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Planning Ecologically Just Cities: A Framework to Assess Ecological Injustice Hotspots for Targeted Urban Design and Planning of Nature-Based Solutions

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ABSTRACT

This paper presents a typology of ecological injustice hotspots for targeted design of nature-based solutions to guide planning and designing of just cities. The typology demonstrates how the needs and capabilities of nonhuman nature can be embedded within transitions to multi- and interspecies relational futures that regenerate and protect urban social-ecological systems. We synthesise the findings of previous quantitative and qualitative analyses to develop the Ecologically Just Cities Framework that (1) works as a diagnostic tool to characterise four types of urban ecological injustices and (2) identifies nature-based planning actions that can best respond to different types of place-based ecological injustices.

摘要

本文提出了一个生态不公正热点的类型学，用于有针对性地设计基于自然的解决方案，以指导公正城市的规划和设计。该类型学展示了非人类自然的需求和能力如何能够被嵌入到向多物种和跨物种关系的未来过渡中，从而再生和保护城市社会生态系统。我们综合了之前的定量和定性分析结果，制定了生态公正的城市框架，(1) 作为诊断工具来描述四种类型的城市生态不公正；(2) 确定了基于自然的规划行动，可以最好地应对不同类型的地方生态不公正问题。

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Nature-based solutions; ecological justice; social-ecological-technological systems; cities; urban; conceptual framework; science

1. Introduction

The importance of nature in and for cities is now widely recognised as an integral approach to address complex problems such as climate change impacts, biodiversity loss, community wellbeing and justice (Frantzeskaki *et al.* 2019, Andersson 2021, Folke *et al.* 2021, McPhearson 2021, Pörtner *et al.* 2021). Nature-based solutions (NBS) have come to the forefront as a strategy to address these problems through the restoration, rehabilitation and integration of ecosystems and ecological

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processes in city design (Raymond *et al.* 2017, Palomo *et al.* 2021, Frantzeskaki and McPhearson 2021). However, planning, designing and implementing NBS in cities remains a challenge. This is particularly the case when integrating multifunctionality in planning and delivery, that is enhancing functions and co-benefits for people and biodiversity (Eggermont *et al.* 2015, Wickenberg *et al.* 2021).

This challenge is amplified by the human-centred underpinnings of nature in urban development, historically driven by the concept of ecosystem services – a highly anthropocentric, utilitarian framing that emphasises the commoditisation of nature (Chan *et al.* 2012, Raymond *et al.* 2013, Eggermont *et al.* 2015). The wider framing of Nature's Contributions to People (NCP), defined as the benefits (or disservices) that people derive from ecosystem services, offers a pathway to consider the more diverse values of nature, including environmental justice concerns held by Indigenous and local people (Pascual *et al.* 2017, Díaz *et al.* 2018, Peterson *et al.* 2018, Hill *et al.* 2021), yet recent debates raise questions as to whether the NCP concept fully accounts for the morality of care, including extension of the community of justice to non-human entities (Muradian and Gómez-Baggethun 2021).

Existing research on the values of nature in ecosystem management principally draws upon an environmental justice framing comprising of procedural, recognition and distributional justice (Schlosberg 2013, Tozer *et al.* 2020, Anguelovski *et al.* 2020, Herreros-Cantis and McPhearson 2021). Distributional justice considers the fair allocation of ecosystem services (Kabisch and Haase 2014), as well as acknowledging the historic inequalities embedded in ecosystem services production and consumption (Andersson *et al.* 2019, Langemeyer and Connolly 2020). Procedural justice concerns how decisions are made, which affected groups participate in design, planning and management of public spaces, and on what terms (Schlosberg 2007, Martin *et al.* 2020). Recognition acknowledges the social cohesion and functioning of the community, and the respect for differeces in cultures, ideas, and practiices (Martin et al. 2016, Schlosberg 2013).

A recent systematic review shows how environmental justice scholarship has deeply considered distributional justice concerns, including issues of income and race/ethnicity and the factors underpinning social segregation, with a focus regulating and cultural ecosystem services (Calderón-Argelich *et al.* 2021). Other works demonstrate how aspects of recognition and procedural justice can be addressed through multi-level governance processes (Buijs and Jacobs *et al.* 2021, Kabisch and Frantzeskaki 2016). Recent advancements take an intersectional approach to understanding the socio-ecological vulnerabilities of unprivileged social groups, examining how issues of class, race, ethnicity and gender intersect to create new injustices when implementing NBS (Herreros-Cantis and McPhearson 2021).

In parallel, the conservation sciences literature is developing new concepts of "ecological justice" as a way to better account for the needs of nonhuman nature (Bush and Doyon 2019, Maller 2021, Pineda-Pinto *et al.* 2021a). This works also draw on advancements in different fields, such as those applying a more-than-human perspective to planning by embedding ethical relations that can bring to light multispecies entanglements and planning practices that extend political rights, entitlements and reasoning to nonhumans (Houston *et al.* 2018, Metzger 2019).

Calls in political theory to expand social justice towards notions of multispecies justice (Celermajer *et al.* 2021) and addressing climate justice in city planning (Steele *et al.* 2012) have broadened the long-standing anthropocentric bias of justice framings. However, to date there are no frameworks that adequately integrate the qualities of environmental and biodiversity justice scholarship to provide for planning and decision-making a working tool to assess injustices. Such frameworks are crucial in the quest to "balance" biodiversity, justice, equity and wellbeing concerns, as called for in politically defined targets of e.g. the Post-2020 Biodiversity Conservation Framework (Draft) and the European Biodiversity Strategy to 2030. Such frameworks also provide a pathway for operationalising concepts of justice further. Given that urbanisation creates places that are burdened with spatial, social and ecological inequalities (Brenner 2018), it is critical to question who benefits from existing nature-based spaces and future nature-based plans, and what are the urban planning

mechanisms that produce and reproduce unequal and uneven geographies of displacement, exclusion and destruction.

The same applies in the context of environmental and urban planning that is challenged by integrating NBS in the nexus of urban infrastructures (Frantzeskaki *et al.* 2020, Malekpour *et al.* 2021). It is therefore crucial for urban planning to incorporate considerations of justice in theory, practice and experimentally (Campbell and Marshall 2006, Cousins 2021). From a more-than-human lens, cities can be spaces guided by ethical imperatives to recognise ecological diversity and relationality. This in turn will imply the inclusion and emancipation of humans and nonhumans as part of city-making. Justice is an important concept that provides a conceptual and operational benchmark; it guides humans with principles that are grounded by an ethics of what is good or bad, right or wrong (Wienhues 2020), albeit with an ethics of reciprocity, respect, care and compassion (Strang 2017, Steele *et al.* 2019). However, for planning to have a contribution to procuring fairness, equality and justice, we need to ensure that abstract theories of justice have practical applicability in the particularities of everyday community experiences, practices and contexts that regulate, shape, and enable new forms of organisation and governance (Campbell and Marshall 2006).

To address this ethical, relational and practical challenge of dealing with ecological justice through planning with NBS (Eggermont *et al.* 2015, Haase *et al.* 2017, Pineda-Pinto *et al.* 2021a), we developed the Ecologically Just Cities Framework. With this framework, we provide an alternative way to plan with and for nature with the goal of seeking the flourishing and integrity of multispecies and health of ecosystems. We do this by first revealing ecological injustice hotspots through the combination of justice dimensions from environmental and ecological justice scholarship for the targeted design of NBS for people *and* nature. The first dimension, distributional injustice, looks at how impacts, benefits and (dis)services are allocated, and who and why specific people, species and ecosystems are burdened and not others (Schlosberg 2012, 2013, Wienhues 2020). The second dimension "recognition" explores how individuals and communities of humans and nonhumans are valued, which links to the third dimension, participation, which unpacks who has a voice and influence or is included in decision-making processes (Schlosberg 2012, 2013). The fourth dimension refers to capabilities in the sense of how humans, nonhumans and ecosystems' integrity and capacities are sustained to ensure a flourishing life (Fulfer 2013, Schlosberg 2013). Ecological capabilities are a critical dimension of ecological justice. They are the elements that enable life to function in a state of wellbeing, not only for individual species, but ecosystems or ecological entities (Kortetmäki 2017, Schlosberg 2007). It is about ensuring that capability thresholds for human and nonhuman individuals and systems allow both to flourish (Nussbaum 2006, Fulfer 2013). An ecological justice approach however, would ideally procure the enhancement of capabilities by adding more value through the fair allocation of multiple ecological functions and benefits to those individuals or systems are devalued or degraded. This can be done by not only ensuring access to healthy habitats, but also taking actions that create opportunities for flourishing and cultivate spaces for choice that allow life to flourish (Nussbaum 2006).

The Ecologically Just Cities Framework offers a multidimensional approach to diagnosing ecological injustices (according to deprivations in terms of distribution, recognition, participation and capabilities), and providing nature-based interventions that are based on the reparation, prevention and anticipation of ecological injustices. Ecological deprivations on one hand refer to unhealthy ecosystems and habitats, fragmented landscapes, and diminished biodiversity, while social deprivations refer to social vulnerabilities and deficiencies that prevent life from flourishing in a state of wellbeing and prosperity. We see this framework as an open model, constructed on a plurality of methods and concepts, that is flexible for contextual and place-based adaptability.

2. Method: Developing a Conceptual Framework

The Ecologically Just Cities Framework for enhancing and expanding multifunctionality of NBS is built through an iterative, abductive process in which we synthesise findings from a mixed-methods

approach that allows us to identify patterns, themes and relationships from different data sources. An abductive approach can be very useful in contexts of collaborative practices and in situations where the evidence, which might not be complete or there are many unknown pieces, provides an explanation based on an inferential process (Aliseda 2006, Denscombe 2008). This pragmatic approach allows fluidity between disciplines and methods and seeks to find practical ways to orient policy and research practice.

We draw from empirical evidence, multi and interdisciplinary bodies of knowledge, and synthesise findings to provide an alternative, interpretative understanding of reality; or as articulated by Jabareen (2009) and Levering, (2002, p. 37), knowledge that repositions, or shifts, in our case, the anthropocentric underpinnings of NBS. To do this we use an adapted version of Jabareen's (2009) conceptual analysis framework (see Figure 1) that provides a structure for bringing together the previous work in which we have conducted conceptual and empirical analyses through different methods and as such have a conceptual baseline with which we synthesise, integrate and categorise. This previous work is formed through four sources: two conceptual methodologies and their respective spatial analysis application in two case studies (Melbourne, Australia and New York City (NYC), USA) (Pineda-Pinto *et al.* 2021b, 2021c), a systematic literature review that looked at the integration of social-ecological justice in the NBS literature (Pineda-Pinto *et al.* 2021a), and a qualitative study (case study research) in the city of Melbourne that explored place meanings and senses of injustices of diverse environmental stewards and practitioners.

2.1. Mapping and Categorising Sources and Data

The diagnosis of ecological injustices in urban landscapes is fundamental to the framework developed in this paper. We define a typology of injustices based on the 4-dimensional model of ecological justice, which includes specific aspects for exploring social-ecological conflicts. To advance this topic, we developed a methodology which operationalises the main dimensions of justice – distribution, recognition, participation and capabilities – to identify parameters and variables that would allow us to spatially analyse urban geographies, which we applied in Melbourne, Australia, and New York City, USA (Pineda-Pinto *et al.* 2021b, 2021c). The variables included indicators such as sources of polluting activities and contaminated land (distribution), number and level of impact

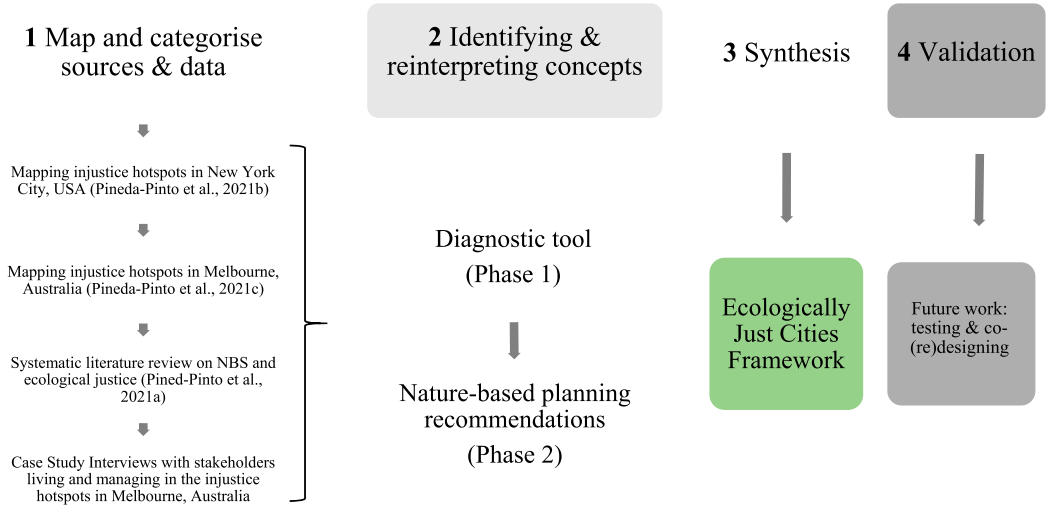


Figure 1. Conceptual framework analysis procedure (adapted from Jabareen 2009).

of environmental community groups involved in rehabilitation activities (participation), protected areas, and quantity and quality of ecological space (recognition).

We applied this methodology in Metropolitan Melbourne, an Australia urban region experiencing rapid population growth and urban sprawl, which has caused extensive habitat and biodiversity loss (Ives *et al.* 2013), and socio-economic polarisation, intensifying spatial and social inequalities (Brain *et al.* 2019). In Melbourne we identified three main injustice hotspots – covering several local government areas to the west (Maribyrnong, Hobson's Bay, Brimbank, Melton and Wyndham), northwest (Hume and Whittlesea) and southeast (Greater Dandenong, Kingston, Casey and Cardinia). These areas were marked with high distributional injustice (that is high concentrations of impacts, contamination or sources of pollution), with low social capital or active, engaged participation from civil society in environmental issues, and an overall misrecognition or devaluation of areas that are supposed to be protected and recognised for their landscape values and environmental significance (Pineda-Pinto *et al.* 2021c). Ecological injustice hotspots are areas that our mapping identified as places in which nature is devalued, misrepresented and affected by anthropocentric impacts, which hinders its capabilities and capacity from being social-ecologically just places for people and nature/species (Pineda-Pinto *et al.* 2021b, 2021c). The initial mapping of Melbourne's injustice hotspots was complemented with an additional study that performed in-depth interviews with community members and practitioners involved in the protection, restoration and environmental planning of social-ecological spaces. This second study was used to identify key elements of how local environmental stewards perceive their local ecologies and their senses of injustices. This work matched many of the occurrences we found in the spatial analysis and contributed to characterising the injustice types.

After the spatial analysis in Melbourne, we further advanced the operationalisation of justice by bridging its four dimensions with the social-ecological-technological systems (SETS) framework (Pineda-Pinto *et al.* 2021b). SETS provides an understating of cities as complex systems that are shaped by the interactions between the social, technological and ecological subsystems and helps us unpack the dynamics that exacerbate or improve systemic problems, such as deeply entrenched inequalities (McPhearson *et al.* 2021). Following this, we defined questions, parameters, variables and indicators which we then applied in New York City. NYC is one of the most population-dense and urbanised regions worldwide, with historical concentration of industrial activities, high rates of environmental degradation and historical socio-spatial inequalities. In NYC, like Melbourne, the injustice hotspots are contested spaces, with generally fragile ecological capabilities and resilience, and some areas are marked by social deprivations and heavy industrial land uses. Some of the community districts flagged with the highest injustices included La Guardia and JFK airports and compact urbanised areas with little green space, particularly in Lower Manhattan.

From these studies, we were able to identify similar occurrences, but also differences. Quantitatively, in both cities, areas with low social capabilities, such as stewardship presence also tend to have diminished ecological capabilities and/or are areas under constant socio-economic threats. This was also found in the qualitative analysis. Each city was different in other aspects. However, in Melbourne, areas burdened with ecological injustices have similarities between studies of environmental or social justice, for example in terms of socio-economic vulnerabilities and access to green space (Astell-Burt *et al.* 2014, Sharifi *et al.* 2021). By contrast, in New York, when looking at ecological capabilities, higher injustices are also evident in places like Queens and Brooklyn and thus not particularly matching higher social distributional injustices (de Sherbinin and Bardy 2015, Herreros-Cantis *et al.* 2020). This is due mainly because many environmental justice studies focus on a specific vulnerability and/or risk, such as flooding, and this tends to highlight certain regions, such as coastal areas.

From a point of view of recognition related to issues of intergenerational and interspecies justice, it was important to look at plans and programmes designed to improve ecological outcomes as they show their effects now or in the future. In NYC, areas with policies that do not recognise the need for protection tend to have diminished ecological capabilities. Similarly, the qualitative data in

Melbourne showed that areas with weak environmental protections and policies favouring economic growth tend to have ecological systems under a lot of pressure and/or in a diminished state.

Both cities have different social, ecological, geographic and climatic characteristics that have led to different planning measures and outcomes throughout time. This has shaped the urban landscape in a certain way, making it difficult to generalise and necessary to dive deep into specific areas to define the specificities of injustices more explicitly. Nonetheless, injustices are systemic and through the 4-dimensional framework used here, it is possible to set a framework to categorise the types of injustices. We believe this is a contribution to urban planning and design as it offers an applied tool to unpack and explore abstract concepts of ecological justice.

The methodological advancements for mapping injustices and the empirical work in Melbourne and New York City provide the diagnostic/assessment tool (phase 1). This phase can be understood in three steps – diagnosis or assessment of injustices, diagnosis of local ecosystems in terms of capacity and integrity (biophysical processes, ecological structure and ecosystem health) and identifying types of injustices based on the deprivations of different dimensions.

The diagnostic phase is the backbone of the second phase of the conceptual framework: identifying nature-based planning and design recommendations that enhance multiple functions and benefits for multi- and interspecies flourishing (Figure 1). Based on the characteristics of each type of injustice hotspot, we then draw on the findings from the systematic literature review and qualitative data from in-depth interviews to extract planning and design recommendations that can target the different ecological injustice hotspot types.

From the in-depth interviews, we identify the different place meanings and senses of injustices-in-place held by the different actors involved in the protection, restoration and management of their local ecologies. These stakeholders shared their place meanings and senses of injustices. From the synthesis of the systematic literature review we identified ways in which NBS can be enacted through the four dimensions of justice where social and ecological capabilities are enhanced, participation and recognition are enacted fairly through a multispecies approach, and distribution of benefits and (dis)services are allocated justly (Pineda-Pinto *et al.* 2021a). From this work, we synthesise and propose a range of broad nature-based design, planning and governance approaches. These range from traditional, more top-down planning of NBS, and co-designed nature-based interventions. As a future step, we propose a number of following stages that bring together diverse stakeholders in co-participatory and co-design processes to find the transformative potential in place of each ecological-injustice hotspot by testing, validating and re-making the framework we present.

3. A Typology of Ecological Injustices in Cities

In response to the first steps for diagnosing ecological injustices, we have identified from the synthesis exercise four ecological injustice types: 1 (On the Edge), 2 (Silenced Voices), 3 (The Other 1%) and 4 (Tainted Landscapes). Each type reflects (a) one or more dimensions of deprivation and (b) the relationality between the many species that inhabit cities and the ecological spaces that support them. They each present different characteristics and all suffer some degree of injustice in one way or another (see Figure 2 and Table 1). These four types and their associated interventions for enhancing and expanding multifunctionality of NBS make up the Ecologically Just Cities Framework. The configuration of ecological injustice types with respect to each dimension of ecological justice is presented in Table 1. The types are used to map injustice hotspot through Melbourne and New York City and propose interventions to redress injustices of this type.

3.1. Type 1 Injustice Hotspot: On the Edge

Injustice hotspots classified as Type 1/"On the edge" hotspots are defined by having the lowest levels of injustice. Although these spaces are at a minimum in terms of ecological deprivations, there is

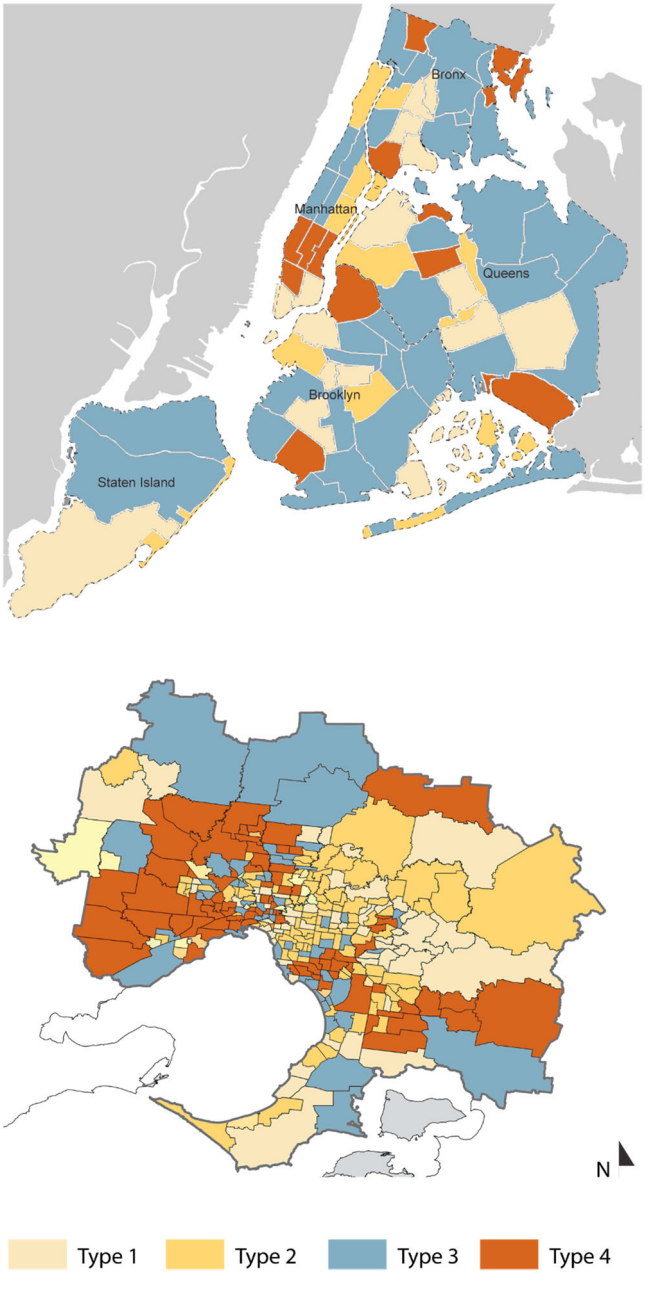


Figure 2. Maps of New York City (upper image) and Melbourne (lower image) with areas marked by types of injustice. Type 1 (On the Edge); Type 2 (Silenced Voices); Type 3 (The Other 1%); Type 4 (Tainted Landscapes).

still a level of injustice marked by a history of urbanisation and landscape modification. Nonetheless, this ecological injustice type is characterised by areas with low distributional injustices, and higher levels of participation with and for nature, in terms of stewardship activities, political action and magnitude of ecological restoration. Type 1 injustices also have some level of recognition at municipal or state level for their protection and/or restoration. The social capabilities in these areas are high, with high levels of participation and representation for the local ecologies. With higher levels of recognition and protection, ecologies in these areas are protected and cared for

Table 1. Typology of ecological injustice hotspots.

Ecological Justice Dimensions	Types			
	1	2	3	4
Distribution	very low*	low	high	very high
Recognition	very high	low	medium	very low
Participation	very high	low	medium	very low
Social Capabilities	very high	low	medium	very low
Ecological Capabilities	low	low	low	very low
	On the Edge	Silenced Voices	The Other 1%	Tainted Landscapes
	Ecological injustice hotspot types			

*Note: Very low distribution means there are low quantities of polluting activities, contaminated land, or disservices in an area – equating to a lower degree of injustice. An area with very high distributional impacts, oppositely, would mean high injustice. Low participation and recognition carry higher injustices as these shows low signs of representation and recognition of nonhuman nature. Very low social-ecological capabilities would mean higher degrees of injustice as this indicates that people and nature are having their capabilities diminished.

than the rest, and highly valued. Although local ecologies are well established, there is a need to support the local social-ecological capabilities, and potential enhancement through new nature-based structures and protections, to avoid their tipping over the edge to more pertinent injustices and vulnerabilities.

In both NYC and Melbourne, some areas tend to have a balanced mix of green space and residential land uses with different densities, particularly in the inner and middle suburbs of Melbourne and in several NYC Community Districts in Queens, Bronx and Brooklyn. However, in both cities, some of these areas also have ecological deprivations in terms of quantity and ecological integrity. Even though this hotspot has the minimum degree of deprivations, there are also regions with ecological deprivation and spaces with denser, competing land uses that put them in a position of contestation and vulnerability. In Melbourne, the areas located in the middle and outer rings, composed of more established townships in the Macedon Ranges, Mornington Peninsula and Eastern regions, tend to have protected reserves and other spaces of ecological significance. In NYC, many of these injustice hotpots, whilst having very small, fragmented pockets of green space, have stronger levels of participation and recognition and lower levels of industrial or harmful impacts.

For an injustice hotspot that is *On the Edge*, we propose strengthening current protections of existing green spaces and anticipating future conflicts in areas where economic growth and gentrification are expected to occur. This implies supporting and increasing the social capital that is already in place and ensuring that newer generations and a diversity of groups are included in current and future programmes to increase ecological awareness and representation. For example, in bringing young generations close to nature, the heterogeneity of attitudes towards NBS across different generations and gender aspects need to be considered to positively impact the implementation of NBS for regeneration (Giachino *et al.* 2021). In places where communities have a historical advantage in terms of economic and political privilege and have secured the protection of green space, it is important to recognise that this has an effect on other areas, where injustices then tend to concentrate because they are not able to benefit from these advantages. As such, nature-based strategies can redress some of the social injustice that concentrates spatially in other areas. For instance, NBS can act as a catalyst of innovation and provision of social and affordable housing.

In places deprived of green spaces, particularly in NYC, we propose building on the existing social capital to innovate and experiment with new ways to increase ecological space and enhance multispecies cohabitation such as turning grey spaces into urban agriculture lots, guerrilla gardening interventions and rewilding derelict and abandoned spaces. Designing cities so that they enhance human–wildlife interactions can increase the co-benefits that they can provide to each other through a positive coexistence (Buijs and Jacobs 2021). This can include experimenting with new ways of creating multispecies habitats in existing buildings, structures and infrastructures and enabling these experiments through adaptability and flexibility of regulatory frameworks i.e. allowing or providing community groups with rent-free public greyfields/brownfields. It can include, for instance, recognising the vital role that bees play as pollinators and designing urban space to cater for their needs in terms of food, mobility and environmental conditions so that they can thrive and bring the multiple co-benefits to the rest of urban inhabitants (Patel *et al.* 2021). From a legislature capacity, either modifying or reinforcing local and state policies and regulations, as well as designing programmes and projects that add and improve long-term resilience and capacity, can ensure that land is secure in the future as interspecies commons, as a guarantee for intergenerational ecological justice.

3.2. Type 2 Injustice Hotspot: Silenced Voices

Type 2 injustice hotspots are characterised by having social capability deprivations, characterised by having very low density or underdeveloped social networks, structures, connections and knowledge in relation to their local ecologies. These hotspots tend to have low distributional deprivations, but low social and ecological capabilities, that are driven by socio-economic vulnerabilities, which also manifest as areas having low levels of recognition and participation. These areas have a stronger ecological network, in terms of green spaces, coastal areas and protected natural spaces.

In Melbourne, areas in the outer western, south-eastern and eastern areas close or within the Green Wedges (which enclose and cut across the urban growth boundary), such as Yarra Valley, Manningham, Narre Warren and Macedon, there is still green space, fragmented to a degree, but the landscape still has the capacity to support new ecologies and protect existing ones. These areas have newer, multiethnic populations, spread out suburbs and socio-economic vulnerabilities. The Bronx in NYC was highlighted with similar characteristics. Although it is a much denser, consolidated urban region, it is characterised by having high socio-economic disparities, but it is also home to Van Cortlandt and Pelham Bay Park, the New York Botanical Gardens and other important ecological areas.

Marked with social capability deprivations, the *Silenced Voices* hotspot presents new opportunities to address deprivations experienced by local communities, through their lenses and needs. This might mean promoting new ways of understating communities' needs in a way that also protects and enhances the needs of existing ecologies. For areas that are experiencing social deprivations in the form of socio-economic vulnerabilities, marginalisation and/or are communities with not a strong sense of place, nature-based actions need to start by enhancing and expanding peoples' capabilities and nurturing capacities that might be presently suppressed or not recognised. We refer to these actions as social capability enhancement and expansion strategies. The intention of these measures is to increase communities' capacities, resilience and possibilities for reconnecting, understanding and working with/for nonhuman nature.

Fundamental to addressing these social deprivations is the need to increase institutional spaces and mechanisms for participation, empowerment, activation of communities and connection to place from multiple actors to increase stewardship and community engagement and action, capacity and empathy (Frantzeskaki 2019, Kabisch 2019, Raina and Dey *et al.* 2020). Nonetheless, prior to leveraging spaces to increase community participation, empowerment and activation, to reduce the risk of replicating or worsening current injustices in communities where basic needs and rights are not guaranteed, it is important to design and promote social capability enhancing

programmes. To grow ecological awareness, care and capacity in vulnerable communities, first and foremost, their needs and capacities need to be developed through place-based socio-economic opportunities, such as employment, access to cultural and political spaces, and other benefits. Multispecies design strategies for community involvement can be achieved through a diverse variety of activities and projects that connect to peoples' socio-economic circumstances such as community gardening programmes that include a multispecies design at their core. This will have a cascade effect and in turn would improve the identification of spaces that need restoration through policy interventions. It can help to identify and map "silent" stewards and "loud" champions that are nurturing and fighting for nature in cities. As such, providing them with new spaces for voice empowerment and championing is critical.

Most importantly, new methods and ways of giving a voice to nonhuman nature need to be explored and enacted. These new pathways for giving a voice to nature need to range from informal, experimental, grass-roots platforms and spaces to "speak out" and create new human-nonhuman dialogues, to formal spaces that legally emancipate and recognise nature as an active agent. Legally recognising nonhumans as active agents might entail radically changing regulatory frameworks, but more critically, ensuring that new frameworks are co-created, operational and able to have practical implications.

Other more informal pathways can be enacted through art-nature projects that work to make hidden natures visible, or can be triggered through different platforms, like citizen science projects that track and reveal the different ways nonhuman lives shape and are shaped by the environment. Online tools and spaces that offer more inclusive spaces for interaction and building knowledge can bring together a more diverse array of people and understandings. Thus, exploring and enhancing nonhuman nature in cities by repairing social deprivations requires building peoples' capacities through their own perspectives and awareness of the world.

3.3. Type 3 Injustice Hotspot: The Other 1%

The third type of injustice hotspot shows deficiencies in all dimensions. These are areas with notably high distributional impacts that have been predominantly industrial land uses for a long amount of time, and polluting activities and events are still present. There is some degree of social capacity, but not enough recognition, participation and engagement from the broader public to create change. Ecological capabilities are very fragile, fragmented and under pressure. This is the most significant characteristic of this hotspot and can be described as being ecologically deprived, or have few remaining remnant ecological spaces. The Other 1% refers to spaces in which ecosystems have been devalued and destroyed. An inaction for protection and recognition of their value has seen these urban ecosystems plummet to extreme lows, shunning them to a category of "other" or another externality.

For example, the New York City case study showed that places with high distributional injustices tend to have diminished ecological capabilities (several community districts in the Bronx and Manhattan). In Melbourne, regions with high distributional impacts tend to clutter in and around the CBD, are denser and are areas with past and current polluting land uses. From a more regional scale, these inner and middle areas also have the highest degree of landscape fragmentation and diminished ecosystem health. In the outer western regions of Melbourne, less than 1% of temperate grasslands and grassy eucalypt woodlands remain (Commonwealth of Australia 2011), going from being a landscape harbouring a unique ecosystem, to one of competing sprawled suburbia and industrial lots.

To address areas with ecological deprivations, NBS need to enhance and expand ecosystem and nonhuman natures' capabilities. These solutions need to focus on restoring, regenerating, and rehabilitating the traces of pollution and environmental degradation, regenerating neglected spaces, and heavily modifying altered landscapes so that they support new ecologies. This can be done through different multispecies strategies that rely on improving and mainstreaming knowledge on

multispecies needs, behaviours and ecologies, in particular of burdened or deprived social and ecological communities. This can be achieved by developing detailed databases sourced from different sources such as urban ecology assessments and citizen science contributions. It can also be achieved by bringing different ways of knowing and being in the urban landscape, such as from indigenous perspectives and posthumanist approaches that challenge traditional planning processes and practices. Some of these strategies can include providing sources of food, habitat and mobility (migration routes) through place-based art and design interventions that can be unscaled to achieve undisrupted ecological spaces and processes that have more transformative power at city-wide and city-region scales.

3.4. Type 4 Injustice Hotspot: Tainted Landscapes

This injustice hotspot type lies at the other end of type 1. It is characterised by being in a state of extreme ecological deprivation. These areas have high distributional injustices, which can range from historical polluting land uses, catastrophic pollution events and/or industrial land uses. They are also marked by having low social capital, linked to issues of misrepresentation, devaluation and lack of engagement and awareness of the local ecologies and impacts. Ecosystems are fragmented, with compromised integrity and resilience.

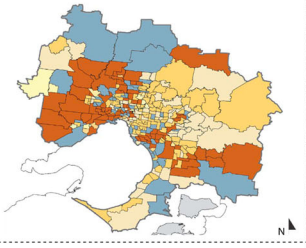
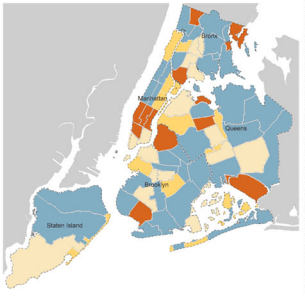
In NYC, these areas have diminished social capabilities, in some cases manifested as socio-economic disadvantages and in others with very low participation and recognition. They also have very small green areas and high distributional impacts. The Melbourne case showed a similar pattern and the qualitative analysis confirmed that ecosystems are highly degraded and fragile. Being extremely deprived places, these hotspot types require challenging the status quo planning that delivers services and benefits to some groups, both human and nonhuman, and instead openly addresses multi- interspecies trade-offs through different forms of stewardship, care, respect and active representation.

To repair and rehabilitate these *Tainted Landscapes* we propose extreme measures. Hotspot type 4 requires a comprehensive, complexity and systems thinking approach, which builds on all the strategies proposed for the injustice hotspot types 1–3, but additionally develops an integrated, long-term, anticipatory vision that positions the enhancement of ecological capabilities as the desired state to achieve. Embedding a nature-based planning or nature-based urbanism logic into all strategic and statutory levels and sectors of city planning can put at the core the enhancement of ecological capabilities.

For this we propose implementing the concept of ecological redistribution (Wienhues 2020) in new urban development plans as a strategy to design new habitats for species, restructuring and creating hybrid infrastructures that can sustain multiple species, and generating ecological connectivity, fluidity and patterns into city designs. In consolidated urban landscapes, conducting spatial distribution analysis through a lens of multiscalar biophysical processes and human-nonhuman relations (Pineda-Pinto *et al.* 2021a, 2021b, 2021c), can provide assessments on social-ecological deprivations.

This can indicate which areas are deprived and which ones need to be protected, and set baselines for actions of redistribution of ecological space or ecological processes that can sustain and enhance multispecies capabilities. These analyses can also identify areas with high risk of anthropocentric burdens to pre-empt the need to build social capital, create place ownership, encourage people-wildlife relations and provide space for community eco-mobilisation (Pineda-Pinto *et al.* 2021a). It is necessary to map and identify degraded spaces to rehabilitate and regenerate them considering the needs of future human-nonhuman inhabitants and find ways to minimise threats and risks posed by historic anthropocentric burdens, such as long-lasting contamination (Pineda-Pinto *et al.* 2021a). Understanding and addressing human needs is absolutely essential. Social capital and other social capabilities can only be developed and enhanced until social vulnerabilities are addressed from a place-based understanding.

Table 2. Ecologically Just Cities Framework: nature-based actions for Melbourne and New York City.

Case Study Injustice Hotspots	Ecological Injustice Types 1 *On the Edge* minimum in term of ecological deprivations	2 *Silenced Voices* social capability deprivations	3 *The Other 1%* ecologically deprived	4 *Tainted Landscapes* extreme ecological deprivation
Case Study 1: Melbourne, Australia 	Design programs and projects that that secure land in the future as interspecies commons, (guarantee intergenerational ecological justice).	Implement multispecies design strategies by involving communities through a diverse variety of activities and projects that connect to peoples' socio-economic circumstances and allows *Silenced Voices* to speak out in their own terms.	Provide sources of food, habitat, mobility (migration routes), uncontaminated and undisrupted ecological spaces and processes that guarantee health and wellbeing.	Reframe Victoria's planning and regulatory systems at local and state levels by radically embedding multi and interspecies intergenerational decision-making and design.
	Ecologically just nature-based actions			
Case Study 2: New York City, USA 	Bring strong eco-social networks to experiment with new ways of creating multispecies habitats in existing buildings, structures, and infrastructures.	Use existing ecological spaces as platforms to improve peoples' ecological capabilities, enhance human-nonhuman interactions, and give a voice to the *Silenced Voices*.	Identify the traces of past and present polluting and contaminating activities and rehabilitate these neglected and heavily altered landscapes so that they support new ecologies.	Radically repurpose roads, brownfields, derelict buildings and other unused/obsolete infrastructure into ecological spaces that are interconnected at different scales and are designed to enhance multispecies capabilities.
	Ecologically just nature-based actions			

In summary, we suggest creating and experimenting with innovations that can enable multi-scalar, interconnected ecological spaces that enhance and expand ecological capabilities. These innovations can be translated as radical urbanism reforms that enable, for instance, the repurposing of roads into urban forests or blue infrastructure spaces that allow migratory birds and other species to seek refuge and rest, acting as urban migratory routes. Repairing Type 4 injustice hotspots will require upscaling nature-based actions, which will involve trade-offs, e.g. in seeking to create more ecological space in already dense urbanised areas, by embedding or repurposing building structures or obsolete infrastructures, humans might not be able to purchase and profit from those spaces. Embedding ecological justice as a planning agenda will prioritise ecological commons, rather than private development agendas.

Table 2 summarises the diverse strategies that can support the reparation and rehabilitation of the different injustice types, based on the application of the Ecological Just Cities Framework. Some are purely "nature-based" as in they refer to the creation, rehabilitation or protection of ecological space and functions in deprived spaces, while others provide governance and design tools for guiding human-nonhuman engagement processes and capacity building. The conceptual developments are framed around ways for expanding and enhancing social and ecological capabilities – a

fundamental building block for creating nature-based cities for people and nature. They are also set out as approaches to find ways of revaluing and representing nonhuman nature and embedding multi and interspecies intergenerational considerations in procedural and strategic planning processes.

4. Discussion and Conclusion

In this paper we have proposed a practical working framework with a typology of ecological injustices and associated nature-based actions that can contribute to resolving these social-ecological conflicts in contested and deprived urban habitats. The Ecologically Just Cities Framework is built on conceptual, theoretical and empirical work through a conceptual framework analysis. We have done this for the purpose of enabling an assessment tool that can contribute to urban policy-making for planning ecologically just cities that recognises nonhuman nature as an active agent with capabilities and thus the capacity to flourish and exist. This framework is an effort that recognises the need for urban practitioners and city-shapers to have practical tools that can help translate the abstract concept of justice to nature, to assist them in assessing injustices and prioritising investments in nature in cities. From diverse methods and ways of understating ecological injustices, it offers evidence-based data to pursue urban transformations with and for nature (Frantzeskaki *et al.* 2022).

This vision also sees nonhumans as having an active role in the design of cities by designing open and inclusive ways of representing nonhuman nature in transparent and democratic processes, where nonhuman nature is active in decision-making. NBS require a framework that considers the nonhumans in order to plan and design cities that can deliver nature-based benefits, both to humans and nonhumans. This will require different types of analysis and new ways of understanding that challenge our relation to nonhuman nature from one of services and benefits to humans, to one of stewardship, care, respect and active representation.

We suggest that multi- and interspecies and intergenerational planning are two approaches that need to inform the four injustice hotspot types. The reason for this is that landscapes are constantly changing, complex and in places where injustices manifests, usually spaces of contestation. This requires ongoing negotiations and discussions of who, how and where is the power in decision-making – making it particularly important to have inclusive, emancipatory, evaluative, and reflective processes and spaces embedded in all decision-making. Critically important are NBS that prevent the reproduction of inequalities through a notion of re-greening, but instead foster a participatory and emancipatory dialogue, particularly with underrepresented and marginalised communities.

Similarly, notions of interspecies and intergenerational planning should inform all plans, projects and legislations at neighbourhood, city and regional scales. When trying to address any type of injustice, having long-term visions in which multispecies coinhabit and ecosystems are regenerated for current and future human-nonhuman generations can have a powerful impact now and in the future. Now because it brings communities together to form new understandings and ways of creating knowledge and experimenting, but also into the future because imagining a "concrete future" (Ache 2019) in which an ecological just state is envisioned, has the potential of being achieved.

The Ecologically Just Cities Framework proposes to move beyond inclusivity and inclusive participation, to emancipatory and self-determining planning processes and governance structures. This framework seeks to shift nature-based planning from enhancement and harnessing of NBS, to restitution, reparation and redistribution of benefits through NBS for the multiple live forms that inhabit urban territories. Finally, it moves beyond protection and restoration to repair injustices, to adding social-ecological value in a futures-thinking anticipatory process. We present this working framework as a first step in putting "ecological justice in practice" by bridging different fields of knowledge, which will need extensive scrutiny, validation, negotiation and recreation

through multi-actor, multilevel, diverse and multidimensional workshopping exercises. For urban planners, policy-makers, urban researchers and other participants engaged in reshaping urban development, this framework is an alternative stepping stone in shifting planning's entrenched human-centred legacies. Testing this preliminary framework in a context-specific place can progress our understanding of how to plan NBS with the purpose of enhancing multifunctionality for human-nonhuman natures.

To produce this nonhuman nature-based justice mix, we need to go further and interrogate how we can design and plan urban regions if we also consider nonhuman lives as enablers, co-creators, and active, intentional agents. New methods and practices that allow for diverse ways of including nature in decision-making and urban policy processes, positioning it within the community of justice, as an active agent in political/discussion agendas need to be brought forward. We have provided a first glimpse of how we can progress ecological justice by enhancing NBS multifunctionality. Future research can continue to advance this pathway through empirical testing and multistakeholder creations and future thinking imaginations that envisions a nature-based city that repairs and restores ecological injustices through a capability enhancing and expansion approach, redistribution of ecological space, emancipation through participation and anticipation as a tool to strive for intergenerational and interspecies justice.

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