npj | urban sustainability

Review

Published in partnership with RMIT University

https://doi.org/10.1038/s42949-025-00281-1

Subjects of justice: rethinking invasive weeds through multispecies justice

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Invasive species are widely posited as a major threat to native biodiversity worldwide. However, in urban and post-industrial environments, invasive species often contribute to the formation of novel ecosystems that support critical ecosystem services for Earths others. Despite this, current management approaches typically prioritise control and eradication, with little regard for local ecological contexts or the functional roles invasive species play. As a result, the removal of certain invasive species from urban environments can lead to a reduction in both functional and species diversity. We argue that a multi-species justice (MSJ) framework offers a productive way to engage with the complexity, uncertainty, and contested values surrounding invasive species by extending justice. Using an urban green space case study, we propose MSJ as a way of managing the tensions between nativeness and invasion. We invite a rethinking of how nativeness and flourishing are understood and enacted in shared urban environments.

The Earth is confronting a biodiversity and species extinction crisis, brought about by development-driven habitat loss and fragmentation and exacerbated by anthropogenic climate change. It has long been recognised that biodiversity decline is driven by a set of interrelated anthropogenic pressures. The main suite of factors acting singly and synergistically was characterised by Diamond et al.[1] as the "Evil Quartet" behind the extinction crisis: habitat destruction, overexploitation/overharvesting, invasive species, and secondary loss through co-extinction. Wilson[2] added human activities such as pollution and overpopulation as additional factors accelerating biodiversity loss, while more recently, the dramatic impacts of climate change on extinction risk have been embedded in this framework[3].

Invasive plant species are species introduced outside of their natural range that have one or more negative impacts, and are widely considered to be a major driver of global biodiversity loss[4]. By outcompeting native vegetation for essential resources such as light, water, and nutrients, they can fundamentally alter community composition and ecosystem functioning[5]. This displacement of native flora disrupts trophic interactions, leading to declines in native fauna reliant on indigenous plants for food, shelter, and other ecological services[6]. Additionally, many invasive species modify critical ecological processes, including fire regimes, nutrient cycling, and hydrology, exacerbating habitat degradation and further reducing native biodiversity[7]. The global spread of invasive plants is strongly associated with human activities such as land-use change, urbanisation, and global trade, underscoring their central role in the accelerating decline of biodiversity worldwide[8]. As such, it is unsurprising that active removal of invasive species has long been seen in conservation biology as a "nasty necessity"[9]. Conservation discourse has often been informed by a paradigm that native plant species inherently support native biodiversity, whereas non-native species, and particularly invasive non-native species, are viewed as threats to ecological integrity[4]. Notwithstanding the lively debates surrounding the meaning and value of terms like 'nativeness' and 'invasiveness'[10–12], in urban environments, native plants are said to support higher faunal diversity and support ecosystem services more effectively than non-native plants[13]. However, such binary framing fails to capture the ecological complexity of species interactions at the local scale. While some non-native species may act as invasive and highly disruptive agents in certain ecosystems, in others they may provide important ecological functions or support novel biodiversity assemblages[14]. Consequently, indiscriminate removal of non-native species may produce unintended negative consequences for particular components of biodiversity[15], especially in highly modified ecosystems.

Multispecies justice (MSJ) approaches offer a conceptual and practical framework for renegotiating these tensions in disrupted urban and post-industrial ecologies. MSJ extends justice beyond humans to recognise all Earth beings and the relationships that sustain them, thereby recognising them as subjects of justice[16]. It also suggests that understandings of value need to be recast beyond narrow anthropocentric frameworks. In this sense, MSJ is an approach that enables a more complex engagement with the value of invasive species in disrupted ecosystems, weakening the often-intractable polarity of native/invasive debates in landscape management[17]. In fact, an MSJ approach may suggest that in certain contexts, justice would favour

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support for invasive species and the Earth others they can support. MSJ does this by providing a framework within which we can critically and constructively reflect on which species and ecosystems are being privileged or ignored in specific contexts[18], and a pragmatic mechanism for representation of Earths others in decision-making processes[19].

Here, we apply an MSJ lens to the nominally invasive species, *Lantana camara* L. (hereinafter lantana). Native to Central and South America, lantana has been named as one of the 100 worst invasive alien species[20] and the second-most widespread invasive vascular plant species worldwide[20]. It is commonly viewed as an aggressive and fast-growing plant that can thrive on saline to acidic and fertile or infertile soils[21]. Its allelopathic properties and ecological resilience also allow it to colonise a wide range of climate and precipitation niches[22,23]. Invasion risk is considered to be high in Africa, Australia, Oceania and South America, and will increase across all continents under global heating[24]. Invasive risk assessments such as this focus solely on the biophysical, however, and do not include the social, political, legal and policy elements of the novel ecosystem phenomenon. Novel ecosystems can be sites of contestation, offering political spaces for supporting new urban socio-environmental futures and environmental and climate justice[25], with emphasis in the literature on the co-benefits and costs of novel ecosystems to humans. To deal with intractable conflicts associated with invasive species like lantana, it is critical to consider the co-benefits and costs and the processes and practices that lead to these outcomes over time.

The rise of novel ecosystems

Human activities have led to complex global social and ecological changes, the combined and sometimes opposing effects of which are still not well understood[26]. About 20 years ago, the concept of novel ecosystems emerged to describe these fundamentally altered environments. These are systems where abiotic, biotic, and social elements interact, but, due to modern human influences, now significantly differ from previous systems in particular areas[27–30]. Crucially, these new ecosystems tend to self-organize and develop unique characteristics without extensive human intervention, often making it difficult or impossible to restore them to their original state.

Given that cities are inherently dynamic and heavily human-modified environments, they present ideal conditions for novel ecosystems to emerge and for invasive species to thrive. The constant human disturbance in these environments - including fundamental alterations to soils, hydrology, and habitat fragmentation – as well as repeated patterns of introduction and dispersal by humans, favours the fast-growing, adaptable, and quick to spread species characteristic of invasive organisms[31]. Despite the widespread occurrence of novel ecosystems in cities, they have been underexplored in research and practice[32,33]. Recent research suggests, however, that landscapes containing ecological novelty and species once considered invasive become a storied part of an evolving urban nature[25]. These novel landscapes can become sites of social-ecological mobilisations, where historical processes of power, extraction, depletion, and overall transformation are revealed, emphasising the intricate human-nonhuman interactions that give rise and arise from place-making and socio-material practices[33]. In other words, when seen through the lens of co-shaping and place-making, invasive species and novel landscapes come to be seen not as a problem to be dealt with through 'control', 'eradication', and 'culling', but as relational spaces rooted in complex, legal, ethical and political narratives, relations and decisions of 'what' and 'who' belongs in a landscape[34,35]. As part of 'unpacking' these shared stories of urban novel natures, we bring the case of lantana – a controversial, invasive species – that has established in the city of Sydney, Australia.

Lantana: the global invader

As one of the world's most widespread invasive plants, lantana's demonstrated capacity for rapid spread and significant economic and environmental impacts make its management a global challenge. Indigenous to the Americas, it is has now successfully naturalised across tropical, subtropical, and warm temperate regions, including more than 60 countries[36]. Its prolific seed production, extensive vegetative propagation through layering, and broad ecological adaptability render single-method control strategies largely ineffective[36]. Therefore, management efforts universally advocate for integrated weed management (IWM), which strategically combines prevention, mechanical removal, chemical control, fire, and biological control[36].

Lantana has been particularly successful along the east coast of Australia, which has become a global hotspot for this species (Fig. 1). Lantana was first recorded in Australia in 1841[37]. Intended as an ornamental plant, lantana was growing outside cultivation by the late 1850's and was recognised as a weed in 1879. Biological control began in 1902[38].

In Australia, as elsewhere, aggressive measures to control the spread of lantana have had limited success[22]. While mechanical methods like hand-pulling and cut-stump techniques are effective for smaller infestations, larger-scale clearing often stimulates vigorous resprouting, demanding immediate follow-up with herbicides[22,36]. Chemical control, employing foliar spray and basal bark, remains a primary tool, though efficacy is influenced by plant phenology and environmental conditions[36]. Fire can reduce biomass but frequently promotes regrowth, thus serving primarily as a preparatory measure[22,36]. Biological control agents, introduced globally, have achieved varying degrees of success, typically offering suppression rather than eradication due to the complex genetic diversity of *L. camara*[39]. Effective long-term management critically depends on post-control revegetation with competitive native species and sustained monitoring to prevent re-establishment from the persistent seed bank[39].

Regulatory and legislative control

Managing 'weeds' or invasive plants in urban areas to protect other species is a fraught regulatory exercise. In the context of the management of lantana, and in an Australian setting, management begins with classifying the plant as a weed, non-native, or invasive species in both national and state legislation. The law crafts lantana as a problem on the basis that it is determined to be a threat to other species. By way of explanation, in the state of New South Wales, lantana listed as a "key threatening process" (KTP) by the NSW Scientific Committee (2006, following s. 4.34, Division 5 – Key threatening processes) and it appears in Schedule 4 of the *Biodiversity Conservation Act 2016* (NSW) (*BC Act*) as such a threat (paragraphs 13–17 list threats to threatened biodiversity in NSW). A 'threatening process' "means a process that threatens, or that may threaten, the survival or evolutionary development of species or ecological communities" (s.1.6, *BC Act*). Under this NSW legislation, lantana is listed as a threat to at least two endangered animals, being the Eastern Bristlebird and the Back Grass-Dart Butterfly. In addition, lantana is cited for limiting koalas' ability to move between trees. Further, lantana is listed as a threat to other plants, including listed threatened communities being 'Endangered Ecological Communities' under this legislation, and these plants include communities located within urban settings such as the Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion.

Australia's national biodiversity protection legislation, the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), sets out similar parameters. Key threatening processes are listed within this legislation if they threaten the survival, abundance or evolutionary development of a native species or ecological community (s.188(3)). Lantana was nominated as a key threatening process in 2008 and 2009 because "the invasion, establishment and spread of *Lantana camara* impacts negatively on native biodiversity, including many *EPBC* listed species and communities"[40]. Rather than list lantana within its own category, it has now been listed within the 'introduction of novel biota" category. As the Invasive Species Council have pointed out, "a large number of major invasive threats are not listed as individual KTPs but are instead lumped within the 'novel biota' KTP, a moribund listing without a TAP" [41,42, p.3]. A 'TAP' is a Threat Abatement Plan (section 271, *EPBC Act*) which provides for research, management and other actions to reduce key threatening processes.

Beyond the legislative context, weeds such as lantana are also subject to government management through policy guidelines, plans and strategies. In Australia, as a 'weed of national significance' Lantana has had a national plan developed to protect environmental assets. The plan created a 'WINS'

(weed impact to native species) assessment to create a list of native species 'at risk' from lantana[43]. This national plan is linked to the 2017 – 2027 Australian Weeds Strategy[43], which cements lantana as a weed of national significance (p.34) and is managed by the Environment and Invasives Committee[44]. This committee is constituted by representatives from various state, territory and national government agencies and their remit is to identify, prevent and manage invasive species with national policy leadership.

Building on Bartel's[45] observations about the way in which the law, with its dominant hegemonic power, is implicated in creating, endorsing, producing and reproducing particular landscapes we observe that lantana is demonised as an unwanted outsider, as an 'other' to be managed (eradicated) with legislative backing. It is in and through the operation of the law that particular social-political communities cement and shape landscapes. In the decision to nominate and label what belongs where, the law freezes plants and animals with little flexibility and little place sensitivity[46]. We argue, however, that a rigid and abstracted native/non-native binary categorisation of plants and animals at a particular fixed point in time is problematic[34,45]. This approach prioritises some species or communities over others in a hierarchical fashion on the basis of human values[34]. An MSJ perspective makes clear however, that this is an exceedingly anthropocentric approach, one that naturalises particular and historically located human decisions concerning what, where and when a plant or animal belongs in a particular place. We argue that a reframing with an MSJ lens to disrupt the powerful, normative and dominant regulatory framing deciding who, what and where things belong, can better enable plant agency. By plant agency, we mean the recognition that plants are active beings with their own modes of responsiveness and world-making, rather than inert backdrops to human or animal life[47]. Attending to this agency is important because it reorients ethical and political imaginaries, positioning plants as co-constitutive partners in shaping multispecies urban futures[48,49]. If we apply MSJ thinking to the legislative context to balance competing plant/animal interests, we can craft contemporary urban landscapes that provide the conditions for multiple life forms (and which will likely look very different) to function and flourish. Evidence tells us that new landscapes that embrace weeds can, pervasively and counter-intuitively, sometimes enhance biodiversity efforts (Refs. 50,51 and Supplementary Information).

Despite considerable efforts, the regulation and biological control of Lantana has achieved only partial success, meaning the weed is not considered adequately controlled anywhere within its introduced range[22,39]. Spatial invasion risk predictions considering future environmental change show that Lantana will continue to spread in Africa, Australia, Oceania, and South America with an estimated cover of at least 68.98%[24]. Future climate scenarios are predicted to increase the areas climatically favourable for lantana, with notable expansions in Africa, Europe, North America, and parts of Asia and Australia[52]. Given these future predictions, and in particular in regions where lantana has been deemed as one of the most problematic weeds, a recent study suggests that the best approach to managing

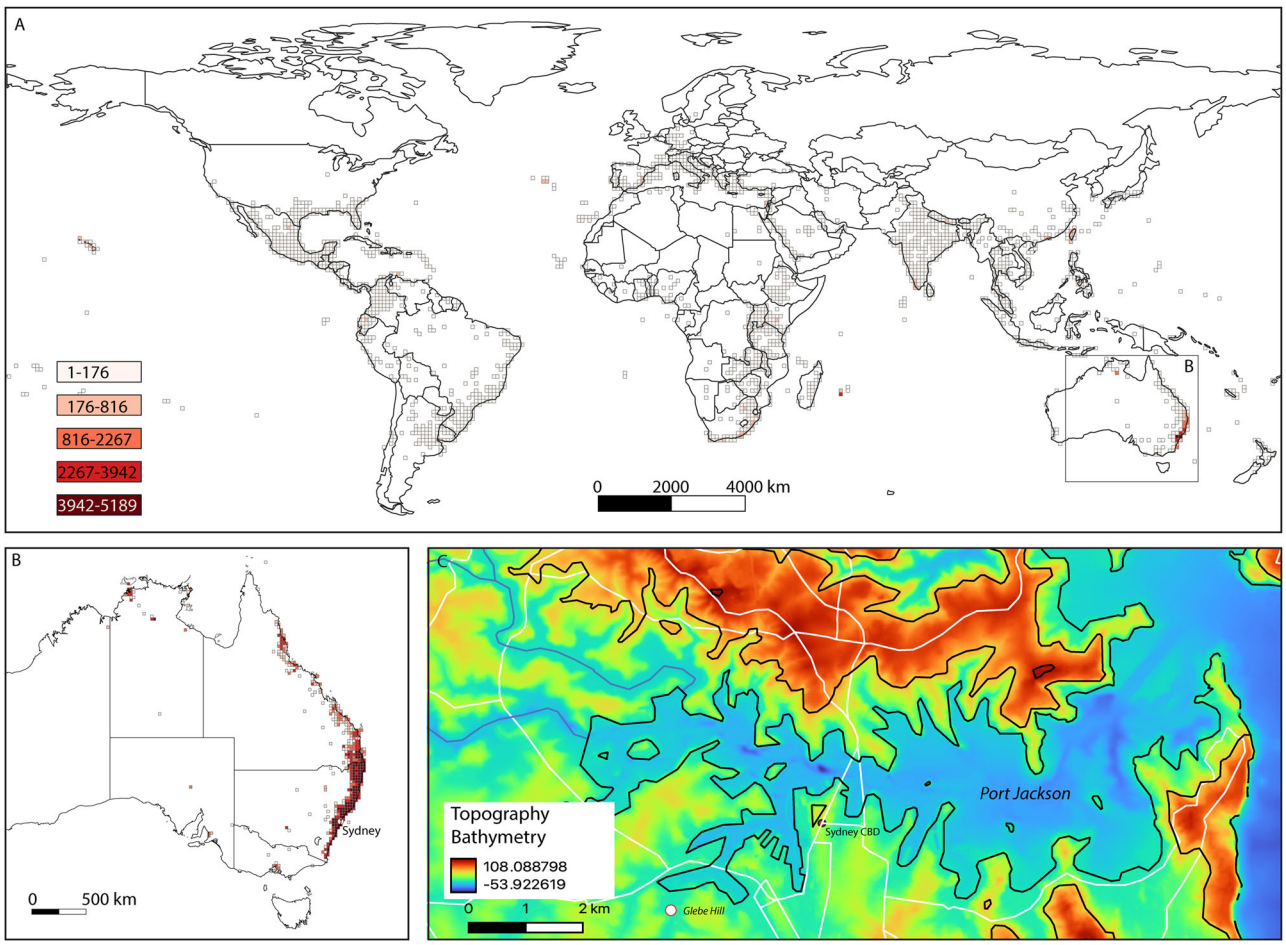

Fig. 1 | Spatial distribution of *Lantana camara* L. occurrence (number of occurences per grid cell) and location of the case study site. A *Lantana camara* L. occurrence records binned into 1° globally and (**B**) 0.25° grid cells across eastern Australia. Occurrence data were sourced from Global Biodiversity Information Facility (gbif.org: https://doi.org/10.15468/dl.8y8sev) and aggregated using a spatial join in QGIS. The count of records per grid cell reflects relative sampling density and species presence intensity. Grid symbology represents the number of records per cell, with higher values indicating areas of greater recorded occurrence. **C** Topography and Bathymetry (in metres relative to Australian Height Datum) for Sydney Harbour Port Jackson from (https://doi.org/10.1594/PANGAEA.885014)[71], showing the location of 'Glebe Hill' in relation to the centroid for Sydney's central business district (CBD). Road and topographic lines from refs. 72.

Table 1 | Overview of the harm and benefit of *L. camara* (see Supplementary Information for more details)

Lantana attribute	*Benefits to species, communities or ecosystems*	*Harm to species, communities or ecosystems*	*Harm or benefits to humans*
Alteration of soil properties[73–75]	Increased organic matter input, deep rooting results in 'nutrient uplift' through the soil profile	Allelochemicals exclude competition from other plant species, reduce alpha diversity	Contributes to lower biodiversity, potential remediation of contaminated soil; increases extinction risk for threatened species
Growth form[21,54,76,77]	Stems provide structure and shelter, particularly for native perching birds and some native and non-native mammals	Prevents regrowth, reduces competition from other plant species, reduces alpha diversity, limits movement through thickets. Biomass toxic to livestock and other mammals incl. Marsupials, reduces habitat availability for some species	Biomass (stems/leaves) used for various purposes, potential for bioethanol/biogas production, supports diversity of animal and insect groups useful to or valued by humans, toxic to humans when ingested. Reduces amenity
Fruiting[54,78]	Abundant and reliable food resource for frugivores, particularly small native birds.	Seed dispersal enables rapid spread, increases the area affected.	Medicinal uses, potential for drug discovery, toxic to humans when ingested.
Flowering[78,79]	Perennial flowering, abundant and reliable food resource (nectar) for insects, particularly butterflies.	Facilitates pollination and seed-set, very high fruit productivity, facilitates reproduction and spread, flowers not accessible to many floral visitors	Ornamental garden plant, medicinal uses, potential fungicide, toxic to humans when ingested.
Phenotypic plasticity[59,60]	Capable of morphological adaptation to varying environmental conditions, including varying light conditions in urban environments. Provides services in liminal urban environments or on polluted soil.	Plasticity enables adaptability and spread, increases area affected.	Supports insect and animal groups in urban or industrial spaces, supports pollinators, and potentially increases urban biodiversity where native ecologies have been excluded.

lantana should include recognising the plant's potential positive impacts and economic uses, which may surpass its negative effects, warranting further cost-benefit analyses for its management[53]. For example, Patel[54] argues that despite its severe detrimental effects as an invasive weed and considering the ineffectiveness of traditional removal strategies, lantana should be managed by exploring its "multiple utilities" with therapeutic, industrial, and agricultural potential, suggesting that utilising its biomass and phytochemicals offers a sustainable management option[54]. A shift in our 'biocontrol' models has been put forward as necessary to respond to the ineffective eradication approach and this includes adaptive management, which focuses more on the role/function of species rather than their origins[55] and accepts 'invasiveness' as part of ecosystem dynamics and flux[56].

Lantana in urban ecosystems in Sydney, Australia

The urgent need to create high quality greenspace supporting biodiversity in cities has resulted in numerous innovative approaches to enhance the liveability of cities for both humans and other forms of life. While conventional approaches to conservation management and restoration of degraded landscapes still dominate the mindsets of many land managers, there is a growing perception that the application of these approaches to highly modified novel ecosystems may have limited success owing to the abundant anthropogenic pressures on plants and animals in these habitats[57]. Put simply, when its impact on different actors in ecosystems is factored into decision-making, a question as fundamental as "should we remove lantana from areas being managed for biodiversity?" quickly becomes complicated.

Despite its infamy as an invasive species, lantana is known to have both positive and negative impacts for humans, other life forms and abiotic processes and systems (see Table 1, and Supplementary Information). In urban and post-industrial environments where native plant ecologies have been extirpated or profoundly disrupted, lantana can provide crucial ecosystem services for animals and insects where many native plants fail to persist. Indeed, lantana might be better suited to this role than comparable native species. The plant's fecundity and reliable fruit-set each year provides a more predictable food resource for native birds than native species with similar fruit[58], and its phenotypic plasticity in response to varying light conditions enables it to exploit liminal spaces in urban systems better than comparable native species[59,60].

Recent initiatives to develop a plan for restoration of the "Glebe Hill", a degraded and contaminated informal greenspace in Sydney, Australia (Fig. 1), expose the dialectic between invasiveness and novel utility. The Hill, as it is locally known, is now located between a former industrial site and a light rail corridor, and was a landfill site known as the Epping tip, receiving domestic waste until the 1920's. The 0.6-hectare site was considered unfit for development in 1926 due to the nature and volume of refuse[61] a position reiterated some 90 years later[62]. In the interstice, the site has been used primarily as a car park for patrons of the adjacent horse and dog racing track at Harold Park, itself now replaced by residential developments. Unsurprisingly, a hybrid ecology has become established on the Hill, dominated by non-native plant species (74%), chief among which are Chinese Hackberry (*Celtis sinensis*) and lantana[61].

Today, this novel ecosystem provides habitat and resources to a range of native and non-native animals. The bird fauna is primarily native (75%), dominated by the welcome swallow (*Hirundo neoxena*) and the noisy miner (*Manorina melanochephala*), while the most commonly observed bird was the non-native common myna (*Acridotheres tristis*). Silvereyes (*Zosterops lateralis*) and grey fantails (*Rhipidura albiscapa*) were particularly associated with dense patches of lantana[61], reflecting the characteristic foraging and nesting services provided by lantana. Indeed, lantana's abundant and reliable fruiting and flowering, along with its dense woody stems, may be more important for supporting urban bird and insect species than comparable native species[58], and Supplementary Information], reflecting the important role some invasive species can play as part of hybrid ecosystems in supporting both native and non-native biodiversity in urban environments. At Glebe Hill, thickets of lantana offered protection to smaller birds from aggressive noisy miner and the pied currawong (*Strepera graculina*), both of whom can suppress local biodiversity through competition and predation respectively[63]. Similarly, the invertebrate fauna was predominantly native (67%), with the butterflies and moths strongly associated with lantana. The mammal fauna was, by contrast, depauperate and dominated by non-native species – cat, fox, and dog – in keeping with similar observations elsewhere[14].

Glebe Hill, considered too expensive to remove and too polluted to remediate, is emblematic of informal urban green spaces that have come to occupy post-industrial limina throughout the world[25]. The clearly expressed desire by some local stakeholders to replace non-native plants[61] as part of a strategy to increase urban biodiversity is confronted by the abundant support those same novel ecosystems currently provide to native animals, particularly those functional groups – such as small-bodied birds - that are often most sensitive to urbanisation[63]. Seeing these informal urban green spaces and the novel ecosystems they support through "native/non-native binaries" [Ref. 61, p. 45] is unhelpful, insensitive to context and the complexity of the socio-cultural processes from which it emerged. Tensions that emerge from these dichotomised understandings of urban nature can become intractable, leading to policy stagnation (such as has characterised

Glebe Hill since the early 20th century), or land management decisions that inadvertently reduce net biodiversity.

The hybrid nature of contemporary ecology at Glebe Hill arises from the unique processes of place-making, embedding use, extraction, depletion and transformation into complex narratives of place. Informal green spaces in cities can align with novel ecosystems to create uniquely valuable places. Instead of viewing these places through the rigid perspective of 'native' and 'invasive', re-thinking their value through an MSJ lens enables us to see places in terms of their value to a range of species, making some groups of animals - in this case, small urban birds, some pollinating insects and lantana itself - the subject of justice. MSJ offers an alternative framework for navigating the complex processes inherent in the management of invasive species. In the following section, we bring forward a discussion on how MSJ can offer an approach that brings deliberation and recognition as core ideas to counter narratives of invasives as ecological and economic problems.

Engaging invasive species through MSJ: from recognition to deliberation

MSJ as a research field expands traditional notions of justice beyond human-centric concerns and perspectives to include the lives of beings other than humans and ecological systems, emphasising the interconnectedness of all living and non-living beings and the importance of respectful relationships between humans and Earth others[18]. MSJ suggests that justice requires a shift away from hegemonic approaches to animal welfare, environmental protection, conservation and biodiversity, all of which treat Earth others as objects of human concern, rather than subjects of justice. At the same time, from the perspective of MSJ, the focus of justice should not be solely on individuals. Rather, justice needs to attend to the relations between beings. Moreover, given the disruptive and harmful effects of certain forms of human life on Earth others and the relationships that sustain them, MSJ's focus is on humanity's disproportionate capacity to shape these relationships. The theory describes a number of challenges to existing legal, political and economic institutions, for example, the inclusion of Earth others in decision making, recognition of the legal personhood of Earth others, and recognition of the Rights of Nature. MSJ scholarship invites a critical, situated, located analysis of the burdens and benefits of multispecies relationships, and therefore the process and practice on critically reflecting not only on who benefits and the processes whereby just outcomes are shaped, but also who is involved in making such judgments[18,64,65].

In this paper, we suggest that a deliberative decision-making process based on the principles of MSJ starts by acknowledging that all Earth other play a role in larger ecological systems and that the well-being of all species and ecological communities is interconnected. This recognition both allows for and implies that justice damands deeper, thicker and more inclusive environmental decision-making processes. Here, the purpose of regulation and management is not to 'solve' an invasive species problem within hybrid ecologies, but rather to attend to the role of invasive species in urban environments in ways that strive to (a) maintain their functionality and capabilities (where it exists) and (b) extend the concept of justice to all Earth others and social-ecological communities, recognising their inherent value, the relations and interdependencies across them. The costs and benefits of invasive species and any management interventions applied to them are context-specific and shared unequally among human stakeholders[66], with marked co-vulnerabilities between marginalised people and Earth-others[67,68]. Extending the notion of justice to all beings does not imply that it is possible to avoid conflicts and trade-offs, but rather creates the conditions for broader and more inclusive deliberative processes that make evident power imbalances, misrecognitions, 'unintended' harms and impacts.

In a policy context, current global frameworks for managing invasive weed species do not necessarily execute, as well as they might, an inclusive approach or process, despite ambitions to do so. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) assessment report on invasive species[20], which defines the international norms within which national biodiversity legislation and policy will catalyse over the coming years, explicitly acknowledges the complexity (1.5.3, p.29) but effectively steps around rather than engages with it[69]. Its consideration of governance and policy options does not recommend formally embedding multispecies approaches into the development of national or local management strategies or structures. In fact, the IPBES' conception of the 'complex socioecological system' in which biological invasions occur does not extend to the other species themselves. Relevant 'actors' (6.2.3.3, p. 747) and 'stakeholders' (6.4, 772) are exclusively human. The 'rights' of other animals (and, *nota bene*, animals only) are considered relevant only when "associated with human values" (Box 6.13, p. 774). Justice, in this context, is narrowly defined and applied. The IPBES's conception of the foundational properties of governance systems, particularly 'Equitable and Inclusive Governance' (SPM7, XLII in SPM) is represented by the roots of a tree, in which plants are the 'problem' and institutions, people and human communities are the only ones included in decision making. We argue that decision-making practices should be extended to include Earth others and their communities, in particular those plants and animal species that have a stake in governance and management decisions that affect them. MSJ offers a pragmatic, deliberative framework to enable this expansion. This is achieved by making invasive species and the faunal communities they support *subjects* of justice. MSJ does this by reimagining decision-making processes so that the needs of Earths others - plants, animals, and ecosystems - are taken seriously, and by informing governance structures that acknowledge their agency. Practical guidance draws from experiments in law, conservation, urban planning, and cultural engagement (e.g., embodied or ceremonial practices that acknowledge and honour relationships with non-human beings) to develop concrete practices for decision-making.

MSJ can help illuminate, provoke or mediate conflicting perspectives on invasiveness and novel ecosystems, and enable us to move away from an anthropocentric, technocratic management tendency, especially in urban green space/infrastructure settings. Building on Raymond et al[18,64], MSJ offers a process and practice for critically reflecting on issues of representation, distribution and agency. Understanding the functional role of an invasive or 'unwanted' species within ecological communities can inform a deliberative platform by recognising hidden values, co-benefits and interdependencies that the native-invasive dichotomy doesn't allow us to explore. The MSJ lens allows us to reconsider, foundationally, the ways in which human interactions with Earth others are constructed, reproduced, and contested. MSJ offers a space to unpack perceived views and concepts that build on dichotomised understandings in conservation and green space management and promote relationality among Earth others, including humans. MSJ can be used by all researchers and practitioners to engage with the relationalities, as well as complexities and conflicts, that enable the flourishing of all life.

Conclusion

Regulatory and physical measures to control invasive species, named one of the five major drivers of biodiversity loss globally, have failed in many cases. Calls for 'a paradigm shift in urban ecosystem management' away from arbitrary decisions based on convention (in simplistic terms 'native equates to good, while non-native is bad') towards evidence-based practice are clear (see, for example[70]). Ultimately, something as apparently simple as advocating for the removal of pervasive environmental weeds like lantana from novel urban ecosystems may have significant impacts on the potential of those sites to support biodiversity. The reliance of many components of urban biodiversity, both invertebrate and avian, on the habitat structure and resources provided by lantana creates a vexed question. There is no doubt that lantana has significant impacts on native plant diversity and contributes to declines in native flora. However, there is also a widespread understanding amongst ecologists and bush regenerators that it is one of the critical elements of habitats that support native animals in cities. Additionally, the expansion of lantana's range in Australia and New Zealand under global heating scenarios[52] will likely increase the importance of this plant for some animal and insect groups over the next half-century at least. As such, many of the simple native/non-native binaries used to consider

biodiversity are not fit-for-purpose when considering how best to manage diversity in the urban forest. MSJ can support a deliberative practice for planners and managers to reconsider the role of multiple species in place-specific settings.

We are suggesting here that planners, environmental managers, ecologists and all stakeholders involved in green space management and policy-making should be required to have an ethical obligation and responsibility to consider all species as they operationalise biodiversity objectives and the law. Bringing and MSJ lens might enhance such practices. Revision of the regulatory and policy settings is an arduous but not impossible task. We note, too, that many current regulatory framings (such as in Australia) prevent a consideration of invasive species such as lantana as anything other than a threat, irrespective of local circumstances and actual relationships. In some degraded urban areas, a different conservation aim might be possible using MSJ as a supporting pillar, and in those contexts, lantana might be regulated and managed differently.

Data availability

No datasets were generated or analysed during the current study.

Received: 27 June 2025; Accepted: 25 September 2025;
Published online: 22 October 2025

References

1. Diamond, J. M. et al. The present, past and future of human-caused extinctions. *Philos. Trans. R. Soc. Lond. B, Biol. Sci.* **325**, 469–477 (1989).
2. Wilson, E. O. *The Future of Life*. Little, Brown & Co. (2002).
3. Bellard, C. et al. Impacts of climate change on the future of biodiversity. *Ecol. Lett.* **15**, 365–377 (2012).
4. Pyšek, P. et al. Scientists' warning on invasive alien species. *Biol. Rev.* **95**, 1511–1534 (2020).
5. Vilà, M. et al. Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities and ecosystems. *Ecol. Lett.* **14**, 702–708 (2011).
6. Gallardo, B. et al. Global ecological impacts of invasive species in aquatic ecosystems. *Glob. Change Biol.* **22**, 151–163 (2016).
7. Ehrenfeld, J. G. Ecosystem Consequences of biological invasions. *Annu. Rev. Ecol., Evol. Syst.* **41**, 59–80 (2010).
8. Early, R. et al. Global threats from invasive alien species in the twenty-first century and national response capacities. *Nat. Commun.* **7**, 12485 (2016).
9. Temple, S. A. The Nasty Necessity: Eradicating Exotics. *Conserv. Biol.* **4**, 113–115 (1990).
10. Oficialdegui, F. J., South, J., Courchamp, F. & Clavero, M. Nativeness is a binary concept—Invasiveness and its management are not. *Biol. Conserv.* **294**, 110631 (2024).
11. Mulcock, J. & Trigger, D. Ecology and identity: a comparative perspective on the negotiation of "nativeness". *Toxic. Belonging?? Identity Ecol. South. Afr.* **178**, 178–198 (2008).
12. Head, L. The social dimensions of invasive plants. *Nat. Plants* **3**, 1–7 (2017).
13. Tartaglia, E. S. & Aronson, M. F. Plant native: comparing biodiversity benefits, ecosystem services provisioning, and plant performance of native and non-native plants in urban horticulture. *Urban Ecosyst.* **27**, 2587–2611 (2024).
14. Berthon, K. et al. The role of 'nativeness' in urban greening to support animal biodiversity. *Landsc. Urban Plan.* **205**, 103959 (2021).
15. Sun, J. et al. Ecological adaptability of invasive weeds under environmental pollutants: a review. *Environ. Exp. Bot.* **215**, e105492 (2023).
16. Celermajer, D. et al. Multispecies justice: theories, challenges, and a research agenda for environmental politics. *Traject. Environ. Polit.* 116-137. (2022).
17. Lidström, S. et al. Invasive narratives and the inverse of slow violence: alien species in science and society. *Environ. Hum.* **7**, 1–40 (2016).
18. Raymond, C. M. et al. Applying multispecies justice in nature-based solutions and urban sustainability planning: Tensions and prospects. *npj Urban Sustain* **5**, 2 (2025).
19. Kütting, G. Moving toward multi-species justice: considering sentience, rights of nature, and legal personhood as avenues to more recognition and representation. *Nat. Cult.* **20**, 99–117 (2025).
20. IPBES. Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Roy, H. E., Pauchard, A., Stoett, P., and Renard Truong, T. (eds.). IPBES secretariat, Bonn, Germany (2023).
21. Sharma, O. P. et al. A review of the toxicity of Lantana camara (Linn) in animals. *Clin. Toxicol.* **18**, 1077–1094 (1981).
22. Bhagwat, S. A. et al. A battle lost? Report on two centuries of invasion and management of Lantana camara L. in Australia, India and South Africa. *PLoS One* **7**, e32407 (2012).
23. Mungi, N. A. et al. Expanding niche and degrading forests: Key to the successful global invasion of Lantana camara (sensu lato). *Glob. Ecol. Conserv* **23**, e01080 (2020).
24. Adhikari, P. et al. Global invasion risk assessment of Lantana camara, a highly invasive weed, under future environmental change. *Glob. Ecol. Conserv.* **55**, e03212 (2024).
25. Trentanovi, G. et al. Contested novel ecosystems: Socio-ecological processes and evidence from Italy. *Environ. Dev.* **40**, 100658 (2021).
26. Heger, T. et al. Towards an integrative, eco-evolutionary understanding of ecological novelty: studying and communicating interlinked effects of global change. *BioScience* **69**, 888–899 (2019).
27. Hobbs, R. J. et al. *Glob. Ecol. Biogeogr.* **15**, 1–7 (2006).
28. Hobbs, R. J. et al. Novel ecosystems: implications for conservation and restoration. *Trends Ecol. Evol.* **24**, 599–605 (2009).
29. Hobbs, R. J. et al. *Novel ecosystems: intervening in the new ecological world order*. John Wiley & Sons (2013).
30. Chapin, F. S. III & Starfield, A. M. Time lags and novel ecosystems in response to transient climatic change in Arctic Alaska. *Clim. Change* **35**, 367–378 (1997).
31. Francis, R. & Chadwick, M. Urban invasions: non-native and invasive species in cities. *Geogr. (Sheff., Engl.)* **100**, 144–151 (2015).
32. Teixeira, C. P. & Fernandes, C. O. Novel ecosystems: a review of the concept in non-urban and urban contexts. *Landsc. Ecol.* **35**, 23–39 (2020).
33. Pineda-Pinto, M. et al. Exploring urban novel ecosystems: Understandings, insights and recommendations for future research and practice. *Futures* **164**, 103487 (2024).
34. Gillespie, J. et al. Letting the plants speak: Law, landscape and conservation. *Ambio* **53**, 470–481 (2024).
35. Gillespie, J. et al. Time, justice, and urban nature: procedural barriers to multi-species flourishing. *npj Urban Sustain.* **5**, 17 (2025).
36. Day, M. D., Wiley, C. J., Playford, J. et al. Lantana Current Management Status and Future Prospects. Canberra. ACIAR Monograph 102. (2003).
37. Swarbrick, J. T. et al. The biology of Australian weeds 25. Lantana camara L. *Plant Prot. Q.* **10**, 82–82 (1995).
38. Day, M., Lantana camara L.-lantana. In Julien, M. et al. (eds) *Biological control of weeds in Australia*, CSIRO Publishing, Melbourne: 334-346 (2012).
39. Zalucki, M. P. et al. Will biological control of Lantana camara ever succeed? Patterns, processes & prospects. *Biol. Control* **42**, 251–261 (2007).
40. Australian Government Department of Climate Change, Energy, the Environment and Water, nd, Key threatening process nominations not prioritised for assessment. https://www.dcceew.gov.au/

environment/biodiversity/threatened/nominations/ktp-not-prioritised-assessment/.
41. Invasive Species Council Australia, 2018, KTPs & TAPs Australia's failure to abate threats to biodiversity. https://invasives.org.au/wp-content/uploads/2018/05/KTPs-and-TAPs-discussion-paper-23-May-2018.pdf.
42. New South Wales Government Dept of Environment and Heritage, nd, Managing the impact of lantana on biodiversity. https://www.environment.nsw.gov.au/topics/animals-and-plants/pest-animals-and-weeds/weeds/widespread-weeds/lantana/lantana-plan.
43. Australian Government Department of Agriculture, Fisheries and Forestry, 2017, 2017 – 2027 Australian Weeds Strategy. https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/pests-diseases-weeds/consultation/aws-final.pdf.
44. Australian Government Department of Agriculture, Fisheries and Forestry, nd. Environment and Invasive Committee. https://www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/pest-animals-and-weeds/eic.
45. Bartel, B., The other is us: conservation, categories and the law. In O'Donnell, T. et al. *Legal Geography Perspectives and Methods*, 167 – 184. Routledge (2020).
46. O'Donnell, T. et al. *Legal Geography Perspectives and Methods*. Routledge (2020).
47. Marder, M. *Plant-thinking: A philosophy of vegetal life*. New York: Columbia University Press (2013).
48. Bennett, J. *Vibrant matter: A political ecology of things*. Durham, NC: Duke University Press (2010).
49. Kohn, E. *How forests think: Toward an anthropology beyond the human*. Berkeley: University of California Press (2013).
50. Sjöman, H., Morgenroth, J., Sjöman, J. D., Sæbø, A. & Kowarik, I. Diversification of the urban forest—Can we afford to exclude exotic tree species?. *Urban For. Urban Green.* **18**, 237–241 (2016).
51. Potgieter, L. J., Gaertner, M., Kueffer, C., Larson, B. M., Livingstone, S. W., O'Farrell, P. J. & Richardson, D. M. Alien plants as mediators of ecosystem services and disservices in urban systems: a global review. *Biol. Invasions* **19**, 3571–3588 (2017).
52. Taylor, S. et al. Climate change and the potential distribution of an invasive shrub, Lantana camara L. *PloS One* **7**, e35565 (2012).
53. Negi, G. C. S. et al. Ecology and Use of *Lantana camara* in India. *Bot. Rev.* **85**, 109–130 (2019).
54. Patel, S. A weed with multiple utility: Lantana camara. *Rev. Environ. Sci. Bio/Technol.* **10**, 341–351 (2011).
55. Davis, M. A. et al. Don't judge species on their origins. *Nature* **474**, 153–15 (2011).
56. Foxcroft, L. C. An adaptive management framework for linking science and management of invasive alien plants. *Weed Technol.* 1275-1277 (2004).
57. Seastedt, T. R., Hobbs, R. J. & Suding, K. N. Management of novel ecosystems: are novel approaches required?. *Front. Ecol. Environ.* **6**, 547–553 (2008).
58. Gosper, C. R. & Vivian-Smith, G. Selecting replacements for invasive plants to support frugivores in highly modified sites: a case study focusing on Lantana camara. *Ecol. Manag. Restor.* **7**, 197–203 (2006). pp.
59. Goyal, N. & Sharma, G. P. It takes two to tango: variable architectural strategies boost invasive success of Lantana camara L.(sensu lato) in contrasting light environments. *Biol. Invasions* **21**, 163–174 (2019).
60. Carrión-Tacuri, J., Rubio-Casal, A. E., De Cires, A., Figueroa, M. E. & Castillo, J. M. Lantana camara L.: a weed with great light-acclimation capacity. *Photosynthetica* **49**, 321–329 (2011).
61. Hochuli, D. F. et al. Glebe's Hill: unravelling its biodiversity secrets and potential. Report to the Glebe Society and the City of Sydney. https://doi.org/10.25910/n3yb-av34 (2024).
62. Architectus & Clouston Associates. Johnstons Creek Master Plan Stage 3: Draft Master Plan (2013).
63. Humphrey, J. E., Haslem, A. & Bennett, A. F. 'The noisy neighbor conundrum: what influences the value of urban sites for forest birds?'. *Urban Ecosyst.* **27**, 717–732 (2023).
64. Celermajer, D. et al. Multispecies Justice: Theories, Challenges, and a Research Agenda for Environmental Politics. *Environ. Polit.* **30**, 119–140 (2021).
65. Celermajer, D., Burke, A., Fishel, S., Fitz-Henry, E., Rogers, N., Schlosberg, D. and Winter, C. Institutionalising Multispecies Justice. *Elements in Earth System Governance*. Cambridge University Press, (2025).
66. Shackleton, R. T., Shackleton, C. M. & Kull, C. A. The role of invasive alien species in shaping local livelihoods and human well-being: A review. *J. Environ. Manag.* **229**, 145–157 (2019).
67. Cannon, C. E., McInturff, A., Alagona, P. & Pellow, D. Wild urban injustice: A critical poet model to advance environmental justice. *Environ. Justice* **17**, 120–127 (2024).
68. McInturff, A., Volski, L., Callahan, M. M., Sneegas, G. & Pellow, D. N. Pathways between people, wildlife and environmental justice in cities. *People Nat.* **7**, 575–595 (2025).
69. Sá, R.M. The IPBES Thematic Assessment on Invasive Alien Species and Their Control: Futurity and Policy Opportunities in a More than Human-World. In *Global Public Goods Communication* (pp. 135-156). Springer, Cham, (2025).
70. Jensen, J. K. et al. Evidence-based urban greening: a missing piece in biodiversity conservation. *Trends Ecol. Evol.* **40**, 523–526 (2025).
71. Wilson, K.M., Power, H.E. Seamless bathymetry and topography dataset for Sydney Harbour (Port Jackson) at 10m gridsize [dataset]. School of Environmental and Life Sciences, University of Newcastle, Australia, PANGAEA, https://doi.org/10.1594/PANGAEA.885014 (2018).
72. Colquhoun, G.P. et al. New South Wales Seamless Geology dataset, version 2.5 [Digital Dataset]. Geological Survey of New South Wales, Department of Primary Industries and Regional Development, Maitland (2025).
73. Wang, R. et al. Influence of Lantana camara on soil II. Effects of Lantana camara leaf litter on plants and soil properties. *Allelopath. J.* **35**, 207–216 (2015).
74. Osunkoya, O. O. & Perrett, C. Lantana camara L.(Verbenaceae) invasion effects on soil physicochemical properties. *Biol. Fertil. Soils* **47**, 349–355 (2011).
75. Alaribe, F. O. & Agamuthu, P. Lantana camara—an ecological bioindicator plant for decontamination of Pb-impaired soil under organic waste-supplemented scenarios. *Pedosphere* **29**, 248–258 (2019).
76. Turner, P. J. & Downey, P. O. Ensuring invasive alien plant management delivers biodiversity conservation: insights from an assessment of'Lantana Camara'in Australia. *Plant Prot. Q.* **25**, 102–110 (2010).
77. Kath, J. et al. Interspecific competition and small bird diversity in an urbanizing landscape. *Landsc. Urban Plan.* **92**, 72–79 (2009).
78. Kalita, S. et al. A review on medicinal properties of Lantana camara Linn. *Res. J. Pharm. Technol.* **5**, 711 (2012).
79. Goulson, D. & Derwent, L. C. Synergistic interactions between an exotic honeybee and an exotic weed: pollination of Lantana camara in Australia. *Weed Res.* **44**, 195–202 (2004).

Acknowledgements

We acknowledge the Gadigal people as custodians of the land upon which we work. This research was supported by the Sydney Environment Institute at the University of Sydney. MPP is also supported by the Mckenzie Postdoctoral Fellowship Award, established by the Deputy Vice-Chancellor, University of Melbourne. This paper was also supported by the MUST Strategic Research Council project, Finland (Decision Number: 358365).

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Competing interests
The authors declare no competing interests.

Additional information
Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s42949-025-00281-1.

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