

The spectrum of non-human agency: Rethinking participation in multispecies placemaking



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This paper advances participatory urban design by introducing the Spectrum of Non-Human Agency, a framework that systematically incorporates non-human actors into design processes. While participatory approaches have traditionally centered on human actors, increasing ecological pressures demand models that acknowledge the active role of non-human communities. The spectrum adapts and extends stakeholder participation models to account for ecological and multispecies processes, aligning levels of non-human agency with design phases, and translating them into operational conditions. Grounded in a qualitative analysis of 38 nature-inclusive design cases and four in-depth case studies, the framework provides both conceptual and methodological tools for assessing how non-human agency unfolds across design phases. The findings reveal that non-human actors are often engaged during early phases as sources of ecological data, while their influence frequently diminishes during implementation and long-term stewardship. However, selected cases demonstrate how non-human actors can assume co-creative and autonomous roles, challenging anthropocentric design norms. In doing so, the study proposes multispecies placemaking as a pathway for extending participatory urban design, positioning non-human actors as partners in shaping more adaptive, ecologically attuned, and relational urban environments.

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1 Introduction

Urban environments are increasingly affected by ecological pressures such as biodiversity loss, intensified climate events, and the disruption of ecosystems that support everyday life (EU, n.d.). These dynamics directly shape how communities adapt to uncertain futures (Elmqvist et al., 2019; Folke et al., 2021). Yet most urban design frameworks continue to prioritize human needs, preferences, and aesthetics, reducing nature to a passive backdrop or technical constraint (Pincetl, 2010; Raymond et al., 2017). Recent work in sustainability and urban governance argues for explicitly integrating multispecies justice and more-than-human perspectives into city-making (Fieuw et al., 2022; Sheikh et al., 2023). Other contributions highlight the importance of eliciting place-based ecological knowledge through participatory processes as a foundation for regenerative and nature-inclusive design (Toner et al., 2025). Together, these perspectives underscore the need to recognize non-human communities (plants, animals, fungi, and their ecosystems) as active participants in shaping cities, and to rethink participatory urban design as a multispecies practice grounded in cohabitation (Haraway, 2008; Whatmore, 2006).

Despite growing attention to ecological entanglements in fields like landscape architecture and urban design, participatory frameworks like placemaking remain largely human-centered and struggle to respond to ecological pressure. Most remain centered on human stakeholders, offering limited guidance for how non-human communities might actively contribute, even as biodiversity loss, climate uncertainty, and ecological instability increasingly shape urban conditions and decision making. Drawing on perspectives from post-humanism and more-than-human scholarship, including Actor-Network Theory (Callon, 2014; Haraway, 2008; Latour, 2005), cities are understood as relational environments co-shaped by human and non-human actors where ecological processes and other species actively influence urban form, use, and resilience rather than functioning as a passive context for human action. Addressing this conceptual and methodological gap requires approaches that can recognize and work with non-human agency as part of participatory processes, rather than treating it as external to them.

Placemaking has emerged as a key approach to participatory urban design, emphasizing co-creation, iterative transformation, and long-term stewardship of public spaces by communities (Hes et al., 2020; Silberberg et al., 2013). In this paper, placemaking is understood as a process-based approach to urban design in which influence over public space is gradually redistributed through phases of engagement, co-creation, implementation, and care (Hes et al., 2020; Luck, 2018). Conceptually, it shares core features with participatory design traditions, where design is understood as a situated and negotiated practice (Luck, 2018), shaped through ongoing collective use and care. Within placemaking, participants, guided by placemakers such as designers, urban

planners, and project developers, gain influence over how public urban spaces evolve. Emerging from democratic and advocacy movements (Bødker & Kyng, 2018; Gregory, 2003), placemaking continues to draw on models that conceptualize power as distributed among stakeholders across different project phases. Such frameworks reflect a growing recognition of agency as central to participatory design. A range of frameworks have been used to map participation in such processes, including Veselova's (2023) Spectrum of Stakeholder Involvement, which introduces a multi-level model that captures how roles, responsibilities, and degrees of influence shift dynamically across project phases. Originally developed to assess human stakeholder involvement, it begins to question anthropocentric boundaries of participation, laying the foundation for extending agency to non-human actors. This model forms the backdrop for the theoretical development of this paper and is introduced in more detail in Section 2.2.

Based on Veselova's (2023) model, this paper introduces a main contribution to participatory urban design: the Spectrum of Non-Human Agency. The Spectrum is used to assess how non-human communities engage in participatory processes, positioning them along a continuum from being neglected to exercising autonomous agency. Grounded in empirical analysis of 38 nature-inclusive design projects and four in-depth case studies, the Spectrum offers both conceptual and operational advances. By aligning levels of agency with the adaptive and process-based logic of placemaking, it extends this participatory approach beyond human actors, reframing placemaking as a multispecies practice. By defining specific conditions for evaluating non-human agency, the framework provides a structured approach to analyze how multispecies collaboration unfolds across placemaking phases, thereby contributing to a broader theory of nature-inclusive participatory design.

Section 2 develops the theoretical foundation, introducing placemaking, stakeholder participation frameworks, and agency. Section 3 presents the Spectrum of Non-Human Agency and its development. Section 4 outlines the methodology for validating the Spectrum by means of case-study analysis. Section 5 presents the results of the case study research. Section 6 reflects on the implications, limitations, and broader theoretical contributions of the Spectrum for advancing multispecies placemaking.

2 Expanding stakeholders' involvement and agency in participatory urban design

This section outlines the conceptual foundation for expanding participation in urban design beyond human stakeholders. It begins by introducing *placemaking* as a spatial and process-based articulation of participatory urban design, emphasizing the distributed agency of stakeholders gradually transferred across phases. It then reviews key participation models, explaining how roles

and decision-making power shift among human actors during participatory processes. Finally, the section turns to the concept of *agency* to consider how non-human actors might also exercise the ability to influence urban form.

2.1 Placemaking as a foundation for participation and agency

Placemaking is a participatory approach to urban design in which communities collaboratively shape public spaces through iterative processes of use, co-creation, implementation, and long-term stewardship. It is grounded in the belief that people, especially those who inhabit and use urban public spaces, should be directly involved in shaping their environments. Therefore, it transforms the role of urban designers and communities alike and provides a clear process structure through which participation is enacted over time (Hes et al., 2020). Following work that treats participation as a situated and relational practice rather than a fixed ladder (Luck, 2018), we frame placemaking as an ongoing, context-bound dialogue in which influence is negotiated and redistributed through use, care, and encounter, an orientation that can also accommodate more-than-human relations.

The placemaking process typically unfolds through four overlapping and interdependent phases: (1) engagement and visioning, (2) design and co-creation, (3) implementation, and (4) long-term stewardship. These phases support the development of spatial interventions and create conditions for the redistribution of agency from professional placemakers to local stakeholders over time. This phasing aligns with the broader shift from consultation to co-creation, where creativity and authorship are distributed among participants (Sanders & Stappers, 2008), and the designer's role becomes one of enabling collective making over time.

Two key characteristics make placemaking a suitable foundation for extending more-than-human agency. First, it adopts an extended urban design framework that continues beyond physical implementation to include long-term stewardship. Second, it explicitly emphasizes the redistribution of agency through participatory processes. Seeing participation as continuous rather than event-based also resonates with work on infrastructuring collaboration (Giaccardi & Stappers, 2017): placemaking requires socio-technical and organizational supports that keep participation alive across phases, which is precisely where non-human relations (seasonal growth, maintenance cycles, ecological succession) can be rendered consequential. Table 1 provides a summary of placemaking's core characteristics.

Yet, placemaking's ideals do not always hold in practice. While it aspires to inclusivity and long-term stewardship, processes may be co-opted by institutional or corporate actors, deploying participatory rhetoric to legitimize pre-determined agendas. Such practices can accelerate gentrification, displace

Table 1 Summary of placemaking across design phases: key characteristics and roles (Akbar & Edelenbos, 2021; Björgvinsson et al., 2010; Gehl, 2010; Hes et al., 2020; Hou, 2020; Lydon & Garcia, 2015)

<i>Phases</i>	<i>Key characteristics</i>		<i>Roles</i>
1. Engagement & visioning	• Articulating shared values and goals • Defining the place's identity • Using participatory methods: Mapping, storytelling, interviews, walk-alongs, workshops • Facilitating inclusive dialogue and mutual learning	Placemakers	Convener, facilitator of dialogue, builder of trust
		Participants	Share local knowledge, articulate needs and visions
2. Design and Co-Creation	• Generating and testing ideas collaboratively • Applying tools: Design charrettes, prototyping, simulation • Iterative adaptation based on feedback • Balancing community creativity with technical constraints	Placemakers	Design facilitator, technical advisor, iterative process guide
		Participants	Co-designers, testers, contributors of feedback
3. Implementation	• Translating ideas into spatial interventions • Enabling hands-on involvement in building or modifying space • Applying tactical urbanism and flexible interventions • Remaining responsive to community input and real-time conditions	Placemakers	Process manager, ensure responsiveness to site & feedback
		Participants	Builders, implementers, hands-on contributors
4. Long-term stewardship	• Supporting local maintenance and adaptive management • Fostering long-term engagement and ownership • Encouraging ongoing community improvements • Reinforcing every-day care through feedback loops and ecological cycles	Placemakers	Gradually withdraw, enabling local ownership
		Participants	Stewards, caretakers, long-term decision-makers

existing communities, or result in standardized landscapes that erode local distinctiveness (Mattern, 2020). Critical scholarship calls for practices that resist tokenism and instead foreground equity, situated knowledge, and ecological specificity, with studies showing how low-tech and situated storytelling methods can amplify marginalized voices (Gonsalves et al., 2024).

To keep up with its promise of inclusion, placemaking must be reconceptualized in broader terms. Its process-oriented nature not only redistributes agency across stakeholders but also opens possibilities for what we term *multispecies placemaking*: an emerging approach that extends participation to non-human actors as legitimate participants (Choi et al., 2023; Sachs Olsen, 2022). Building on placemaking's relational and iterative logic, this perspective considers how plants, animals, fungi, and ecosystems co-shape public spaces through their ecological roles, behaviors, and presence (Bastian & Bayliss Hawitt, 2023; Houston et al., 2018; Tsing, 2015).

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2.2 Stakeholders' involvement in participatory processes

Placemaking is part of a broader tradition of participation in urban design and planning, shaped by collaborative approaches that emphasize mutual learning, dialogue, and inclusion (Friedmann, 1993; Forester, 1982; Healey, 2020; Innes, 1995; Sandercock, 1998). These traditions advanced participation as a means to promote social inclusion, incorporate lived experience into design outcomes, and foster negotiation among planners, designers, and stakeholders (Luck, 2003; Sanoff, 1999; Simonsen & Robertson, 2013). Rather than treating participation as a static distribution of power, these perspectives stress its dynamic and evolving character, as roles and influence shift through interaction.

Multiple frameworks have shaped the conceptualization of stakeholder involvement in participatory processes. Arnstein's (1969) Ladder of Citizen Participation remains foundational, critiquing tokenistic engagement through a hierarchy from manipulation to citizen control. Bammer (2019) adaptation of the IAP2 Spectrum introduced a process-sensitive model, emphasizing how stakeholder roles evolve throughout project phases and in response to context. While and Whitehead's (2013) typology, meanwhile, advanced the discourse by linking participation forms (nominal, instrumental, representative, and transformative) to underlying motivations and outcomes (Tisdall, 2013).

While these models advanced participatory theory, they remain largely procedural, stakeholder-centered, or constrained by rigid, linear structures that oversimplify participation as a one-way progression (Cornwall, 2008), often failing to address how participation shapes physical space and evolves through long-term stewardship. As Sanders and Stappers (2008) argue, the collaborative turn in design has shifted attention from "designing for" to "designing with," emphasizing co-creation as a dynamic and collective process. This reorientation moves beyond procedural frameworks toward distributed authorship, aligning more closely with the iterative and open-ended character of placemaking.

Placemaking, by integrating spatial transformation, social identity, and ongoing care, already offers a more dynamic and situated model of participation. Such an understanding resonates with research emphasizing the infrastructures of participation that sustain collaboration over time (Giaccardi & Stappers, 2017), highlighting that participation is not a discrete event but an ongoing process. Building on this, recent work has begun to explore how placemaking itself can expand further to include multispecies interaction and co-creation, recognizing non-human actors as part of the participatory field (Choi et al., 2023; Mancini & Lehtonen, 2018).

2.3 *The Spectrum of Stakeholders' involvement*

Building on earlier participation models, [Veselova's \(2023\)](#) Spectrum of Stakeholder Involvement responds to critiques of linear frameworks like Arnstein's by introducing a multi-level model that captures how stakeholder power and participation shift dynamically over time, depending on actor relationships, project stages, and collaborative processes. The spectrum distinguishes seven levels of stakeholder involvement (see Table A1, [Appendix A](#)), ranging from exclusion and passive observation to full autonomy. At the lower end, stakeholders are ignored or symbolically acknowledged; in the middle, they contribute knowledge through dialogue and collaboration while designers retain primary control; at the highest levels, they become co-leaders or autonomous agents, directing the process with minimal professional input. Rather than suggesting a linear progression, the model highlights partial, shifting, and non-linear forms of participation that better reflect real-world complexities, where stakeholders may move across different positions within a single project.

This adaptability also makes the spectrum a valuable starting point for extending participation beyond the human. Non-human actors, such as animals, plants, fungi, and ecosystems, do not engage through conventional participatory means, yet they interact with and influence design processes in ways that can be observed, interpreted, and supported. The spectrum's process-based orientation provides the conceptual flexibility to treat these entities as relevant participants, whose roles may likewise range from passive acknowledgement to active spatial shaping depending on the design phase.

For placemaking, the spectrum's non-linear structure is especially relevant, since participation unfolds iteratively and agency is redistributed over time. It thus supports analysis and facilitation of participatory placemaking while laying the conceptual foundation for integrating non-human agency into urban design, a direction developed in the following section.

2.4 *Expanding agency: from human to non-human actors*

A growing body of scholarship in design theory, Science and Technology Studies, and environmental humanities challenges anthropocentrism ([Despret, 2004](#); [Kirksey & Helmreich, 2010](#); [Whatmore, 2006](#)) by stressing the distributed character of agency across human and non-human actors ([Bennett, 2010](#); [Haraway, 2008](#); [Latour, 2005](#); [Whatmore, 2002](#)).

Building on insights from Actor–Network Theory (ANT) ([Callon, 2014](#); [Law, 1992](#)), places can be viewed as both products of human planning and complex networks of living and non-living forces that co-shape urban spaces ([Latour, 2005](#)). Processes such as tree roots displacing pavement, spontaneous vegetation altering drainage flows, or animals shifting mobility patterns illustrate

how ecological dynamics continuously reconfigure urban environments (Gillner et al., 2013; Kowarik, 2011). Multispecies ethnography further draws attention to the rhythms, needs, and behaviors of other species, such as birds, fungi, or plant communities, as active forces in shaping the urban fabric (Andersson et al., 2014; Kimmerer, 2013; Sijtsma et al., 2020).

Post-humanist thinkers deepen this reframing by rejecting the human–nature dualism. Haraway (2008) notion of “companion species” emphasizes interdependence and co-evolution, while Ingold’s (2021a) “meshworks” describe landscapes as dynamic fields of movement and growth, continually remade through ongoing interactions of materials, weather, species, and sensory engagement (Ingold, 2021b). Lachmund’s (2013) study of Berlin shows how ecological behaviors become embedded in monitoring and planning, influencing corridors, maintenance, and green infrastructure. These perspectives foreground cohabitation as a principle of design.

In design research, this shift is echoed by work framing agency as distributed across humans, artefacts, and environments (Giaccardi & Stappers, 2017), extending participation from individual stakeholders to broader relational ecologies. Recent contributions in multispecies design advance this further: practice can be framed as co-creation across species (Mancini & Lehtonen, 2018; Sachs Olsen, 2022) and oriented towards principles of coexistence that decenter human control (Cotsaftis et al., 2023). Interaction design and smart urbanism have also explored systematic ways to include more-than-human actors through methods such as non-human personas (Tomitsch et al., 2021), and through broader frameworks like multispecies justice in sustainable urban development (Fieuw et al., 2022) and more-than-human urban governance (Sheikh et al., 2023).

Taken together, these post-humanist, multispecies perspectives point to the need for frameworks in urban design and placemaking that can translate forms of agency into operational concepts (see Section 3). They challenge linear, human-centered models of design and support a relational ontology in which urban space emerges through continuous negotiation between species, materials, and environments (Whatmore, 2006; Wakkary et al., 2016). This has critical implications for participatory urban design and, in particular, for placemaking: it broadens the scope of participation, redefines how agency is recognized and distributed, and foregrounds the interspecies character of knowledge production, negotiation, and shared decision-making.

The following section introduces the Spectrum of Non-Human Agency, a framework for assessing how non-human communities may contribute to shaping urban environments across design phases.

3 Spectrum of non-human agency

Building directly on [Veselova's \(2023\)](#) Spectrum of Stakeholders' Involvement and the expanded notion of agency outlined above, the Spectrum of Non-Human Agency adapts these ideas to address non-human communities. While Veselova's model provides a robust structure for understanding how power and participation shift across human stakeholders, it assumes forms of communication, recognition, and decision-making that do not translate directly to non-human actors. This adaptation requires both conceptual and methodological adjustments to better reflect how non-human actors shape design through indirect, relational, and ecological processes.

To develop the Spectrum of Non-Human Agency, Veselova's seven levels were critically reinterpreted through an ecological and multispecies lens. The two most exclusionary levels in her original framework, 'Denigrated' and 'Neglected', were conceptually reconsidered based on their applicability to non-human actors. Denigrated was excluded from the adapted framework, as the focus of this study is on nature-inclusive design projects, where deliberate exclusion of non-human actors is not documented or systematically addressed. Neglected, however, was retained as a valid category, as it captures design processes in which non-human actors are simply left out or overlooked, despite their ecological relevance. The remaining levels were adapted to reflect positive recognition and degrees of involvement, ranging from passive observation to autonomous non-human agency. Beyond these adjustments, the novelty of the framework lies in its systematic alignment with placemaking phases, its re-framing of participation categories around ecological processes rather than stakeholder negotiations, and its translations into operational conditions that make non-human agency empirically traceable across real-world projects. The visual alignment between levels of agency and placemaking phases is presented in [Figure 4](#) and discussed further in [Section 6](#). This conceptual adaptation informed the structure of the framework used in the empirical analysis presented in the following sections.

The revised framework includes six non-linear context-dependent levels, each representing a distinct way in which non-human actors may influence, participate in, or co-create design outcomes (see [Figure 1](#)). While developed for analyzing nature-inclusive practices, the framework is adaptable to broader participatory and multispecies design contexts.

4 Methodology

In this study, the Spectrum of Non-Human Agency serves both as a conceptual framework and an analytical tool. After its development, the framework was tested and refined through empirical research, combining two complementary qualitative methods: a content analysis of 38 nature-inclusive design examples, and four in-depth case studies, together providing both a broad

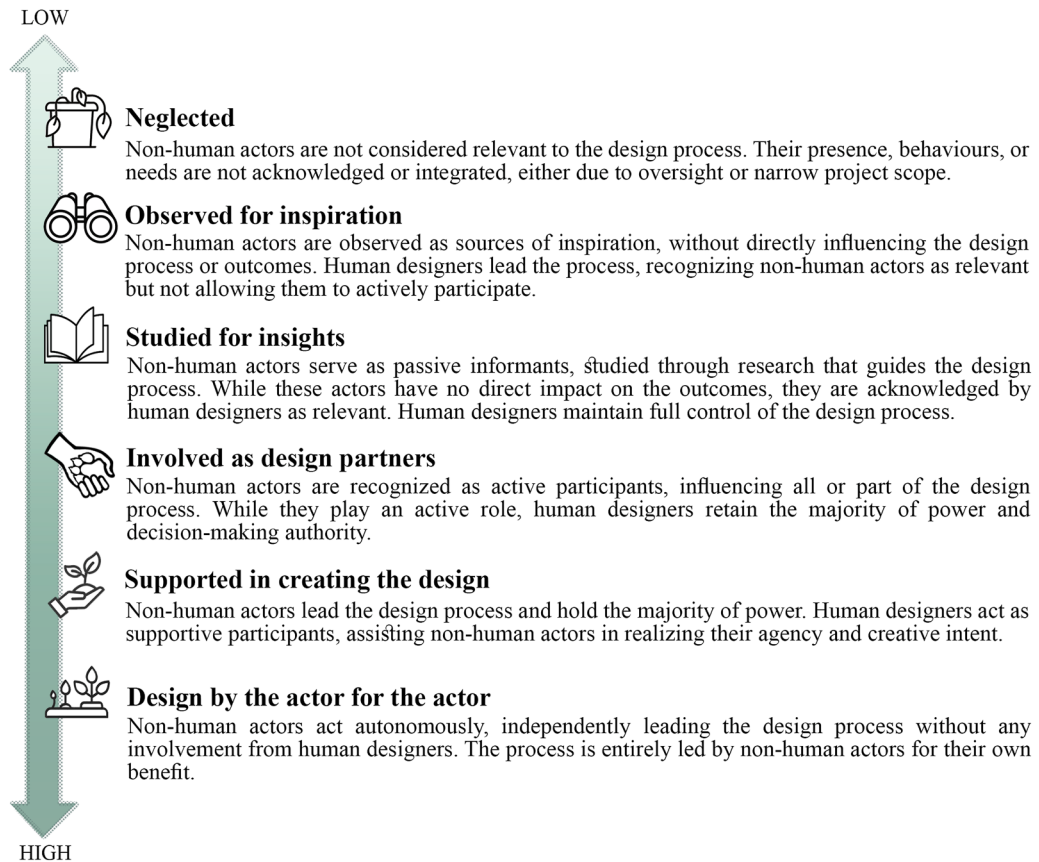


Figure 1 Spectrum of non-human agency

overview and nuanced insights into how non-human agency is integrated into design processes.

The framework was applied throughout this analysis to classify levels of non-human agency based on observed design practices, project documentation, and interview data. This allowed for consistent coding across cases and supported cross-case comparison of how non-human agency manifests across the phases of placemaking (engagement, co-creation, implementation, stewardship).

By identifying and naming the varying roles that non-human actors play in participatory processes, the framework contributes to an expanded understanding of urban space as co-produced by multiple species. This methodological strategy not only tested the Spectrum empirically but also clarified its value as a tool for interpreting multispecies placemaking.

4.1 Content analysis of nature-inclusive design examples

For the qualitative content analysis, projects were initially identified through online design media platforms (e.g., ArchDaily, Archello, Designboom) and complemented by recommendations from professional networks. Once identified, detailed information for each project was collected primarily from the designers' or initiators' official websites and publications, which were given priority to ensure accuracy and to reflect the language and framing used by the project authors themselves. Where needed, these sources were complemented with additional materials such as project reports or academic publications, enabling triangulation of data and reducing reliance on a single source. This combination ensured coverage of both widely disseminated and practitioner-recognized projects while grounding the analysis in primary sources.

The examples were selected based on the following criteria: (1) the project's explicit aim to support or benefit non-humans as a primary design goal, while also recognizing indirect benefits for humans; (2) location in urban, suburban, or rural settings, with a focus on urban public spaces (metropolitan-scale projects were excluded due to their broader scope); (3) representation across all six levels of the Spectrum of Non-Human Agency in order to test the full analytical range of the framework; (4) geographic diversity, including projects from various countries to reflect different ecological and planning contexts; and (5) inclusion of participatory or collaborative elements, such as co-creation activities, shared maintenance practices, or interdisciplinary design processes, even if not framed explicitly as placemaking. Additionally, projects from media architecture or digital/interactive art, though sometimes illustrating high levels of agency, were excluded to ensure comparability and keep the scope grounded in urban design practice within physical public space.

All material was systematically organized in Notion, a digital workspace platform. Each project was labelled according to the following categories: location (city, country); urbanity scale (rural, suburban, urban); habitat type (e.g., forest, grassland, wetland, mountain, coastal, urban area); implementation status (conceptual, implemented, ongoing, temporary); primary non-human beneficiaries (e.g., ecosystems, pollinators, plants, animals, fungi, trees, bats, bees, insects, endangered species); level of non-human agency (based on the framework introduced in section 3); and keywords (e.g., biodiversity, public space, habitat enhancement, awareness, infrastructure, urban gardens).

To support the coding process, short explanatory notes were added to justify key labels. Each assigned level of non-human agency was accompanied by a brief rationale describing how and when non-human actors influenced the process, including references to specific phases. Additional bullet points were used to summarize project objectives and clarify the role of non-human actors and

The level of non-human agency is defined as “Neglected” if:	
Non-human actors:	- are not acknowledged in the design process - are not considered relevant or present - have no influence on decisions or outcomes
Human actors:	- lead the process without recognizing non-human actors - operate within a human-centric framework - make decisions without ecological considerations
The level of non-human agency is defined as “Observed for inspiration” if:	
Non-human actors:	- have no direct impact on the design process - are observed for inspiration - are recognized as relevant stakeholders by the human designers
Human actors:	- lead the design process
The level of non-human agency is defined as “Studied for insights” if:	
Non-human actors:	- serve as passive informants - have no direct impact on the design process and outcomes - are studied through research that guides the design process - are recognized as relevant stakeholders by the human designers
Human actors:	- lead the design process
The level of non-human agency is defined as “Involved as design partner” if:	
Non-human actors:	- are recognized as active design partners with an active role in and impact on the whole or part of the design process
Human actors:	- retain the majority of the power
The level of non-human agency is defined as “Supported in creating the design” if:	
Non-human actors:	- lead the design process. - retain the majority of the power
Human actors:	- act as helpers in the design process
The level of non-human agency is defined as “Designed by the actor for the actor” if:	
Non-human actors:	- design by themselves
Human actors:	- are not involved in the design process at all

Figure 2 Operational conditions of the Spectrum of Non-Human Agency

types of beneficiaries involved. A detailed overview of all 38 projects, including case descriptions and coding summaries, is available via the project's Notion database.

To ensure analytical consistency and compatibility, the Spectrum of Non-Human Agency framework was operationalized into a set of conditions (see [Figure 2](#)) specifying how the roles of both non-human and human actors are displayed across levels of agency. For example, a project was categorized as 'Studied for insights' if non-human actors were acknowledged as relevant and studied by humans to inform decisions but had no direct influence on design outcomes. In such cases, human actors maintained full control over the process. These operational conditions served as analytical criteria to evaluate the presence and expression of non-human agency across project types and phases.

Coding was conducted by the first author with a reflexive approach: explanatory notes were systematically recorded to document decision-making, and all projects were revisited iteratively to check for internal consistency. The predefined operational conditions ([Figure 2](#)) provided a stable reference across cases, while triangulation of sources (designers' official websites, project reports, and academic publications) further reduced subjective bias and ensured accuracy.

Once coded, the data was transferred into Miro, an online collaborative platform, to visually map patterns and relationships across the 38 projects. This visual mapping allowed for a comparative analysis of how non-human agencies were distributed across the different design phases (see [Figure 3](#)).

4.2 Case studies through interviews and archival materials

The four case studies were selected based on the following criteria: (1) location in the Netherlands, reflecting both the location of the research team and ensuring contextual consistency in planning culture, governance, and ecological settings; (2) representation of higher degrees of non-human agency (specifically cases ranging from 'involved as a design partner' to 'designed by the actor for the actor') which were less common among the 38 examples and therefore selected for deeper exploration; and (3) implemented status, enabling on-site validation.

Each case was explored through semi-structured interviews (approximately 1 h) with lead designers or project initiators, supported by archival documentation such as project proposals, technical drawings, publications, and meeting records. Triangulating interviews and archival material reduced reliance on any single perspective and strengthened the robustness of the analysis.

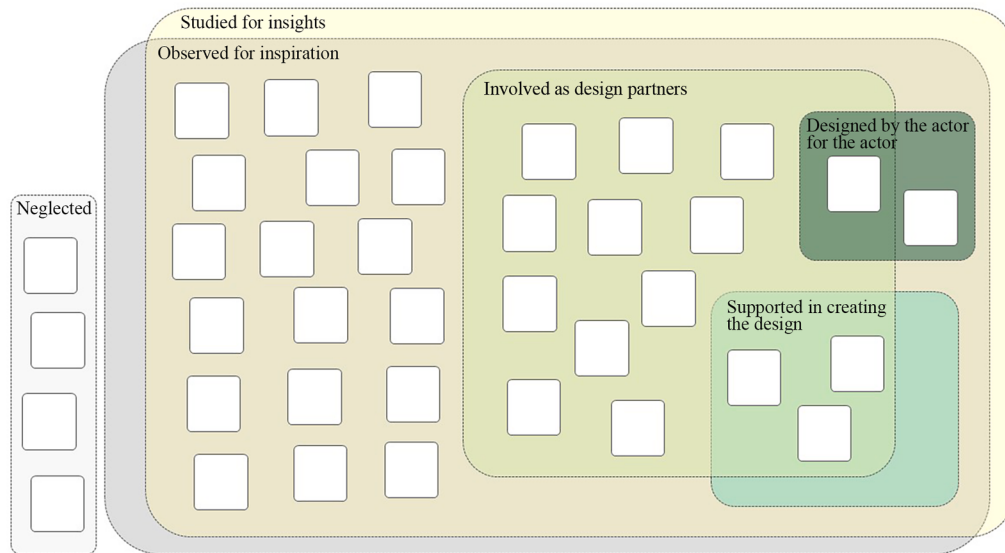


Figure 3 Overview of 38 nature-inclusive design examples

Interviews were transcribed and coded in Atlas.ti, with a focus on recurring strategies for engaging with non-human actors, challenges encountered, and adaptations made throughout the process. This coding framework was developed inductively. To enhance reliability, coding decisions were documented through explanatory notes, and case interpretations were revisited iteratively to ensure internal consistency and alignment with the Spectrum of Non-Human Agency.

The Spectrum provided a consistent reference point for analysis, enabling comparisons across cases and design phases. Visual synthesis of the codes was later organized in Miro to identify patterns and overlaps across cases. A cross-case comparison then highlighted patterns of multispecies collaboration and innovation, while triangulation with documentation and archival material added robustness to the findings. These measures ensured methodological rigor and transparency, despite the analysis being conducted by a single researcher.

5 Results and discussion

5.1 Results overview

As shown in Table 2, most of the 38 nature-inclusive urban design projects are clustered in the mid-range of the Spectrum. Eighteen were categorized as ‘Studied for insights’, often overlapping with ‘Observed for inspiration’, where nature informed the design through observation or research. Seventeen

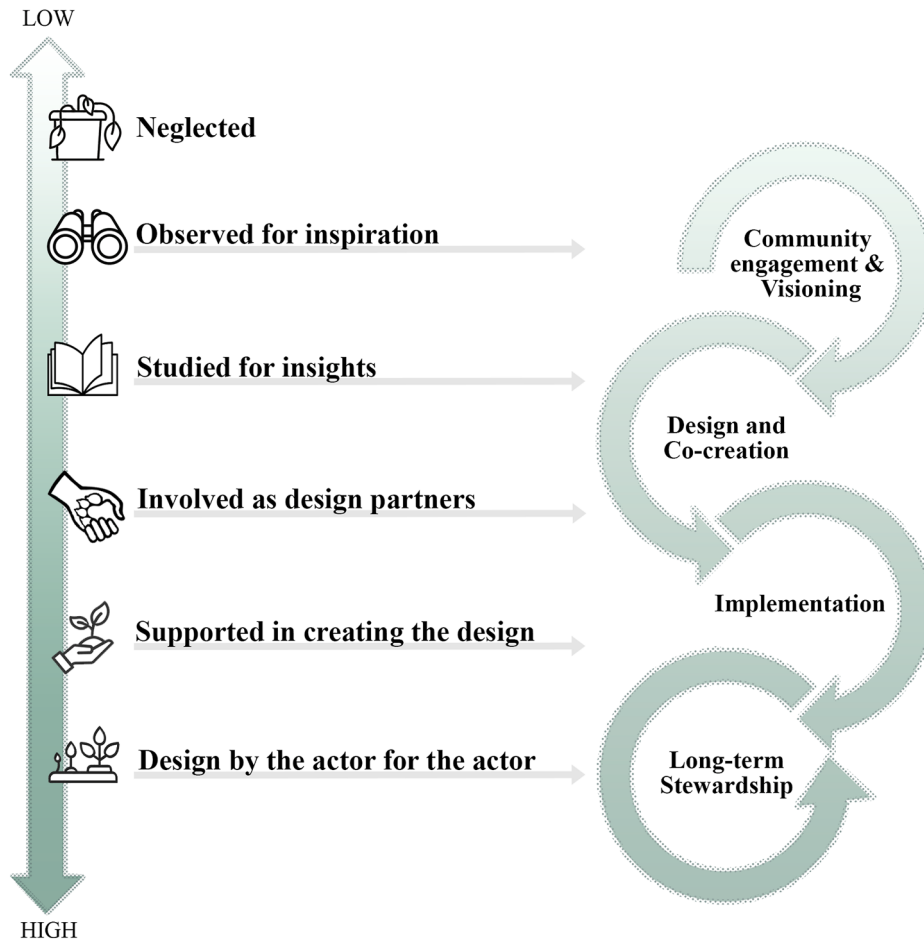


Figure 4 Alignment between levels of non-human agency and phases of placemaking

projects demonstrated higher degrees of non-human agency ('Involved as a design partner', 'Supported in creating design', or 'Designed by the actor for the actor'), whereas only two reached the highest level of autonomous agency. Four cases were classified as 'Neglected', offering a contrast that helped test and validate the full framework.

Most projects were located in urban (23), suburban (8), or rural (7) settings. Thirty-six were implemented, while two remained conceptual and six were temporary or artistic. Ten cases featured placemaking elements, with five explicitly framed as such and five integrating participatory practices like co-creation or stewardship. Regarding non-human beneficiaries, pollinators (10), bats (8), and birds (4) were most represented. Thirteen projects supported multiple species, reflecting interdependence in urban ecosystems.

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Table 2 Design projects overview

<i>Characteristic</i>	<i>N. examples</i>	<i>Characteristic</i>	<i>N. examples</i>
Agency level		Implementation status	
Neglected	4	Implemented	36
Observed for inspiration	26	Conceptual	2
Studied for insights	18	Temporary	6
Involved as design partner	11	Non-human focus	
Supported in creating design	4	Insects (pollinators)	10
Designed by actor for actor	2	Bats	8
Urbanity scale		Birds	4
Urban	23	Multispecies/Ecosystems	13
Suburban	8	Placemaking elements	
Rural	7	Explicitly placemaking	5
		Implicit placemaking traits	5

5.2 Testing the spectrum of agency

The application of the Spectrum of Non-Human Agency reveals notable patterns in how non-human actors participate in design processes. As outlined in the results overview, the levels ‘Observed for inspiration’ and ‘Studied for insights’ occurred most frequently. This reflects a widespread design approach in which ecological knowledge, such as that derived from species behaviors or habitat needs, serves primarily to inform human decision-making. In these cases, nature is observed to inspire aesthetics, atmospheres, or concepts, or studied systematically to gather data on non-human needs and ecosystem dynamics (Lachmund, 2013; Andersson et al., 2014).

For instance, in the Alusta Pavilion in Helsinki, pollinators and plants were studied through ecological research to guide the design of a human-scale insect hotel and multispecies meeting space. These non-human actors acted as passive informants, shaping the project’s direction indirectly. However, they did not exert direct influence on design decisions, which remained controlled by human designers. While these levels suggest limited agency, they are foundational: no multispecies design process can proceed meaningfully without some degree of ecological understanding. These projects typically align with early phases of placemaking, engagement and visioning, translated here into engagement with site ecologies rather than human users alone (Hes et al., 2020; Darchen, 2023); see also Table 1 for a summary of placemaking characteristics across phases.

In contrast, projects at the levels ‘Involved as a design partner’, ‘Supported in creating design’, and ‘Designed by the actor for the actor’ represent more collaborative or autonomous models of non-human agency. In these cases, non-human actors shape design outcomes through their ecological rhythms, needs, or material growth. The Fab Tree Hab project in rural New York exemplifies this: willow trees are cultivated to grow into pavilion structures,

co-determining spatial form through both human intention and plant behavior. Such co-evolutionary strategies reflect the design and co-creation phase of placemaking, in which responsiveness and iteration emerge from the interplay of multiple actors (Hou, 2020; Ingold, 2021a).

These higher agency levels also align with placemaking's later phases, particularly implementation and long-term stewardship. In Le Roy Garden in Heerlen, Netherlands, for example, a decades-long collaboration between human and non-human actors (e.g., plants, soil, decay processes) shapes the evolving structure over time. This approach reflects placemaking principles, such as adaptive maintenance and shared ownership, and emphasizes the distributed and temporal nature of agency (Folke et al., 2005).

Several projects illustrate a holistic, ecosystem-based perspective that supports multispecies interdependence. In Volpelleres Forest Park in Sant Cugat del Vallès, Spain, designers integrated circulation paths and use zones around forest regeneration patterns, treating the forest as a co-designer. Though not labeled as placemaking, this approach reflects placemaking traits such as site specificity, iterative co-creation, and relational design (Gehl, 2010; Haraway, 2008).

Other examples focus on species-specific strategies, especially for urban pollinators. The Pollinator Pathmaker implementations in the UK and Germany structure planting schemes based on pollinator preferences, indirectly allowing insects to shape spatial arrangements. These examples emphasize mutual benefit and co-functionality; key traits of multispecies placemaking, even if they do not involve direct spatial co-creation (Goddard et al., 2010; Kimmerer, 2013).

Together, these cases demonstrate how the Spectrum of Non-Human Agency clarifies the diverse ways participatory principles are applied to non-human involvement in urban design. They also illustrate how placemaking's phase-based, adaptive, and stakeholder-driven logic can be extended to include other species, contributing to a broader theory of nature-inclusive participatory design (Hes et al., 2020; Veselova, 2023).

5.3 Case-based insights into multispecies participation and urban design agency

Building on the spectrum analysis of all 38 design examples, this section takes a closer look at four selected cases — Four Siblings, Le Roy Garden, Mosaic Mowing, and Flora voor Fauna — to explore how nature-inclusive design practices unfold in specific contexts. While the previous section highlighted overarching patterns in how non-human agency manifests across diverse projects, these in-depth case studies reveal how participatory urban design

dynamics evolve when placemaking is reimagined as a multispecies process (Hes et al., 2020).

Each case illustrates a distinct approach to integrating non-human actors into urban design, ranging from structured interventions guided by ecological research to open-ended spatial transformations led by natural processes. Analyzed through the Spectrum of Non-Human Agency, they make visible the varied ways in which design power is shared between human and non-human actors over time. These examples also clarify how core principles of placemaking, such as iteration, co-creation, and long-term stewardship (Hou, 2020; Silberberg et al., 2013), can be expanded to accommodate non-human agency, offering concrete insights into the challenges and opportunities of multispecies placemaking. Extensive descriptions of each case are provided in Table B1, Appendix B.

5.3.1 Nature as a design collaborator: from passive input to active agency

The cases of Four Siblings and Le Roy Garden reflect distinct but complementary strategies for integrating non-human agency. They translate placemaking's core values, such as shared authorship, iteration, and long-term stewardship, into multispecies relationships. While Four Siblings uses structured, adaptive planning to guide interactions between halophytic vegetation and spatial use, Le Roy Garden embraces long-term ecological succession, where nature becomes the primary spatial agent.

The Four Siblings project moves beyond the conventional role of plants as static landscape elements, treating them instead as active agents shaping microclimates, spatial configurations, and material conditions. It specifically integrates halophytic vegetation (salt-tolerant species) to influence shading, wind dynamics, and soil stabilization. These plants were selected through ecological research (linked to the level 'Studied for insights'), where designers assessed their adaptive capacities before incorporating them into the spatial framework. During implementation, plant growth was allowed to shape conditions dynamically, moving toward the level 'Involved as design partners', where non-human actors influence design decisions. As vegetation expands, its autonomous growth continues to alter spatial relationships, illustrating the level 'Supported in creating design', where non-human actors co-create transformations alongside human intervention. According to Emiel Wolf of The Beach, "We don't see plants as decoration; they structure the space and determine how we use it." Human actors act as facilitators, periodically assessing how plant growth changes environmental conditions and adapting interventions to stay aligned with broader ecological and social goals, while allowing nature to take the lead.

In contrast, Le Roy Garden does not follow a conventional design process. As Pieter Wouda of Stichting TIJD explains, “We don’t define it as a design process; we work with time, not against it.” Initiated by Louis Le Roy as an ongoing experiment, the site evolves without fixed timelines, imposed structures, or predefined functions. Plants, fungi, and organic materials gradually reshape the space, with human interventions acting as catalysts rather than directive forces. At the level ‘Designed by the actor for the actor’ in the Spectrum, this case represents the highest form of non-human agency, where nature takes control of spatial transformation. Unlike Four Siblings, which still follows a structured but adaptive framework, Le Roy Garden remains intentionally unfinished, challenging norms that prioritize finality and human control. This highlights the importance of temporality in nature-inclusive design and placemaking’s emphasis on long-term stewardship, slow change, and intergenerational participation.

5.3.2 Fostering multispecies interactions through management and species-specific approaches

While the previous cases emphasize nature as a spatial co-creator, Mosaic Mowing and Flora voor Fauna shift focus to how non-human agency can emerge within structured, maintenance-driven practices. These projects do not fully hand over authorship to non-human actors but intentionally create ecological conditions that support non-human life. Their logic mirrors placemaking practices of co-creation and adaptive implementation, particularly through care and iterative interventions. Both show how management and species-specific strategies can help negotiate human–nature relationships within institutional frameworks, offering practical insights for evolving participatory urban design beyond human-centered norms.

Mosaic Mowing is a biodiversity-focused municipal land management strategy that staggers mowing across urban grasslands to create varied habitats for pollinators, birds, and plant communities. This approach resists norms of visual tidiness, instead promoting ecological diversity through variability. Its alignment with the levels ‘Involved as design partners’ and ‘Supported in creating design’ reflects its intention to create conditions for plants and insect life to influence the space over time. Human actors facilitate this process, balancing species’ needs with spontaneous ecological development. Yet, as one of the ecologists from Bureau Stadsnatuur notes, public resistance remains: “People don’t see the value in letting things grow wild.” The case highlights tensions between ecological intentions and prevailing preferences for urban order.

Flora voor Fauna adopts a curated, species-specific approach to urban habitat design, focusing on wildlife such as bats, pollinators, and birds. In close collaboration with ecologists, the project translates species’ habitat needs into micro-

interventions (like bat boxes, bee hotels, and tailored planting) embedded in buildings, infrastructure, and green spaces across Rotterdam. This structured process reflects the level ‘Involved as design partners’, where non-human needs shape design within a human-led framework. While the project enables cohabitation, it also raises questions about which species are prioritized and why. Compared to more open-ended approaches like Le Roy Garden, it represents a more instrumental form of nature-inclusive design. Still, it plays a key role in promoting multispecies awareness and institutional engagement.

5.3.3 Common challenges and opportunities across case studies

Despite their methodological differences, all four case studies reveal common challenges in integrating non-human agency into participatory design. A key tension lies in the clash between human-centered aesthetics and ecological processes. Urban spaces are often managed for visual order and predictability, which conflicts with the autonomy and variability of natural systems. Mosaic Mowing and Le Roy Garden show how open-ended ecological change can face institutional resistance for disrupting maintenance norms.

Another major challenge is the temporal disconnect between ecological cycles and human planning processes. Four Siblings and Le Roy Garden expose the limits of short-term planning when long-term ecological evolution is needed. This is especially clear in Four Siblings, where insecure land tenure threatens the project’s future. As one of the project’s authors notes, “We have no guarantee we can stay,” underscoring precarious long-term access to the site, and thus the need to align land policies with ecological timeframes and long-term stewardship.

At the same time, these cases point to new roles for designers and other actors involved in the design process, not as sole decision-makers but as facilitators of ecological processes. This is particularly evident in Le Roy Garden, where participants see themselves as enabling, not directing, spatial change. As Pieter Wouda puts it: “It’s not about designing spaces; it’s about creating the conditions for life to flourish.” This mindset invites more adaptive and open-ended design practices.

Furthermore, the cases suggest placemaking must evolve beyond human-centric frameworks to include non-human actors as co-creators. When placemaking tools like iterative feedback, adaptive co-design, and community-led care are used with ecological sensitivity, they support multispecies participation. Flora voor Fauna does this through species-specific interventions, while Four Siblings allows vegetation to dynamically shape space over time.

These four case studies show how non-human actors can shape, respond to, or even lead spatial transformations when ecological processes are given space within participatory urban design. The analysis highlights how core placemaking principles can be reinterpreted in multispecies terms. From structured interventions to open-ended ecological succession, the cases make visible the varying degrees and conditions under which non-human agency is acknowledged and supported. Meanwhile, they reveal structural limitations, including aesthetic norms, short planning cycles, and fragile land tenure. As the next section argues, these insights point to the need for reconfiguring urban design processes altogether, toward more flexible, long-term, and ecologically attuned frameworks that position non-human actors not at the margins but as co-shapers of future urban practices.

6 *Conclusions: advancing multispecies placemaking*

The Spectrum of Non-Human Agency advances more-than-human perspectives in urban design in three ways. First, it reframes categories originally developed for stakeholder negotiations to capture ecological and multispecies processes in participation. Second, it aligns levels of non-human agency with the iterative phases of placemaking, highlighting how degrees of agency shift across design phases. Third, it translates these levels into operational conditions that enable systematic comparison across projects. Together, these contributions move debates on non-human participation from abstract concepts towards a practical analytical tool for analysis and design research, showing why a more-than-human perspective is needed to address ecological dynamics that human-centered participatory models cannot adequately recognize or govern, and what it contributes by making non-human agency visible, comparable, and actionable across design phases.

In what follows, we reflect on how the framework clarifies non-human involvement across placemaking phases and consider its theoretical contributions to debates on participation and agency. Finally, we outline its practical limitations and the challenges of positioning participation as the sole pathway to ecological inclusion.

By applying the Spectrum across a wide range of projects, the study revealed how non-human agency can be situated along a continuum of involvement that aligns with the phases of placemaking. In the early stages of engagement and visioning, non-human actors typically serve as sources of ecological knowledge, informing designers about species needs, habitat conditions, and ecosystem dynamics. At this stage, non-human participation remains indirect, as humans interpret and translate ecological data into design goals. As projects move into design and co-creation, non-human actors may actively shape spatial arrangements, microclimatic conditions, or material processes through their behaviors and growth patterns. Examples like Four Siblings and Mosaic

Mowing illustrate how plants and pollinators become design partners, influencing decisions as their interactions with the site unfold. Finally, in the long-term stewardship phase, non-human actors can fully take the lead in ongoing spatial transformation. Cases like Le Roy Garden exemplify how natural processes, spontaneous growth, and ecological succession redefine the site's evolution over time, requiring human actors to shift from designers to caretakers. Beyond the projects included in this study, other examples reinforce the plausibility of higher levels of non-human agency. Hortum machina, B (Sheikh et al., 2021), a mobile, plant-responsive structure operating in public space, uses real-time plant electrophysiology to guide its movement through urban microclimates. While it was excluded from our dataset due to its hybrid framing across media architecture and speculative design, the project demonstrates how plant behavior can drive spatial decision-making with minimal human input. As such, it offers a compelling precedent for autonomous non-human agency in designed urban contexts, complementing cases like Le Roy Garden where ecological processes shape space over time. This reinterpretation of placemaking phases highlights the potential for non-human agency to remain active and evolving throughout the entire process, not only at its early stages (Hou, 2020). This evolving interaction between placemaking phases and levels of non-human agency (visualized in Figure 4) forms the basis for multispecies placemaking, where ecological actors are integrated as active participants across the entire process.

The selected case studies show how this integration can take shape. From structured collaboration with species (as in Flora voor Fauna), to enabling spontaneous ecological change (as in Le Roy Garden), each example reconfigures the role of the designer as a facilitator of multispecies interaction. Placemaking principles such as co-creation, iteration, and stewardship are extended to include more-than-human communities, enabling new forms of shared authorship (Choi et al., 2023). The reinterpretation of placemaking through this lens highlights how non-human actors can engage differently depending on temporalities, land tenure, and institutional norms, factors often overlooked in traditional design approaches and highly context-dependent across socio-ecological settings.

Reflecting on the broader scholarly discourse, the framework contributes to debates on participation and authorship, offering a way to operationalize what is often left abstract in design research: how different forms of agency can be systematically recognized and compared across projects (Luck, 2003; Sanders & Stappers, 2008). By tracing how ecological actors shape outcomes across phases of placemaking, it grounds theoretical ideas of entanglement, care, and cohabitation (Haraway, 2008; Kirksey & Helmreich, 2010) in an applied design methodology. Within the field of design research, it advances debates on participation and material agency (Luck, 2018) by extending them to non-human actors and introduces placemaking as a design research

context that has been largely absent from the scholarly discussion. Framed as intermediate-level knowledge (Höök & Löwgren, 2012; Giaccardi & Stappers, 2017), the Spectrum thus acts as a conceptual bridge between participatory design research and urban placemaking practices, opening possibilities for future scholarship on multispecies design within the field. Furthermore, it complements approaches in planning and governance that stress adaptability and ecological embeddedness (Folke et al., 2005; Houston et al., 2018), by introducing a more explicit focus on multispecies justice within decision-making processes. Taken together, these connections show how design research can learn from, and contribute back to, broader conversations about how more-than-human actors participate in shaping urban futures.

Although participation is an important pathway for moving design beyond human exceptionalism, it has limitations that deserve attention. Multispecies practices often rely on continuous forms of care (from maintenance and monitoring to the everyday labor of upkeep), which are unevenly distributed and easily overlooked in design accounts. Meantime, ecological processes rarely align neatly with participatory ideals: enabling one species to thrive may disadvantage another, and many projects necessarily focus on one or a few species (for instance, pollinators in the Pollinator Pathmaker), which can foreground certain ecological roles but also risk enclosing biodiversity within selected spaces rather than enabling broader ecological dynamics. In addition, urban environments are shaped by spontaneous and unpredictable ecological processes, where species establish themselves and transform sites in ways not anticipated by design (Luong, 2022), further showing how non-human agency can exceed and complicate participatory frameworks. Such kinds of trade-offs produce situated conflicts and ethical dilemmas. These considerations suggest that participation should be seen not as a singular solution but as one element within a broader set of commitments that include long-term stewardship, responsibility, and multispecies justice (Metzger & Hillier, 2024).

The framework also faces practical limitations that must be acknowledged. Its applicability depends strongly on cultural and governance contexts: what counts as “participation” varies across planning traditions, and the recognition of non-human actors may be difficult in contexts where human participation is contested. Applying the framework further requires long-term commitment and ecological expertise, resources that may not always be available. Finally, the process of coding inevitably involves interpretation: while operational conditions increase consistency, they also risk oversimplifying the diverse and situated ways non-human agency unfolds in practice. These limitations highlight the need to apply the spectrum reflexively and adaptively, rather than as a universal template.

This study has developed and applied the Spectrum of Non-Human Agency as a way to systematically recognize and analyze how ecological actors

participate in urban design. By testing the framework across 38 examples and four case studies, it has shown that non-human agency is not an abstract idea but a practical reality that can be traced across design phases. These findings suggest that multispecies placemaking is not a radical break from participatory urban design, but a natural expansion of existing values of engagement, co-creation, and long-term stewardship, now extended to include ecological perspectives. For practitioners, this means designing not only *for* nature but *with* it, across all stages of the process (Wakkary et al., 2016). For urban governance, it means rethinking planning cycles and land-use structures to support ecological timeframes and interspecies cohabitation.

Ultimately, the paper argues for a shift from treating urban nature as a constraint or resource to recognizing it as an active participant in shaping livable, adaptive, and resilient cities. Embracing non-human agency introduces complexity rather than simplicity, reflecting the real entanglements of socio-ecological systems (Mancini & Lehtonen, 2018). By expanding participatory processes toward multispecies placemaking, urban design can better respond to ongoing environmental uncertainties and foster long-term ecological stewardship, and create spaces that evolve with, rather than against, the dynamics of the living world.

CRediT authorship contribution statement

Giulia Gualtieri: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Oana Druta:** Writing – review & editing, Supervision. **Pieter van Wesemael:** Writing – review & editing, Supervision, Resources, Funding acquisition. **Evert-Jan Velzing:** Writing – review & editing, Supervision.

Declaration of generative AI and AI-assisted technologies

During the preparation of this work, the author(s) used ChatGPT in order to improve the readability, clarity, and structure of the text. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendices. (if applicable)

A.

Table A1 Spectrum of Stakeholders' Involvement (Veselova, 2023).

<i>Scale of stakeholders' involvement</i>	<i>Names and descriptions of the levels</i>
LOW ↑	Denigrated The stakeholder is neither acknowledged nor included in the design process and may be deliberately excluded or dismissed. The designer does not recognize the stakeholder as relevant and disregards their potential contribution. Neglected The stakeholder is recognized as potentially relevant but is intentionally not involved in the process. The designer chooses to exclude the stakeholder despite acknowledging their relevance. Observed for inspiration The stakeholder is recognized as potentially relevant but does not take part in the process. The designer observes the stakeholder for inspiration but retains full control over decisions. Studied for insights The stakeholder is acknowledged as relevant and becomes the subject of research that informs the design. The designer collects insights but does not engage the stakeholder directly or share decision-making power. Involved as a design partner The stakeholder actively participates in some or all phases of the design process. The designer collaborates with the stakeholder but maintains the majority of decision-making authority. Supported in creating design The stakeholder leads the design process and holds primary decision-making power. The designer takes on a supportive role, helping to implement the stakeholder's ideas. Designed by the actor for the actor The stakeholder acts autonomously, designing for themselves without any involvement from the designer, who is entirely absent from the process.
↓ HIGH	

The spectrum of non-human agency

B.

Table B1 Overview of the four case studies.

Project Title	Project Author(s)	Location	Objective	Type of Design Process	Non-Human Beneficiaries	Project Duration
Four siblings	Emiel Wolf, Müge Yilmaz, and local community (The Beach)	Amsterdam, (Nieuw-West)	To create a community space integrating sustainable agriculture, collaborative art, and biodiversity, fostering engagement between residents, artists, and farmers.	Participatory, community-driven, iterative	Salt-tolerant plants, local vegetation, soil microbiota	2020 – Ongoing
Brief description: The Four Siblings project, located in Amsterdam Nieuw-West, is a community-driven edible landscape combining art, agriculture, and social engagement, led by the social design studio The Beach. Based on the traditional Latin American <i>milpa</i> system, the design interplants maize, beans, pumpkins, and sunflowers in a mutually supportive arrangement that enhances biodiversity, soil health, and microclimatic conditions. The edible labyrinth invites visitors to explore, interact with, and learn from the growing vegetation while directly experiencing plant interdependencies. Beyond its agricultural dimension, the project serves as a platform for participatory learning, bringing together local residents, artists, farmers, and permaculture practitioners. Through workshops, collaborative gardening, and public events, participants engage in dialogues on food sovereignty, ecological stewardship, and cultural diversity. The Four Siblings operates both as a living experiment in urban agroecology and as a tool for fostering community empowerment in shaping inclusive, sustainable, and ecologically attuned public spaces.						
 Photos: Deniz Buga and Müge Yilmaz, 2023						

Le Roy garden	Louis Le Roy and Stichting TIJD (= Time Foundation)	Heerenveen	To create a self-sustaining, evolving landscape that integrates ecological and cultural processes, fostering human-nature relationships and community participation.	Non-linear, self-organizing process (not defined as a "design process")	Plants, fungi, soil organisms, spontaneous vegetation	1960s – Ongoing
Brief description: Le Roy Garden, also known as the Eco-Cathedral, is a long-term experimental landscape project initiated by Louis le Roy in Heerenveen, the Netherlands. Rather than following a fixed design plan, the site evolves through ongoing interaction between human interventions and autonomous natural processes. Using recycled construction materials such as bricks, concrete slabs, and rubble, le Roy and local volunteers created complex structures that serve as scaffolding for spontaneous vegetation growth, soil development, and ecological succession. The project rejects conventional ideas of completion, instead embracing an open-ended timeline where plants, fungi, and other organisms progressively reshape the space. Since its inception in 1966, the Eco-Cathedral has operated as a living demonstration of co-creation between humans and nature, challenging dominant notions of authorship, aesthetics, and temporality in urban design. Managed by Stichting TIJD, the site also serves as an educational platform, offering insights into how urban spaces can accommodate slow ecological transformation and intergenerational stewardship.						

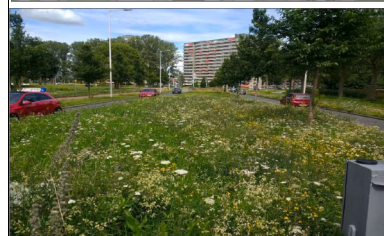
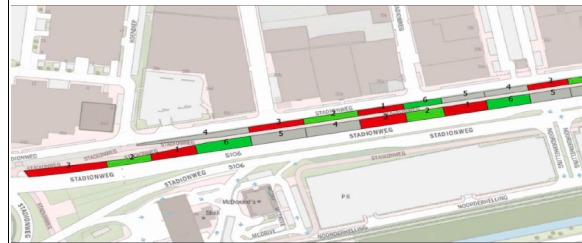


The spectrum of non-human agency

Photos: Giulia Gualtieri 2025

Mosaic mowing	Evellen van Doorn, Remko Andeweg (Bureau Stadsnatuur)	Rotterdam (multiple locations)	To enhance urban biodiversity allowing diverse plant and animal species to thrive in urban green spaces.	Municipal ecological management, adaptive strategy	Pollinators (bees, butterflies), meadow flora, soil organisms	2016 – Ongoing
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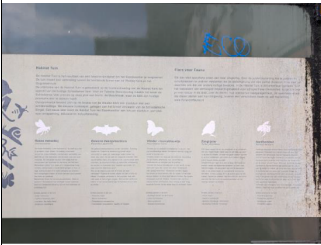
Brief description: Mosaic Mowing is an urban biodiversity management strategy initiated and implemented in Rotterdam by Bureau Stadsnatuur, focused on enhancing ecological diversity within roadside verges and urban green spaces. The approach involves staggered mowing schedules, where different sections of grasslands are cut at varying times, allowing portions of vegetation to grow undisturbed throughout the year. This variability supports pollinators like bees and butterflies by maintaining continuous access to flowering plants, nesting sites, and habitat structures. The practice also helps prevent nutrient overload in the soil by carefully managing cuttings and nutrient cycling. Developed in response to challenges of biodiversity loss in highly managed urban landscapes, Mosaic Mowing applies ecological research to adapt conventional maintenance routines into more species-friendly regimes. The project is monitored through biodiversity surveys and species inventories to track ecological outcomes, making it a data-informed, operational approach to integrating ecological processes into municipal land management.



Photos: Bureau Stadsnatuur,
2016-2020

Flora voor Fauna	Marieke de Keijzer, Marlou de Jong Rotterdam (multiple locations)	To create urban habitats for wildlife, engage communities in green space stewardship, and promote ecological awareness through nature-based solutions.	Designer-led, species-targeted intervention Bats, pollinators (bees, butterflies), birds	2018 – Ongoing
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Brief description: Flora voor Fauna is an initiative focused on enhancing urban biodiversity by integrating species-specific habitat design into everyday urban spaces. The project combines ecological expertise with participatory design, working closely with residents, ecologists, designers, and municipal actors. Design interventions include green routes, postage stamp gardens, habitat gardens, and micro-habitats embedded in the built environment, such as nesting boxes, insect hotels, and pollinator-friendly plantings. Educational features, such as species-marked paving stones and interpretive signage, foster public engagement and ecological literacy. Workshops and collaborative sessions enable local residents to contribute to both the design and ongoing care of these spaces, embedding long-term stewardship into the project’s structure. By translating species needs into targeted design solutions, Flora voor Fauna demonstrates how community-led processes can operationalize nature-inclusive design, creating multifunctional urban spaces that serve both human and non-human users.



Photos: Giulia Gualtieri, 2025

Data availability

Data will be made available on request.

References

- Akbar, P. N. G., & Edelenbos, J. (2021). Positioning place-making as a social process: A systematic literature review. *Cogent Social Sciences*, 7(1), 1905920. <https://doi.org/10.1080/23311886.2021.1905920>.
- Andersson, E., Barthel, S., Borgström, S., Colding, J., Elmqvist, T., Folke, C., & Gren, Å. (2014). Reconnecting cities to the biosphere: Stewardship of green infrastructure and urban ecosystem services. *Ambio*, 43, 445–453. <https://doi.org/10.1007/s13280-014-0506-y>.
- Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners*, 35(4), 216–224. <https://doi.org/10.1080/01944366908977225>.
- Bødker, S., & Kyng, M. (2018). Participatory design that matters—Facing the big issues. *ACM Transactions on Computer-Human Interaction*, 25(1), 1–31. <https://doi.org/10.1145/3152421>.
- Bammer, G. (2019). Key issues in co-creation with stakeholders when research problems are complex. *Evidence & Policy*, 15(3), 423–435. <https://doi.org/10.1332/174426419X15532579188099>.
- Bastian, M., & Bayliss Hawitt, R. (2023). Multi-species, ecological and climate change temporalities: Opening a dialogue with phenology. *Environment and Planning E: Nature and Space*, 6(2), 1074–1097. <https://doi.org/10.1177/25148486221111784>.
- Bennett, J. (2010). New materialisms. A vitalist stopover on the way to a new materialism. In D. Coole, & S. Frost (Eds.), *Ontology, agency, and politics* (pp. 47–69). Duke University Press. <https://doi.org/10.1515/9780822392996-003>.
- Björgvinsson, E., Ehn, P., & Hillgren, P.-A. (2010). Participatory design and "democratizing innovation." In *Proceedings of the 11th biennial participatory design conference* (pp. 41–50). <https://doi.org/10.1145/1900441.1900448>.
- Callon, M. (2014). Actor-network theory—The market test. *The Sociological Review*, 47(1_suppl), 181–195. <https://doi.org/10.1111/j.1467-954X.1999.tb03488.x>.
- Choi, J. H.-j., Braybrooke, K., & Forlano, L. (2023). Care-full co-curation: Critical urban placemaking for more-than-human futures. *City*, 27(1/2), 15–38. <https://doi.org/10.1080/13604813.2022.2149945>.
- Cornwall, A. (2008). Unpacking 'participation': Models, meanings and practices. *Community Development Journal*, 43(3), 269–283. <https://doi.org/10.1093/cdj/bsn010>.
- Cotsaftis, O., Williams, N., Chyon, G., Sadar, J., Va Pesaran, D. M., Wines, S., & Naarden, S. (2023). Designing conditions for coexistence. *Design Studies*, 87, 101199. <https://doi.org/10.1016/j.destud.2023.101199>.
- Darchen, S. (2023). Regeneration and 'placemaking' without governance in a grey field context: The transformation of Salisbury, Queensland, Australia. *Built Environment*, 49(1), 115–131. <https://doi.org/10.2148/benv.49.1.115>.
- Despret, V. (2004). The body we care for: Figures of anthropo-zoo-genesis. *Body & Society*, 10(2/3), 111–134. <https://doi.org/10.1177/1357034X04042938>.
- Elmqvist, T., Andersson, E., Frantzeskaki, N., McPhearson, T., Olsson, P., Gaffney, O., Takeuchi, K., & Folke, C. (2019). Sustainability and resilience for transformation in the urban century. *Nature Sustainability*, 2(4), 267–273. <https://doi.org/10.1038/s41893-019-0250-1>.

- EU. (n.d.). Urban agenda for the EU. <https://www.urbanagenda.urban-initiative.eu/partnerships/greening-cities>.
- Fieuw, W., Foth, M., & Caldwell, G. A. (2022). Towards a more-than-human approach to smart and sustainable urban development: Designing for multi-species justice. *Sustainability*, 14(2), 948. <https://doi.org/10.3390/su14020948>.
- Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, 30(1), 441–473. <https://doi.org/10.1146/annurev.energy.30.050504.144511>.
- Folke, C., Polasky, S., Rockström, J., Galaz, V., Westley, F., Lamont, M., Scheffer, M., Österblom, H., Carpenter, S. R., Chapin, F. S., Seto, K. C., Weber, E. U., Crona, B. I., Daily, G. C., Dasgupta, P., Gaffney, O., Gordon, L. J., Hoff, H., Levin, S. A., & Walker, B. H. (2021). Our future in the Anthropocene biosphere. *Ambio*, 50(4), 834–869. <https://doi.org/10.1007/s13280-021-01544-8>.
- Forester, J. (1982). Planning in the face of power. *Journal of the American Planning Association*, 48(1), 67–80. <https://doi.org/10.1080/01944368208976167>.
- Friedmann, J. (1993). Toward a non-Euclidian mode of planning. *Journal of the American Planning Association*, 59(4), 482–485. <https://doi.org/10.1080/01944369308975902>.
- Gehl, J. (2010). *Cities for people*. Island Press.
- Giaccardi, E., & Stappers, P. J. (2017). *Research through design. The encyclopedia of human-computer interaction* (2nd ed.). IxDF – Interaction Design Foundation. <https://ixdf.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/research-through-design>.
- Gillner, S., Vogt, J., & Roloff, A. (2013). Climatic response and impacts of drought on oaks at urban and forest sites. *Urban Forestry and Urban Greening*, 12(4), 597–605. <https://doi.org/10.1016/j.ufug.2013.05.003>.
- Goddard, M. A., Dougill, A. J., & Benton, T. G. (2010). Scaling up from gardens: Biodiversity conservation in urban environments. *Trends in Ecology & Evolution*, 25(2), 90–98. <https://doi.org/10.1016/j.tree.2009.07.016>.
- Gonsalves, K. F., Foth, M., & Caldwell, G. A. (2024). Liminality, situated digital tales, and the pandemic: Three cases of radical placemaking in Australia. *Antipode*, 56(5), 1642–1664. <https://doi.org/10.1111/anti.13035>.
- Gregory, J. (2003). Scandinavian approaches to participatory design. *International Journal of Engineering Education*, 19(1), 62–74.
- Höök, K., & Löwgren, J. (2012). Strong concepts: Intermediate-level knowledge in interaction design research. *ACM Transactions on Computer-Human Interaction*, 19(3), 23. <https://doi.org/10.1145/2362364.2362371>.
- Haraway, D. J. (2008). *The companion species manifesto: Dogs, people, and significant otherness*. Prickly Paradigm Press.
- Healey, P. (2020). *Collaborative planning: Shaping places in fragmented societies*. Bloomsbury Publishing.
- Hes, D., Mateo-Babiano, I., & Lee, G. (2020). Fundamentals of placemaking for the built environment: An introduction. In C. Hernandez-Santin, & D. Hes (Eds.), *Placemaking fundamentals for the built environment* (pp. 1–13). Springer.
- Hou, J. (2020). Guerrilla urbanism: Urban design and the practices of resistance. *Urban Design International*, 25(2), 117–125. <https://doi.org/10.1057/s41289-020-00118-6>.
- Houston, D., Hillier, J., MacCallum, D., Steele, W., & Byrne, J. (2018). Make kin, not cities! multispecies entanglements and ‘becoming-world’ in planning theory. *Planning Theory*, 17(2), 190–212. <https://doi.org/10.1177/1473095216688042>.

- Ingold, T. (2021a). *Being alive: Essays on movement, knowledge and description*. Routledge. <https://doi.org/10.4324/9781003196679>.
- Ingold, T. (2021b). *The perception of the environment: Essays on livelihood, dwelling and skill*. Routledge. <https://doi.org/10.4324/9781003196662>.
- Innes, J. E. (1995). Planning theory's emerging paradigm: Communicative action and interactive practice. *Journal of Planning Education and Research*, 14(3), 183–189. <https://doi.org/10.1177/0739456X9501400307>.
- Kimmerer, R. W. (2013). Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants. *Milkweed Editions*. <https://doi.org/10.3138/seminar.55.4.rev005>.
- Kirksey, S. E., & Helmreich, S. (2010). The emergence of multispecies ethnography. *Cultural Anthropology*, 25(4), 545–576. <https://doi.org/10.1111/j.1548-1360.2010.01069.x>.
- Kowarik, I. (2011). Novel urban ecosystems, biodiversity, and conservation. *Environmental Pollution*, 159(8), 1974–1983. <https://doi.org/10.1016/j.envpol.2011.02.022>.
- Lachmund, J. (2013). *Greening Berlin: The co-production of science, politics, and urban nature*. MIT Press. <https://doi.org/10.23987/sts.55337>.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press. <https://doi.org/10.1093/oso/9780199256044.001.0001>.
- Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systems Practice*, 5(4), 379–393. <https://doi.org/10.1007/BF01059830>.
- Luck, R. (2003). Dialogue in participatory design. *Design Studies*, 24(6), 523–535. [https://doi.org/10.1016/S0142-694X\(03\)00040-1](https://doi.org/10.1016/S0142-694X(03)00040-1).
- Luck, R. (2018). What is it that makes participation in design participatory design? *Design Studies*, 59, 1–8. <https://doi.org/10.1016/j.destud.2018.10.002>.
- Luong, T. (2022). Feral atlas: The more-than-human Anthropocene. *Journal of Peasant Studies*, 49(6), 1344–1348. <https://doi.org/10.1080/03066150.2022.2092696>.
- Lydon, M., & Garcia, A. (2015). *Tactical urbanism: Short-term action for long-term change*. Island Press. <https://doi.org/10.5822/978-1-61091-567-0>.
- Mancini, C., & Lehtonen, J. (2018). The emerging nature of participation in multispecies interaction design. In *Proceedings of the 2018 designing interactive systems conference* (pp. 907–918). <https://doi.org/10.1145/3196709.3196785>.
- Mattern, S. (2020). Post-it note city. *Places Journal*. <https://doi.org/10.22269/200211>.
- Metzger, J., & Hillier, J. (2024). Bugs in the smart city: A proposal for going upstream in human–mosquito co-becoming. In M. Foth, R. Clarke, & S. Heitlinger (Eds.), *Designing more-than-human smart cities: Beyond sustainability, towards cohabitation* (pp. 147–166). Oxford University Press. <https://doi.org/10.1093/9780191980060.003.0009>.
- Pincetl, S. (2010). From the sanitary city to the sustainable city: Challenges to institutionalising biogenic (nature's services) infrastructure. *Local Environment*, 15(1), 43–58. <https://doi.org/10.1080/13549830903406065>.
- Raymond, C. M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Razvan Nita, M., Geneletti, D., & Calfapietra, C. (2017). A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science & Policy*, 77, 15–24. <https://doi.org/10.1016/j.envsci.2017.07.008>.

- Sachs Olsen, C. (2022). Co-creation beyond humans: The arts of multispecies placemaking. *Urban Planning*, 7(3), 315–325. <https://doi.org/10.17645/up.v7i3.5288>.
- Sandercock, L. (1998). *Towards cosmopolis: Planning for multicultural cities*. John Wiley & Sons.
- Sanders, E. B.-N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign*, 4(1), 5–18. <https://doi.org/10.1080/15710880701875068>.
- Sanoff, H. (1999). *Community participation methods in design and planning*. Wiley. [https://doi.org/10.1016/S0169-2046\(00\)00063-3](https://doi.org/10.1016/S0169-2046(00)00063-3).
- Sheikh, H., Gonsalves, K., & Foth, M. (2021). Plant(e)texture: Towards a multi-species media architecture framework for amplifying plant agencies. In *Proceedings of the 5th media Architecture biennale conference* (pp. 87–99). ACM. <https://doi.org/10.1145/3469410.3469419>.
- Sheikh, H., Mitchell, P., & Foth, M. (2023). More-than-human smart urban governance: A research agenda. *Digital Geography and Society*, 4, 100045. <https://doi.org/10.1016/j.diggeo.2022.100045>.
- Sijtsma, F. J., van der Veen, E., van Hinsberg, A., Pouwels, R., Bekker, R., van Dijk, R. E., Grutters, M., Klaassen, R., Krijn, M., Mouissie, M., & Wymenga, E. (2020). Ecological impact and cost-effectiveness of wildlife crossings in a highly fragmented landscape: A multi-method approach. *Landscape Ecology*, 35(7), 1701–1720. <https://doi.org/10.1007/s10980-020-01047-z>.
- Silberberg, S., Lorah, K., Disbrow, R., & Muessig, A. (2013). *Places in the making: How placemaking builds places and communities*. MIT. <https://static1.squarespace.com/static/528268e5e4b05645e637fda0/t/54cab7be4b00-d2a992b4d4f/1422572667850/Places+in+the+Making+MIT+DUSP+2013+excerpt.pdf>.
- Simonsen, J., & Robertson, T. (2013). *Routledge international handbook of participatory design*. Routledge. <https://doi.org/10.4324/9780203108543>.
- Tisdall, E. K. M. (2013). The transformation of participation? Exploring the potential of ‘transformative participation’ for theory and practice around children and young people’s participation. *Global Studies of Childhood*, 3(2), 183–193. <https://doi.org/10.2304/gsch.2013.3.2.18>.
- Tomitsch, M., Fredericks, J., Vo, D., Frawley, J., & Foth, M. (2021). Non-human personas. Including nature in the participatory design of smart cities. *Interaction Design and Architecture(s) Journal*(50), 102–130. <https://doi.org/10.55612/s-5002-050-006>.
- Toner, J., Reis, K., Kanasa, H., Hayes, S., Hes, D., & Desha, C. (2025). Sensing place-based ecological knowledge for regenerative development and design. *Design Studies*, 100, 101334. <https://doi.org/10.1016/j.destud.2025.101334>.
- Tsing, A. L. (2015). *The mushroom at the end of the world: On the possibility of life in capitalist ruins*. Princeton University Press. <https://doi.org/10.14237/eb1.6.1.2015.506>.
- Veselova, E. (2023). *Designing with nature for sustainability – Towards a critical approach for including natural nonhuman stakeholders in collaborative and participatory design when designing for sustainability*. Aalto Yliopisto University. [Unpublished doctoral dissertation].
- Wakkary, R., Odom, W., Hauser, S., Hertz, G., & Lin, H. (2016). Material speculation: Actual artifacts for critical inquiry. In *Proceedings of critical alternatives: 5th decennial aarhus conference*. <https://doi.org/10.7146/aahcc.v1i1.21299>.

- Whatmore, S. (2002). *Hybrid geographies: Natures cultures spaces*. Sage. <https://doi.org/10.4135/9781446219713>.
- Whatmore, S. (2006). Materialist returns: Practising cultural geography in and for a more-than-human world. *Cultural Geographies*, 13(4), 600–609. <https://doi.org/10.1191/1474474006cgj377oa>.
- While, A., & Whitehead, M. (2013). Cities, urbanisation and climate change. *Urban Studies*, 50(7), 1325–1331. <https://doi.org/10.1177/0042098013480963>.