherent unpredictability of relational life leaves national and international governing bodies and international trade agreements scrambling to keep up, and poses problems for risk assessments based on current observations – as good behaviour in one environment fails to guarantee docility in another – particularly in the context of climatic shifts (Barker 2014: 3-4).

Of particular relevance to our study is attention to the *practices* of governing (Bulkeley and Broto 2013; Boyd et al. 2014) the everyday, fine-grained activities that make up the broader assemblage that comes to be called governance. Many kinds of labour are involved in governing invasive plants; writing funding applications, reporting on funded grants, establishing and running community education programs, negotiating among adjacent landholders, and undertaking occupational health and safety training. Understanding such practices requires methodologies that are attuned to the everyday – ethnography, participant observation and in-depth interview. Institutional relations or technologies of governing such as funding programs are not pre-existing but are brought into being by everyday practice. Similarly, legislation and policy does not simply cascade into a sequence of actions which people subsequently practice. In these respects our work chimes with other research in which the social processes involved in invasive plant management are firmly on the agenda (Klepeis et al. 2009; Epanchin-Niell et al. 2010; Gill et al. 2010).

Following Mather and Marshall's (2011) call to specify more clearly what 'living with' might involve, and how choices might be made in the biosecurity field (mostly related to animal disease), a number of studies have analysed biosecurity as an ongoing, enacted achievement; it takes work (Enticott et al. 2012; Phillips 2013). In her examination of the work it takes to live with(out) fruit flies in Australia, Phillips argued that existing flexibilities (such as those

documented by Barker 2008) are currently underestimated, and that there needs to be much more practical and material specification of how biosecurity is achieved. Like Mather and Marshall, Enticott et al. (2012) demonstrated the important of locally situated practices and knowledge in relation to bovine tuberculosis, arguing that these ‘are more likely to have an impact on biosecurity behaviour than those which attempt to standardise biosecurity and disease’ (Enticott et al. 2012: 327).

Adaptive governance differs from more centralist, linear approaches and has been put forward as a more dynamic way of managing uncertainty. Effective adaptive governance ‘involves coordination of effort by apparently independent systems of users, knowledges, authorities and organized interest groups’ (Cook et al. 2010: 1304). It is heavily dependent on information flow – along larger numbers of shorter and more locally-relevant information pathways than in a centralised system. Most current weed policies do not even countenance the possibility of failure; an adaptive governance framework suggests however, that understanding failure will be as important as success. In cases where environmental costs are yet to be fully reconciled against pastoral economic dependency, such as Buffel grass (*Cenchrus ciliaris*) in central Australia (Friedel et al. 2011; Marshall et al. 2011; Grice et al. 2012), adaptive governance may be a useful framework for managing species which have so far proved too socially contentious. In this particular case social analysis has revealed some mutual acceptance of different stakeholder perspectives, suggesting that adaptive governance may be a way forward where it is possible to achieve mutually agreeable goals. In demonstrating the many different, often independent, actors involved, our approach has some features in common with that of Cook et al. (2010).

In summary, by focusing on the practices of invasive plant management and governance, we are not advocating ‘anything goes’, nor giving up on the very severe socioecological problems posed by invasives. Rather we take issue with the assumption that all problems are there to be fixed and are fixable through ‘good’ policy and governance. The challenges of rapid and unpredictable change in the Anthropocene are overlaid on an existing situation in which contest, chaos and failure are a normal part of the policy and governance process (Higgins 2004; Mann and Absher 2014). The extent to which invasive species management acknowledges this reality and frames itself in terms of effective governing practice, is thus also an important theme we attend to here.

### **3.0 Methods**

The environmental governance literature shows the practices of governance to be particularly significant, and to this end our empirical contributions use multiple qualitative methods. These methods are recognised as providing important contributions to the analysis of governance and complex systems (Duit et al. 2010; Hagerman et al. 2010) by highlighting everyday practices, complexities and contradictions. We analyse the governance framework through documents and policies. We then draw on semi-structured interviews with 51 participants in different contexts (policy-makers, scientists, landholders, ranger groups, landcare volunteers), plus participant observation of field activities and stakeholder workshops, across Queensland, the Northern Territory and Western Australia, between 2010 and 2013 (Table 1). Interviews were transcribed in full and coded according to common themes structured by the questions (descriptive codes), and emergent themes that arose during the interviews (thematic codes) (Cope 2005). The time period of fieldwork coincided with the declaration of Gamba grass under the Weed Management Act NT in 2010, the establishment of formal governance processes, and the raised profile of Gamba due to its fire threat across

the Northern Territory community. In the concluding discussion we consider the wider implications of this work.

#### **4.0 Invasive plant governance in Australia and the case of Gamba grass**

Gamba grass (*Andropogon gayanus*) was introduced from Africa to Australia as part of a Commonwealth Government pasture improvement program in the 1930s (Cook and Dias 2006). In its present genetic expression Gamba can be understood as an Australian cultivar, a result of the CSIRO experimentation and pasture release pathway (Anon. 1987). A perennial tussock growing to 4 metres, Gamba grass produces large amounts of seed (70,000 per m<sup>2</sup>) and grows in a wide range of environments (Flores et al. 2005). It out-competes native grass species and thus alters grassland species composition, hydrological function and nutrient composition (Rossiter-Rachor et al. 2009). Gamba grass now currently covers between 100-150,000 ha in the Northern Territory (NT) and about 60,000 ha in Queensland (Qld) (DEEDI 2011), but is thought to have the potential to cover 380,000 ha of the NT (NRETAS 2010). A number of incursions have recently been recorded in northern Western Australia (WA).

The main threat posed by Gamba grass 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 (Rossiter et al. 2003). Its ability to radically alter fire regimes also threatens a range of human activities, including those on the peri-urban bushland fringes of Darwin and Palmerston in the NT. Setterfield et al. (2013) calculated that fire management costs had multiplied about nine times over the previous decade, primarily due to Gamba invasion.

With the three levels of government in Australia having different environmental responsibilities, invasive plant management is necessarily a cross-scalar process. The federal government has legislative responsibility for quarantine and prevention processes that attempt to prevent non-native species coming into the country, and also for biodiversity conservation through the Environmental Protection and Biodiversity Conservation (EPBC) Act 1999. Land management generally is a state or territory responsibility, and most planning jurisdiction resides at the state and/or local government level.

In Bulkeley et al.'s (2007) terms, the practices of governance in Australia coalesce around *species* as the primary entity to be governed. A spatial prioritisation process operates underneath that, for each species. Until recently, Gamba grass has been classified differently in state and territory jurisdictions (see for example, Table 6.6 in AWC (2013)), the primary focus being its declaration in the NT in 2010 and accompanying statutory management plan. More recently invasive plants have been examined by the Commonwealth under the 'key threatening process' provision of the EPBC Act 1999. The first plant to be considered, Gamba was listed as a threatening process in its own right under this mechanism<sup>1</sup> (effective 2009), although a subsequent review now groups Gamba together with five other introduced grass species<sup>2</sup> (Beeton, no date). In addition to articulating the scientific assessment of these species as threats, listing as a key threatening process triggers assessment for a national Threat Abatement Plan (TAP) which aims to provide the framework for 'consistency of management actions across all jurisdictions' (Beeton no date, p14).

In a parallel but separate process, a concerted effort has been made by the Commonwealth to provide more effective co-ordination and collective effort across jurisdictions. A key feature has been the development of the list of Weeds<sup>3</sup> of National Significance (WoNS), which arose

out of the ‘National Weeds Strategy’ (1997), re-released in 2007 as the ‘Australian Weeds Strategy’ (NRMMC 2007). The national strategy is underpinned by a science backed prioritisation process and a management planning and risk assessment procedure strongly informed by the concept of nativeness, notwithstanding considerable critique of this concept (Davis et al. 2011), and the fact that some native species may be considered invasive in local contexts (NSW 2006). Criteria against which WoNS species are assessed are drawn from the ecological literature and include factors such as invasiveness, impacts and the potential for spread. Although the federal government does not have legislative jurisdiction here, through this mechanism, it can effectively direct natural resource (including weed) management by channelling its funding processes towards action on national priority WoNs species..

Although the TAP is yet to be finalised, the combination of it, the WoNs strategy and the existing state and territory legislation arguably constitutes the most complex and rigorous governance framework for any plant in the country. Yet even in this example, a level of acknowledged ungovernability operates in the spatial prioritisation process beneath the species level plans. The NT Gamba grass management plan permits different kinds of practices in different management zones, based on where regulators consider certain weed outcomes are feasible or not. Classes are designated A (to be eradicated), B (growth and spread to be controlled) and C (not to be introduced in the NT), with mixed classes reflecting varying feasibility of control. In the AC zone, for example, eradication is considered feasible and cost effective. The overarching rationale in the BC zone is that the weed is only controllable, not eradicable. Such contingencies change over time; in the most recent review (DLRM 2014), eradication zones have been expanded.

Weed policy is often framed as something that can be ‘made clear’ or fixed when good

science, co-ordination and capacity building come together in the right way (AWC 2013). The problems of bringing such governance into being are recognised to a limited extent within policy. For example, the Gamba grass strategic plan (AWC 2013:3) views management as a ‘shared responsibility’ requiring ‘co-ordination’ and ‘capacity’. That is, policy recognises that a particular kind of distributed human agency is required, in that many different kinds of labour and human effort is required even though legal responsibility lies with landholders. It must also respond to a clearly distributed and mobile plant agency, something commonly responded to through calls for better mapping and/or monitoring processes. Our contention is that a more realistic framing of weed governance, away from control, would present it as realised with always imperfect knowledge, across complex social and ecological landscapes, in a context where both humans and nonhumans are active agents. Experience elsewhere suggests reassessing control frames will be part of what is necessary to bring about more effective actions (van Wilgen et al. 2012).

## **5.0 The practice of governing and managing invasive plants**

This section is structured around three key aspects in which the practices of bringing governance into being are expressed most clearly. Interview quotes are used in these sections as exemplars of wider trends. In Table 2 we have summarised the sources of friction and traction that emerge from the study, with a view to identifying the most effective practices. It can be seen that friction or problems generally exceed traction or solutions, and there are no sources of traction without complementary frictions.

### **5.1 Practices of priority setting and species declaration**

Most managers we spoke to agreed there are simply too many weeds to do something about all of them. In the Northern Territory for example, managers assessed over ninety-seven

species as part of their assessment. Increasingly, priority setting takes place via a risk assessment process which considers the risks to industry, the environment and human health, and the feasibility of control. According to our government manager participants, priority setting must be ‘formalised, transparent, evidence-based, and defensible’, meaning that choices have to be made about how limited weed budgets will be allocated, and whether the legal ramifications of those choices will stand scrutiny in a court of law. But there is also a more complex politics of priority setting that the following interview extract illustrates:

we won't be recommending any declarations because [some species are] too valuable and well established, and part of the risk assessment process is feasibility of control... Many of these things, the feasibility of control is so low now that if you plant it, it will spread so far - like buffel grass in the Centre [Central Australia]. Regularly there are calls for a declaration or discussion of making a weed of national significance, but it's not done because the industry resistance would be so high we probably couldn't get it done. And even if we could it would damage the credibility of the weed management agencies and make our jobs more difficult, make it more difficult to declare things in the future, and besides, what would declaration achieve? The feasibility of control is very low indeed. (Government Senior Manager A)

In this quote, a senior bureaucrat identifies two influential factors that could stop a damaging weed being declared; the ecological unfeasibility of stopping the spread of weeds already considered out of control, and the political opposition by groups such as pastoralists who value some weeds for economic purposes. Gamba grass is one example of the latter; many pastoralists have opposed its declaration as a weed because they still use it as a resource. To quote one Landcare coordinator describing the perspective of a pastoralist he

knows: ‘I’m actually shooting myself in the foot by spending time and effort spraying something that the cattle will eat to be replaced by something that they don’t eat’.

This land manager and others describe without irony a risk assessment process in which ‘feasibility’ is a key variable. They refer to documents that outline the scientific risks, but the political risks and feasibilities they are explicitly juggling are just as important in the process. Particular industry groups are known to be very vocal and powerful lobbyists within consultative forums. By its very nature the process of species declaration acknowledges that some weeds cannot be managed, either being too widespread and costly to control, or too valuable to industry.

So what tipped the balance to getting Gamba grass declared? The threats that it poses to biodiversity are relatively long term, and not particularly visible to the non-expert land manager. Its fire risk is more visible, immediate and a threat to human settlements and safety. The plant itself is imposing, standing up to 4m tall and clearly carrying a significant fuel load of dry matter in linear stands along fences and roadsides (Figure 1). In recent years property and infrastructure loss in the Darwin area as a result of more intense Gamba fires (Setterfield et al. 2013) has served to highlight the consequences of inaction. Fire risk has been crucial in mobilising political action, as explained by a Government Senior Manager:

The reason we got Gamba grass declared was because of its fire risk ultimately, because you know the Darwin rural area’s got thousands of 10 hectare blocks so there’s a lot of people out there and apart from the fact that it [Gamba] likes bush blocks, it’s ruining them, it’s very much a fire risk and so it was politically possible to declare it...It is the worst of the terrestrial environmental weeds but there’s plenty of others. (Government Senior Manager A)

For those species that do end up at the top of the priority list, a key policy aim is to shift practice. Although there are in fact ‘quite draconian powers’ provided for in the Act (e.g. the right for weed officers to enter and search property), our government participants emphasised that enforcement was not something they were pursuing, and that prosecutions would need to be limited and strategic. In fact there is probably limited social license to enforce the Act in the wider political context of the Northern Territory, where individual freedom and frontier independence are strong cultural values.

In this context, managers understand legislation and regulation as working to provide the incentives and lubricant for the flows of money and people which are required to make changing practices possible, as a Government officer explains:

It was really good to try and come from a position where, only two years before, the plant hadn’t even been declared, to a complete change in legislative status and immediate need to involve everybody. So all major stakeholders, Power and Water, you know, the big players like NT Parks and right down to the 5 acre blockies. So we actually developed an assistance program [in] which we went out with spray equipment. We provided herbicide, we provided identification advice, we helped with property management planning, we developed a whole range of extension material... We did everything that we could think of to try and raise the profile of Gamba and the damage that it was causing, and it actually had quite good results. It was nice to see.

(Government Officer A)

The provision of herbicide that this officer notes raises the important issue that much invasive plant management across the extensive areas involved in northern Australia is dependent on the application of chemical herbicides. Funding is crucial because of the labour and

equipment involved in their application.

In summary then, attention to the practices of weed prioritisation and declaration brings to light a cultural politics of which the legislative and policy aspects are but one dimension. The process of weed governance itself acknowledges that the majority of weeds cannot be governed. Weeds exceed and burst out of governance in a variety of ways: when ‘the horse has bolted’ and control is practically not feasible, when they are so valuable to some human groups that political control is not possible, in spaces where containment rather than eradication is the goal, and in political contexts when strong legislative powers exist but lack the social license to operate. On the other hand, the more visible risk of fire can mobilise necessary political action; the interaction of policies relating to different aspects of land use produces results with implications for weeds.

## **5.2 Practices of managing interacting risks – weeds and fire**

The threat of intense fire as a consequence of Gamba fuel loads now means that fire, rather than other ecological issues, sets the ongoing management priorities for some of the land managers we spoke to. The rapidly changing fire environment (the NT experienced its first catastrophic fire danger warning in August 2011 due to ongoing dry conditions and high fuel loads (Brennan 2011)) has consequences for slower moving weed policy. A key principle of weed policy is to treat outlying infestations and work back toward the centre (WMG 2011). Fire policy tends to the opposite spatial prioritisation; it necessarily concentrates on large central infestations where fuel loads are highest, those around human settlements and assets that need protection.

One government officer we spoke to is responsible for weed management on extensive tenure

across the NT. When asked how she prioritised work on such a scale, this manager recognised the need to manage outlying patches or infestations as ‘good’ weed management. Yet in practice the threat of fire in the urban and peri-urban areas is a more immediate concern and takes up much of her time, as she explains:

Gamba’s our huge issue because of the fire risk. So yeah, we just have to prioritise where we’re going to be working and spending the money... more in residential areas as well, if there’s going to be a fire risk. Yes, I was actually checking a fire break, because we’ve got Territory Day on Monday, where people can let off fireworks, so fire’s a huge issue... We’ve got a good eight metre break.  
(Government Officer B)

Stretched and competing resources are a common problem for government land managers, but the increased workload of managing the patchwork fabric of this peri-urban area and resulting increased edge effects, means that some managers, like the one above, must more often prioritize the immediate risks of fire. Other land managers are responding to the fire threat posed by Gamba grass by incorporating it into routine management activities. In this respect they are responding to both fire and weed regulations, albeit in different ways. Routine weed and fire management is more commonly encountered where weeds are a minor problem or where there is a legal obligation for weed removal. For example, one extractive industries member routinely sprays and burns his mine site a couple of times a year.

*Interviewee:* The weeds don’t affect us. It’s just, you know, it’s the right thing to do, I suppose, but it doesn’t affect the operation. It doesn’t really affect the operation at all. Yeah. It’s more just an obligation, I suppose, under the [weed] regulations.

*Interviewer:* And do you have to do fire control work around your site as well?

*Interviewee:* We get the local volunteer bushfire brigade to do that, because we're reasonably close to a residential area. They like to ensure that all that's under control, and fire breaks are in, and they've done back burns before. (Extractive industry member)

In this case managing Gamba grass is now routine because managing weeds is outsourced to a contractor, and a minor imposition on the business. Managing fuel loads and fire threat is also a legal obligation and is in practice made routine through the 'free' provision of labour from the local fire brigade, as well as through their expertise in managing the risks of lighting fire breaks on particular days. Regular spraying of weeds works in combination with fuel reduction, reinforcing the routine. Managing weed risk and fire risk together is possible because both are outsourced and predictable; actions can be planned and scheduled. Hence the risks of spraying and of setting the fire breaks become someone else's expertise and their 'responsibility'.

In other situations managers have incorporated weed management work into routines where there is a clear business case, as well as legal obligations to do so. An environment manager with a large air transport industry described her operations across the NT, recounting their risk assessment process to us in some detail. In highly regulated spaces there are multiple regulations to consider, and multiple 'keepers' to 'keep me on my toes'. Any fire is a significant attractant to Black Kites (*Milvus migrans*) which pose a serious bird-strike risk to aircraft. This manager spoke to us of 'heart palpitations' every time she sees a fire burning in and around the airport. Not only is there a bird-strike risk, but the ash fallout also poses a fire risk to underground fuel tanks and to refueling activities. In this situation, she manages fuel loads by slashing and spraying Gamba rather than by burning fire breaks. This more

expensive management option is funded through airport governance processes and customer charges.

In summary, weed governance does not operate in a vacuum. Rather, managers must incorporate it into other layers of governance and regulation including those relating to fire. This adds to work loads and provides little guidance around competing priorities other than when human life and property is at risk, where the urgency of fire risk drives its own priorities. Incorporating weed management into regular land management practice is routinely done where it incurs a minimal cost, where there are opportunity costs or where there is recurrent funding available. Routine, while not a panacea for good management, is certainly a point of traction. However, such traction will not necessarily conform to best practice weed management principles.

### **5.3 Practices of responsibility**

Whatever the challenges on individual landholdings, they are magnified across complex tenures, and practices of responsibility are partly spatial. The Gamba grass strategic plan (AWC 2013) acknowledges that weed management is a ‘shared responsibility’ requiring ‘co-ordination’ and ‘capacity’ (AWC 2013:3). Thus a particular kind of distributed agency is recognised as necessary, but its complexities are often glossed over. Governance proliferates to include a variety of non-state actors (private landholders, business operators, volunteers) acting on a patchwork of property tenures (public land including conservation and other tenures, private land, leasehold, Aboriginal land) with complex layers of responsibility. The particular spatialities of different tenure systems are also influential; for example, road verges and powerline easements provide classic corridors for the spread of weeds. Notwithstanding the responsibility of the state to legislate and regulate on issues of invasive plant management,

and regardless of how governance mechanisms might attribute legal duty, most study participants agreed that responsibility for land management should be the task of individual land managers. At the same time, participants recognised that the work of weeding (like weeds themselves) must be distributed across and owned by the whole community for it to be effective. Government managers are very aware of this when working with landholders:

We see it as if you manage land or own land and you have weeds on it then they become your weeds and your problem...and we try and provide landholders with knowledge and skills to manage them and prevent them from becoming worse or establishing. (Government Officer C)

As the example in the previous section also exemplifies, government extension programs are undertaken in the context of trying to ‘get people managing their land responsibly’ rather than prosecuting or targeting them.

In our interviews we did not encounter any sense of hopelessness or giving up, instead a sense of individual responsibility for land management was a recurrent theme, with participants referring to the ‘independent spirit’ of people in the NT as well as a sense of ‘doing things differently’. This may mean for example, finding ways to manage millions of square kilometres of land on one’s own. These framings were mostly viewed as a helpful dimension in weed management because of the perception that a sense of self-reliance often translates into individuals ‘doing the right thing’, including in situations where they are not under any specific obligation to do so. In one case a participant described a sense of community care in his neighbourhood around a Landcare project, and getting the ‘shits’ when it seemed like certain neighbours did not care about their own ‘blocks’ of land. Similarly this participant described the satisfaction of working on other weeding projects without ever being asked or required to do so. Being required or legally obliged to manage weeds was clearly a point of

contention for some, even amongst those who prided themselves on their contribution to weed management. Being legally bound was viewed as yet another bit of government regulation or ‘red tape’ that had to be dealt with, even though there was also grudging recognition that it might be required where not all land managers were doing the ‘right thing’.

The tensions around responsibility and obligation were especially important in the context where government was itself the land manager. Most participants were keenly aware that government had been responsible for introducing Gamba grass in previous decades. Some participants were critical of the Northern Territory government’s dual role as both land manager and weed authority. During the more private context of our interviews they were quick to point out examples where they perceived government not to be managing weeds appropriately on its own land. As one participant put it, conflating ‘government’ and ‘scientists’:

So, the government’s – and the same with the bloody cane toads, which we never had for a long time! Bastard things! So scientists have got a bit to answer for. But now, they can’t just say, “Well, now the weeds are there and you’re administering that block of land. It’s your responsibility to make sure they’re not there.” It’s just bloody ridiculous, you know what I mean? (Extractive industry member)

A different atmosphere prevailed in the more formal stakeholder engagement meetings we observed. We noted that any open critique of changing government perspectives, or of government’s performance in managing its own land, created a very uncomfortable atmosphere between government representatives and other land managers. In the context of coming together to deal with contemporary problems, historical ‘sticking points’ were not aired openly. Tightly scheduled stakeholder meetings provide limited opportunities for more

broad-ranging discussion of these issues, thus contributing to continuity rather than circumvention of cynicism and dissatisfaction with the current process.

## **6.0 Discussion and policy implications**

Returning to our overall questions, we address our third, most specific question first. What can be learned from these everyday practices of IPM, in which people live with invasive plants in various ways? Certainly Gamba governance will need to be more responsive to the rapidity of ecological change taking place and the ways in which different actors are responding. But it also needs to be alert to the diversity and politics of the practices it recognises and validates. In parallel with the literature on climate change (Bulkeley and Broto 2013), our analysis shows that the governance of invasive species is constituted by diverse, pragmatic practices. Our findings identify three areas of focus.

*The practices of priority setting and species declaration* show that, contrary to the rhetoric of getting rid of weeds completely, there is already considerable acknowledgement of living with them in policy and in on-ground practice, the most obvious example being the exclusion of species from lists of declared weeds where control is considered unfeasible. At the moment the cultural-political power of the pastoral industry exceeds both the power of the scientific advice, and affects the social license to enforce the legislation upon which it is based, but in quite hidden ways. (On the other hand, that power was not sufficient to stop Gamba being declared.) This also raises questions about the accounting of scientific advice and how other factors are weighed against such advice. Further, the effectiveness of the state as a credible actor or enforcer is compromised by its history of having introduced and fostered Gamba in the first place, and by being seen in some circumstances as a poor manager of its own lands.

*The practice of managing the combined Gamba grass-bushfire risk assemblage* has both advantages and disadvantages. An advantage is that it has mobilised community feelings and galvanised political action, providing a new set of intervention levers through fire policy. The materiality of the plant and fire has rendered risk extremely visible. The Gamba example shows that weeds are not only or even best approached through weeds policy but can also be managed through fire policy. Bushfire governance has a longer history than weed governance, stimulated by the threats to people and property. Overall then, there are more systematic coordination processes in place, and the role of volunteers is explicit. Nevertheless evident ambiguity about the responsibilities of landholders and government in fire management (DLRM 2013) indicates that there may be parallel challenges to those of invasive plant management.

One disadvantage of managing weeds through fire policy is that the latter's focus on human spaces deflects action away from best practice weed management that stipulates a focus on outlier occurrences. Outliers tend to be in the areas of savanna where biodiversity is both high and at risk. So being driven by fire risk diverts effort from both these outlying spaces, and other invasive species that may be just as problematic, albeit not to humans. Future research could usefully examine and monitor how these weed and fire governance regimes interact in both complimentary and conflictual ways over time, including intersectorally for example, as demand for land release and urban expansion continues. As both are projected to become more serious issues under climate change, the relationship between invasive plants and bushfire stands out as warranting more detailed governance attention, in addition to the ecological focus of research in this area in parallel contexts, such as the fynbos in South Africa (van Wilgen et al. 2009) and the western United States (Keely 2006).

Giving more systematic voice to the messy realities of living with and killing weeds – *practices of responsibility* -- will help mobilise a broader range of resources including individual landholders and networks that are coordinated for different motivations. An unlikely example comes out of the pervasive theme in this study of individual autonomy and resistance to government control. In practice, purely legal renderings of land management responsibility are not necessarily easily established or uncovered and these alone will not be enough for effective weed management. Similarly, landholders' perceptions of obligation versus responsible practice do not necessarily map neatly onto one another. Our in-depth interviews and participant observation methodology highlight some of the differences between what is said and discussed in formal stakeholder engagement processes, and what landholders are willing to disclose in private about the factors that may inhibit or alter good weed practice. Cynicism directed towards government was often used to justify limited action, but was also a genuine expression of frustration rather than unwillingness to participate. This raises procedural questions, even for more dynamic framings such as adaptive governance, where common goals may not be agreed upon. We suggest in a more dynamic understanding of governance, the identification of double standards and weak links in the chain should be valorised as aiding effective practice. Thus cynicism and paralysis could potentially be turned to effective action, but this will require more honest acknowledgement from government of its own historical contingencies, ever-changing government discourses and limited capacity to act.

What do these findings mean for our second question; how well suited is the current policy process to more mobile and distributed agencies? The recognition of invasive plants as a global environmental issue, and one likely to become more significant in particular regions under climate change, has led to important steps in cross-scalar and cross-jurisdictional

coordination, such as the Australian Weeds of National Significance program. We have shown how much governance work takes place in the spaces between policy and action, and the much wider set of political spaces that are furled in (as illustrated in Table 2). The ongoing tension here is how a more responsive and open process of governance incorporates learning and deals with failure, as well as whose interests are best served within the current framework. With enormous biodiversity loss at stake, we argue that the rationale of invasive plant governance should be reframed away from absolute control, which is impossible, in order to clarify some of the political and policy choices involved in living with invasives. In the context of a national, multi-species program van Wilgen et al. (2012) have suggested that the effectiveness of on-ground works may in fact be improved in more targeted adaptive strategies. Because this issue is so important, the most effective governance practices need to be identified. We have shown the multiple ways in which weeds exceed and escape governance, and other circumstances in which governance is effective and could gain wider traction. Many aspects of on-ground management practice already reflect much more nimble, pragmatic engagements than the top-down policies imply.

## **7.0 Conclusion**

To return then to the broader implications of our first question; how should we act when the total context may be ungovernable? This is not only a question for some future time, called the Anthropocene. A focus on the practices of governance shows the many ways that the ideal of present control is illusory. But there are also many ways in which vernacular experience and knowledge provides effective accommodations with invasive plants. We hope that making those vernacular engagements more visible, as we have done in this paper, gives greater recognition to the diverse cultural resources that will be needed as invasive species

problems shift and intensify. Future research might usefully chart these contingent practices as they develop.

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Figure Caption:

Figure 1. XXXX standing beside *Andropogon gayanus* in peri-urban bushland near Palmerston, Northern Territory. Photo XXXX

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<sup>1</sup> Originally titled ‘Ecosystem degradation, habitat loss and species extinction due to invasion of Top End NT by introduced Gamba Grass (*Andropogon gayanus*)’ (Beeton no date).

<sup>2</sup> Currently titled ‘Ecosystem degradation, habitat loss and species decline due to invasion of northern Australia by Gamba Grass (*Andropogon gayanus*), Para Grass (*Urochloa mutica*), Olive Hymenachne (*Hymenachne amplexicaulis*), Mission Grass (*Pennisetum polystachion*) and Annual Mission Grass (*Pennisetum pedicellatum*)’ (Beeton no date).

<sup>3</sup> The terms ‘invasive plant’ and ‘weed’ are used interchangeably in this paper. Although we prefer ‘invasive’ as being more accurate to describe problematic plant behaviour, ‘weed’ is in common use in legislation, policy, institutional titles and in the conversation of our interview participants.