Transdisciplinary and arts-centred approaches to stewardship and sustainability of urban nature.

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Abstract

This paper explores case studies of how artists working with scientists and land managers affiliated with the Urban Field Station Collaborative Arts Program (UFS Arts) are fostering new relations of care with urban nature and thereby informing landscape decisions.

The 'wicked' problems related to sustainability demand novel, holistic approaches to transformation that engage multiple ways of knowing. We present 4 examples from UFS Arts by triangulating data across programmatic documentation, evaluation, and ethnographic materials from 2016-present. Matthew López-Jensen's *Tree Love* and Nikki Lindt's *Underground Sound Project* sensitise us to the capacities of trees and forests through image and sound. Mary Mattingly's *Swale* is a floating food forest that enacts new forms of community stewardship. The exhibition *Who Takes Care of New York?* maps the stories and practices of civic environmental groups. Three themes in these works suggest opportunities for transformation throughout the knowledge production cycle: posing novel questions, engaging multiple methodologies, and communicating ideas with the public. Through these transdisciplinary works, we learn things we could not have learned via traditional disciplinary or interdisciplinary work and assert that stewardship offers a pathway towards sustainability transforming management practices and landscape decisions by reshaping our relationships to community and the land.

Keywords: stewardship, transdisciplinarity, co-production, arts, urban, ecosystems, decision-making, collaboration, care, relationality

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Introduction

Practitioners working in urban ecosystems, often faced with 'wicked problems' (Brandt et al., 2013), are seeking more sustainable, just, and resilient outcomes (Elmqvist et al., 2018). A key area of sustainability research and practice is stewardship, focusing on care, knowledge, and agency (West et al., 2018). Transdisciplinarity and co-production are consistently identified as important for addressing wicked problems, which requires willingness to value different forms of knowledge (Muñoz-Erickson, 2014). While natural resource and land management agencies have long engaged the arts to portray landscapes and communicate messages, collaborations described in this article involve art as its own 'way of knowing' producing novel insights to catalyse critical reflection (Saratsi et al., 2019). Artists can help decision-makers reach beyond 'business as usual', inspiring novel questions and new approaches. In this article, we reflect on our experience with collaborations between artists, scientists, and practitioners in the USDA Forest Service (FS), The Nature of Cities (TNoC), and local agencies through the Urban Field Station Collaborative Arts Program (UFS Arts).[1] UFS Arts fosters arts-based collaborations with land-managers and scientists working in urban ecosystems. The authors of this piece come from different disciplinary backgrounds including: human geography (LC, MJ), ecology and theatre arts (DM), arts and humanities (CF), social ecology (ES), natural resources management (SH), international development (LP), and the arts (MM, ML, NL). Drawing on key current literature on art and research, this article explores four examples from the UFS Arts program and reflects on the relevance of this work for land management and stewardship. Finally, we discuss how such

collaborations have the potential to transform management practices by reshaping our relationships to community and the land in more sustainable trajectories.

Arts engage with land, place, ecologies, and sustainability

Environmental humanities and ecological art have long demonstrated the role of artists engaging in place-based practices that reimagine our relationship to land and ecosystems. Blanc and Benish's (2018) history of ecological art from the 1960s forward reveals art that interrogates humans' relationship to the environment and place. Geffen et al. (2022, pp. 22–24) characterise ecological art at the intersection of art, science and community. Modeen and Biggs explore what they call 'geopoetics' and argue that 'the value of creative or arts-led research lies primarily in its ability to generate expertise, confidence, understanding and new orientation to issues, problems, concerns and opportunities—including the production of new conceptual tools and practical abilities' (2021, p. 3). These articulations are complemented by relational aesthetics (Bourriaud, 2002; Kester, 2004), which shifts attention from objects to interactions and social-ecological situations and artists as catalysts. Relationality focuses attention on social situations, with artworks taking the form of temporary interventions: meals, gardens, and educational programs; or documentation of everyday activities such as care for trees. Underlying some relational art is the critical pedagogy of Paolo Freire (2018), understanding the socio-political context of all interactions and the experiences that learners bring to situations. These approaches challenge conventional forms of evaluation in the arts because they involve the arts in decision-making and policy with pragmatic 'success criteria' (Bishop, 2012).

Gkartzios and Crawshaw (2019) further develop our understanding of relationality as key to art as a 'way of knowing' drawing on Ingold's proposal (2013, p. 8) that we 'regard art as a discipline which shares with anthropology a concern to reawaken our sense and to allow knowledge to grow from the inside in the unfolding of life'. They highlight the potential for

artists' strategies to be understood as methodologies relevant to other disciplines and practices (2019, p. 606) and they conceptualise art as a relational diagnostic (2019, p. 593), not solving problems per se, but rather as 'a way to "read" a community "in the making" in support of enhanced and continuously transformative governance arrangements' (2019, p. 605).

Conservation and land management practitioners have a history of engaging with arts via a range of approaches. This includes using visual arts, radio, television, and films for public communications (Geraci, 2009), as well as embedding artists in public lands (e.g. the National Parks Arts Foundation programme[2]). Field stations are one of the physical sites at which such residencies take place, co-locating artists with researchers in place-based engagements (Billick et al., 2013). For example, USDA Forest Service National Forests and the National Science Foundation-supported Long Term Ecological Research (LTER) network have engaged artists and writers in residence (Goralnik et al., 2017; Swanson, 2015).[3]

Co-production, transdisciplinarity, and relationality

Sustainability sciences increasingly recognise the need to engage in co-production and transdisciplinarity (or 'convergence' (Petersen et al., 2021)) in order to realise transformational pathways for social-ecological systems and transition toward sustainability (Miller & Wyborn, 2020; Muñoz-Erickson, 2014). Both approaches recognise different realities such as the spiritual and the quantitative, the subjective and the generalised. Co-production involves widening the set of actors that participate in knowledge production and decision-making such that diverse collaborators—in our examples including artists—work together to identify questions, develop methods, gather and interpret data, and propose solutions (Wyborn et al., 2019). Norström et al. (2020) identify four principles of co-production: it should be context-based, pluralistic, goal oriented, and interactive. Chambers et al. (2021) identify multiple modes of co-production, including: researching solutions,

empowering voices, brokering power, reframing power, navigating differences, and reframing agency.

Transdisciplinarity seeks to forge novel 'ways of knowing' that mix disciplines; an 'in-between' that is a melding, not simply two disciplines or practices working together. Both Rigolot (2020) and Russell et al. (2008) suggest that transdisciplinarity takes on the challenge of complexity and offers approaches to knowledge suitable for addressing wicked problems. Transdisciplinarity is a framework for recognising that different disciplines' truth claims resulting from their specific methodologies need to be recognised as such, and are potentially conflictual. Anderson (2013) highlights that while we share ideas, we are loyal to our methods and this can be an obstacle. As such, transdisciplinarity that includes arts, particularly as *research* in Gkartzios and Crawshaw's terms, can be part of a strategy to foster diversity, equity, inclusion, and accessibility (DEIA) (Taylor et al., 2020). Finally, recent work in the sustainability sciences has identified a 'relational turn' (West et al., 2018), in which other ways of knowing and acting, including Traditional Ecological Knowledge and artistic modalities, offer opportunities to advance thinking beyond positivist science. Such modes can be used to embody experiences, reconstruct language and concepts, and articulate ethics and practices of care.

Stewardship as caretaking of urban nature

Different forms of ecological knowledge and diverse care practices are embedded in stewardship of urban ecosystems (Peçanha Enqvist et al., 2018). Civic stewardship activates environments into social infrastructure that supports community cohesion (Campbell et al., 2021). Through caretaking, stewards engage in place-based actions and work across sites and scales as part of network governance arrangements to steer systems toward more sustainable trajectories (Connolly et al., 2013; Muñoz-Erickson, 2014). Stewardship has also been articulated as 'dwelling,' (Cooke et al., 2016) where social-ecological relationships are

framed as ‘embodied’ and ‘enacted’. We define environmental stewardship broadly to include hands-on work such as tree planting, trash pickup, and gardening, but also advocacy and education that aims to engage residents in their communities (Campbell et al., 2021). Stewardship does not require ownership of land—caretaking can occur across a range of sites and property jurisdictions (Fisher et al., 2012). Further, stewardship is more than just ‘volunteer labour’ to fill gaps left by the retreat of the state (Swyngedouw & Heynen, 2003; Wolch, 1993), it is a wellspring of creativity, innovation, and assertion of rights to the city (Fisher et al., 2012). Stewards hail from many different sectors, including public health, social services, education, and housing. These diverse groups share the belief that caring for the environment can be a catalyst for social change (Svendsen & Campbell, 2008).

Feminist theorists, activists, and artists have put care at the centre of their work for decades—acknowledging the importance of ongoing care work and labour that is undervalued, unvalued, or even unseen (e.g. Puig de la Bellacasa, 2011). Sustainable systems depend upon care from a workforce that includes parks departments, land managers, and stewardship groups. Distributed, living green infrastructure—street trees, bioswales—requires tending in order to survive and perform. In acknowledging care, it is important to surface not only the *labour* involved, but also the *love* and the *ethic* that can serve as a wellspring for meaning making. Feminist scholars have discussed an ‘ethics of care’ whereby there is no dichotomy between reason and emotion and where morals are rooted in relationships (Gilligan, 1982). Mol et al. (2010) provide an analysis of care as work and the multiplicity of sometimes contradictory instantiations of care in disciplines and practices. They argue that care needs to be understood as contextual—even place-based. Tronto (2015)

identified several ethical qualities of care, including attentiveness, responsibility, competence, responsiveness, and plurality/solidarity.

Environmental scholars have identified care—along with knowledge and agency—as being conceptual underpinnings that characterise environmental stewardship, drawing particular attention to the need to better understand care as a pathway toward more sustainable outcomes (Peçanha Enqvist et al., 2018). By focusing on stewards, we can amplify the sometimes less-seen, but crucial everyday practices that shape our communities and ecosystems. Furthermore, if we extend the relational view offered in the feminist ethics of care to include non-human nature (Birke, 2010), then we are invited into a more reciprocal relationship between humans and other living systems (Whyte & Cuomo, 2016). This has been part of Indigenous worldviews for millennia. Appreciation is emerging for what such epistemologies can teach sustainability practitioners—including drawing upon sacred and kin-centric ecologies (Kealiikanakaoleohaililani & Giardina, 2016).

Materials and methods: UFS Collaborative Arts Program

UFS Arts was created in 2016 at the NYC Urban Field Station (UFS), a collaboration between the USDA Forest Service and NYC Department of Parks and Recreation. The program brings artists into collaboration with scientists and land managers to create new understanding about cities as social-ecological systems and to inform effective and inclusive land management. The NYC UFS is both a physical place (an office, lab, and residential space) and a network of relationships. Artists can use the residential facility and can engage with field station staff and partners. Their deliverable is a public presentation of their work—a panel, walk or talk—and many continue to develop their projects over subsequent years. Since 2016, the program has expanded to nine locations and offered residencies to 23 artists

in the form of an honorarium and a one-year affiliation in collaboration with the non-profit The Nature of Cities (TNoC).

For this paper, we present 4 case studies from UFS Arts that contribute to strengthening stewardship of urban nature. We are deeply embedded in the cases that we reflect upon here. Thus, we build upon traditions of reflexive research that are used in participant observation and ethnographic methods (Mansvelt & Berg, 2005; Pryke et al., 2003). In developing the case studies, we triangulated across programmatic documentation, evaluation, and ethnographic materials including organising team collective field notes (2016-present); group debriefs from quarterly UFS Arts 'all hands' meetings; and artists program evaluation assessments. The process for writing these cases was iterative and collaborative. First, the organising team reviewed all information from debrief notes and evaluations. Then the lead author (LC) drafted a preliminary text that was reviewed and revised by the artists (NL, ML, MM), and the organising team as a "member check" to strengthen credibility and validity of the analysis (Lincoln & Guba, 1985). Finally, these vignettes were reviewed and coded by CF and LC to draw out their relevance to key challenges as articulated in the literature of arts research (Crawshaw & Gkartzios, 2018; Gkartzios & Crawshaw, 2019), transdisciplinary (Rigolot, 2020; Russell et al., 2008), co-production (Chambers et al., 2021; Norström et al., 2020), and relationality (West et al., 2018).

Case studies

Matthew López-Jensen's* 'Tree Love' and *Nikki Lindt's* 'Underground Sound Project': *Sensitising us to the capacities of trees and forests

Via multiple sensory modalities, artists Matthew López-Jensen and Nikki Lindt attune audiences to the capacities of and relations bound up with urban trees and forests. López-

Jensen trains his eye on the street tree, a form of nearby nature that is for many New Yorkers their first entry into stewardship action (Figure 1). In *Tree Love: Street Trees and Stewardship in New York City* he uses photographic approaches, treating trees as portrait subjects and as landscape, as well as capturing 'tree eye view' images to give viewers new perspectives on the urban forest.[4] López-Jensen's work poses the question: 'What does care look like in the context of an urban forest?' This is not a collection of the oldest or grandest trees in the city. It includes trees girdled by overly tight tree guards, hit by lightning, and struggling to thrive amidst construction fencing. López-Jensen also documents a diversity of care practices, from homemade tree guards to lovingly gardened tree-beds, to handmade signs.

Through the process of researching, the artist participates in his own forms of tree stewardship—including becoming licensed as a Citizen Pruner. Since his residency in 2017, López-Jensen has become further embedded in practitioner networks that care for NYC's urban forest. He offers walks and talks on his work via the New York Botanical Garden, and area universities and not-for-profits; features his work in exhibitions such as the NYC Parks' Arsenal Gallery 'City as Ecosystem*'* and the Queens Museum 'Who Takes Care of New York?' (described below); and participates in the Forest for All NYC Coalition[5], a group of 40+ government, not-for-profit, and other allies.[6]

[Figure 1: Matthew López-Jensen, 'Tree Love: Street Trees and Stewardship in NYC']

Nikki Lindt's 'Underground Sound Project' provides a new perspective on the life and relations of urban forests. By placing microphones in the soil and inside trees, Lindt captures mysterious sounds, patterns, and interactions that people do not usually hear (Figure 2). Her 2020 residency in NYC built upon prior underground acoustic work where she recorded sounds in permafrost thaw in the Arctic, in soils and streambeds at the Hubbard Brook Experimental Forest in New Hampshire as well as other Northeastern forests. She

presented the project as an interactive sound walk, installed in Prospect Park, Brooklyn, through a series of eight stops with signage, text, and QR codes leading to a website with audio files.[7] The walk explores plants, bodies of water, soils, precipitation, streams, and trees through 'melodic, resonant, and otherworldly sonic ecosystems'. Two stops present a spoken-word piece 'We Are Here' speaking from trees' perspectives. One stop focused on human engagement with trees: stewardship practices, transportation sounds, and sounds of polluted soils. It closes with the prompt: 'After hearing our trees and broader ecosystem speak, how do you respond?' Participants can leave their thoughts and sentiments for trees.

Lindt's recordings were created by her, but the framing of these thematic stops and narrative texts was done in collaboration with a team of scientists and land managers.[8] The interactive prompt was informed by a webinar organised by UFS Arts, *Beyond Trees*, and TNoC that posed the question: 'If the trees speak to us, how will we reply?' It was edited into an online, multi-author roundtable essay.[9] Across all these formats, Lindt uses sound recordings as a way to have multi-species encounters; to build empathy for trees and forests; taking scientists and the public beyond their comfort zone or their usual mode of interacting with landscapes.

[Figure 2: Nikki Lindt, 'The Underground Sound Project'; Sound recorded in 'Soil under Wildflowers', video still, 2021]

Both López-Jensen and Lindt's projects are artist-led but embedded in collaborations with stewards and scientists. In curating his large body of photographs, López-Jensen involved social scientists and land managers in a 'first cut', taking account of their feedback on which images resonated and why in the editorial process.[10] Similarly, Lindt begins from her own acoustical curiosity, but the presentation of these sounds and videos is shaped by conversation with soil scientists, foresters, and social scientists. The thematic stops on her soundwalk and the explanatory texts were advised and edited by scientists and land

managers. Lindt acknowledges collaboration as vital to her work in her personal statement.[11] López-Jensen and Lindt continue to participate in the communities of practice engaged in forestry and land management; these practitioner-led groups are reciprocally shaped by the artists' perspectives over time.

Using vision and hearing, respectively, López-Jensen and Lindt invite us to connect with trees and ecosystems on a more intimate basis, from inside unfolding life. While the street trees of the urban forest surround city dwellers, they can sometimes go unnoticed or be seen as a nuisance; urban forest patches can sometimes seem like 'remnant' or wild spaces that are unused. The artists expand the modes of understanding as well as the techniques for reaching the public, capturing their attention about the urban forest, encouraging them to 'speak back' and engage with local ecosystems, and cultivating future stewards, not solving problems but rather 'reading' community in making. Their artistic strategies invite individual engagement and care to be considered in environmental management decision-making processes and can be considered *methods*.

Mary Mattingly's 'Swale'*: Critical provocation, social practice art, and productive landscapes*

Mary Mattingly's 'Swale' is a floating 'food forest' on a barge that created opportunities for both the public and land managers to re-envision how productive landscapes might function in NYC (Figure 3).[12] While foraging is officially prohibited on NYC Parks' property, *Swale* took the concept of waterways as commons to create a space that encouraged foraging. Over several seasons, 'Swale' was programmed with tours and workshops on gardening, composting, beekeeping, and other sustainable practices. 'Swale' docked in the South Bronx as part of the city's first ever 'Foodway' at Concrete Plant Park, at Brooklyn Bridge Park, and at the Brooklyn Army Terminal.[13] Although the barge is currently in storage, the project's ideas continue to travel through networks. The Foodway persists and is

supported by a range of partners in this South Bronx environmental justice community and 'Swale' is reconstituted at Swale House on Governor's Island as a hub for art and ecology.

[Figure 3: 'Swale'. Courtesy Mary Mattingly.]

'Swale' started with creative provocations, 'Why isn't foraging permitted on parkland? Why can't food be free?' Yet it remained in constructive dialogue with land managers. As part of her residency, Mattingly organised a panel featuring researchers, land managers, and activists discussing the dynamics of food systems, both as they currently are and how they might be transformed. In December 2018, 'Swale' helped to catalyse a conversation about urban foraging with municipal leads from NYC, Seattle, Philadelphia, and Baltimore. Workshop attendees discussed both reservations about foraging—due to concerns around human health and sustainability of plant populations—as well as enthusiasm for revisiting existing rules and exploring pilot projects that test approaches to creating additional space for foraging. No change to citywide foraging rules has yet been put in place, but the persistence of the Foodway and the dialogue that was held nonetheless demonstrates the ways in which arts can help open up a space to reflect on existing landscape management practices.

'Swale', while catalysed by Mattingly, is a co-production of many different actors and institutions. It was supported by NYC Parks as the municipal land management agency helped to navigate permits and secure access to free plant stock.[14] As a physical space that also moved to multiple landing sites, it became a literal platform for community-created programming, knowledge exchange, and co-learning about food, horticulture, and stewardship. It also functioned as a temporary urban common where plants could be freely harvested and foraged, creating alternative norms in a public green space. 'Swale'—and the Foodway in the Bronx—opened space to revisit previously held assumptions about what is and isn't possible on public land and became part of a multi-city exchange between decision-makers and scientists. While policies tend to change slowly, such pilot projects provide

means to test out new ideas and to foster discussion by imagining transformational change. We might conceptualise approaches such as this as 'small experiments with radical intent' characterised by 'learning by doing' and 'real departure from previous practice' (Evans, 2014).

'Who Takes Care of New York?' ***Amplifying stories of community stewardship***

The Stewardship Mapping and Assessment Project (STEW-MAP) is a FS-led research project that makes civic capacity for environmental care and action more visible (Svendsen et al., 2016).[15] STEW-MAP gathers social data through surveys and interviews that identify and map diverse practices, territories, and networks of civic stewardship groups—including hyper-local, grassroots groups that can often be ignored. The data allow users to understand the capacities and gaps in stewardship with an aim of creating more equity in the system. Results are shared through maps, databases, and articles. Alongside these traditional science methods and products, the research team found new modes for visualising and supporting stewardship. In September 2019, the team mounted the exhibition 'Who Takes Care of New York?' at the Queens Museum Community Partnership Gallery. FS partnered with the Pratt Spatial Analysis and Visualization Initiative (SAVI) to introduce design-thinking, spatial analysis, and cartography as lenses for understanding stewardship. Artists included two existing UFS Arts residents (Matthew López-Jensen and Julia Oldham) and two new artists identified through an open call for Queens, NY-based artists to make new works aligned with the themes of stewardship, civic engagement, and social infrastructure (Magali Duzant and Jodie Lyn-Kee-Chow). Through photography, drawing, book arts, and performance, these artists reflect upon the work of stewards and create new opportunities for engagement. The exhibition was later adapted for online presentation.[16]

The exhibit aimed to remind visitors of their own capacity to impact their neighbourhoods, amplifying the voices of stewards as agents of change. It shared the stories

of people involved in transforming local environments, putting them on a map that covered one wall of the space. People were invited to add their own stories to an online map.[17] How can we understand both the collective impact and individual experiences of thousands of stewards? Artist Magali Duzant's work explored the work of stewards in Queens, NY, revealing that each of these dots on the map is composed of unique lifeways and histories. Duzant's 'Whole Queens Catalog' is an artist publication that takes inspiration but also departs from the 1960's 'Whole Earth Catalog'. The publication gathers anecdotes, recipes, disaster survival techniques, and other practical wisdom from stewardship groups throughout Queens identified from the STEW-MAP database and represented on the map (Figure 4).

[Figure 4.]

Governance and decision-making are neither solely top-down, nor bottom-up, they are relational and influenced by dynamics that cross sector and scale. STEW-MAP research found the networked structure of the system of stewardship and demonstrates it via diagrams and figures of organisational connections. But now do we show the strength of a network in a more emotional, embodied way? Artist Jodie Lyn-Kee-Chow's work uses a patchwork dress, a picnic, and a participatory performance—each of these forms demonstrate ways in which the whole is greater than the sum of its parts. Lyn-Kee-Chow created a series of participatory picnic performances that set up space for the public to have conversations. Inspired by her grandmother, she sewed together vinyl tablecloths, creating dresses that double as picnic blankets. The performance mounted during the exhibition honoured stewardship groups who centre food justice issues that the artist learned about through the STEW-MAP database

(Figure 5). The event engaged picnic participants in activism, having voter registration cards in multiple languages on hand.

[Figure 5]

Our changing climate has multiple impacts, including more intense coastal flooding and heat. Stewardship groups are on the front lines of observing these impacts, adapting to change, supporting community recovery, and enhancing the ecological function (Caggiano et al., 2022). Artist Julia Oldham's photographic collage series presents an amalgamated vision of NYC's future, especially with regard to climate change. During her residency, the artist used STEW-MAP to connect with scientists, park rangers, gardeners, educators, and volunteers, asking them to share their views of the future. Oldham collected projections ranging from the utopian to the less optimistic and used these narratives for constructed photographic depictions. Oldham's work asked how stewards are actively involved in envisioning and enacting new worlds (Figure 6).

[Figure 6]

'Who Takes Care of New York?' braided together multiple ways of knowing to communicate with the public about stewardship. By starting from the stories and practices of civic stewards, the exhibition aimed to amplify often less-heard perspectives and demonstrate the power of community care. The impact of such an exhibit emerges over time and in subtle, but meaningful ways. Decision-making is influenced by long-term engagements among different ways of knowing—fermentation periods, one might say. The exhibition was visited by numerous decision-makers, including the staff of the Mayor's Office of Resilience, who partnered in the STEW-MAP effort to build new knowledge about the role of civic groups in fostering social resilience. After a city forester gave her entire staff permission to use work hours to visit the exhibit, she reported that community stewardship has grown as a lively

topic of discussion during weekly staff meetings. Ultimately, the aim of the show was to celebrate the many ways of seeing and valuing civic engagement, and thereby proposing new approaches to stewardship.

Discussion

How do place-based collaborations between artists, scientists, and land managers transform stewardship practices? Three themes in these works suggest opportunities for transformation throughout the knowledge-production cycle: posing novel questions, engaging multiple methodologies, and communicating ideas with the public—including an expanded and diverse public who might not otherwise engage with natural resource management issues.

First, by posing new types of questions, rather than by focusing on problem solving (Saratsi et al., 2019, p. 4, Crawshaw & Gkartzios, 2018, p. 180, Kester, 2004, p. 68), art can create an opening for critical reflection. The questions in our examples ('What does care look like in the context of an urban forest?'; 'What does it sound like underground?'; 'Why can't food be free?'; 'Can we amplify commoning and civic stewardship?') are speculative, open-ended, and provocative, opening up space for new ideas and approaches. Questions are generated from the contexts the artists are engaged with and this is a common characteristic of the cited articulations of transdisciplinarity, co-production, and care. Such new questions can help us to move beyond disciplinary silos to envision other ways of organising systems. They encourage interpreting phenomena in new ways and sometimes suggest new scientific enquiries. They encourage land managers to interrogate their fundamental assumptions and governance (e.g., ownership jurisdiction; access and use; rights, rules, and responsibilities).

Second, art can engage multiple ways of knowing and making meaning of place, land, and ecosystems—allowing 'knowledge to grow from the inside in the unfolding of life'. By using multi-sensory modalities, such as visual displays (López-Jensen, Oldham), whole

environments (Mattingly) and immersive sound recordings (Lindt), the arts provide multiple ways to engage with place. In addition to offering surprise and excitement, engaging multiple sensory modes (vision, hearing, touch) can be more inclusive of people with different abilities and ages. Transdisciplinarity explicitly asks for multiple forms of truth to be acknowledged and art explicitly addresses emotion and includes embodied and subjective experience (Edwards et al., 2016).[18] The projects cited might be characterised as re-connecting participants and audiences with ecological systems: 'Foraging for edible weeds in an urban environment represents a type of enacting of the biosphere in a way that encourages an embodied form of earth stewardship' (Cooke et al., 2016, p. 839 authors' emphasis). This focus on the value of 'embodied enactment' shines a light on the roles of artists in making visible or tangible, practices which foreground stewardship in terms of care, knowledge, and agency. Gkartzios and Crawshaw, drawing on Bolt, highlight the 'performative force' of art to 'effect "movement" in thought, word and deed in the individual and social sensorium' (2019, p. 602). The form of knowing provided by the arts is experiential rather than quantitative or qualitative per se.

Third, arts are relational, recognising and engaging in two-way learning and dialogue across differences (Gkartzios & Crawshaw, 2019, p. 605). One-way flows of information where public agencies or scientists aim to do 'outreach' or 'dissemination' to communities does not fully respect community knowledge nor see residents as knowledge producers. Artist-led projects can purposefully flatten conventional hierarchies and create new pathways for co-learning. For example, artist-led projects can surface community wisdom (Duzant). Particularly in the form of social practice work, art can be a platform for facilitating collaboration with residents (Mattingly). This can take many forms, including but not limited to walks, forums, workshops, and interactive performances; performance itself can be a form of stewardship (Lyn-Kee-Chow). By following the community-organising mantra of 'meeting

people where they are', art can be a pathway for engaging publics in ways that respect community contexts and voice, whilst positioning these in the context of global environment challenges. As the environmental field reckons with environmental justice not only as distributional justice, but as procedural and recognitional justice, it needs more ways to authentically engage communities, particularly historically marginalised populations (Campbell et al., 2022). In sum, art can help teach us to engage, not disseminate. This work aligns with DEIJ aims that are being advanced in all sectors, including land management.

Conclusion

Gkartzios and Crawshaw (2019) have provided key concepts which have enabled us to recognise the specific contributions artists can make to transdisciplinary and co-produced work focused on care and stewardship. The examples presented offer evidence of the ways in which transdisciplinary approaches provide multiple entry points for engaging diverse publics in stewardship and care. By posing innovative questions, engaging multisensory and emotion-rich methods, and engaging in co-learning, artists expand the arena of who participates in stewardship and how. West et al. (2018) theorise that stewardship mobilises diverse knowledge, fosters multiple forms of care, and practises stewardship agency. Where land management agencies are creating stewardship programs, artist-led efforts can offer new conduits for engagement in caring for the land and our communities. The complex impacts of these arts-engaged examples go beyond the instrumental to include transformational thinking and will require further research and evaluation.

Just as science alone does not hold the key to sustainability, nor do the arts; these combined perspectives offer a more holistic understanding of urban ecosystems. In these case examples, we see practitioners working at the boundaries of their fields, forging new connections, and seeking novel solutions. While we celebrate the potential for transdisciplinary collaborations, we recognise that they are fragile; they hang in the balance

of individuals who are willing to stretch outside their 'comfort zone'. Trust is both essential and difficult to create. Co-production processes and transdisciplinary spaces require sustained support, staffing, and flexible resources that can be used in the interstices between disciplines and sectors (Campbell et al., 2016). They may require that the traditional rewards and modes of operations in university departments and government agencies change.

New configurations of artists-scientists-land managers require time to incubate and flourish. How do we foster them? Networks that span the local, place-based work of being deeply embedded in communities while sharing ideas and relationships across planetary scales are critical. Such networks share a focus on social-ecological systems and span the domains of research and practice—welcoming artists along with land managers, educators, and urbanists—and can provide participants with access to diverse, small groups that are the lifeblood of transdisciplinarity. Supporting such nurturing spaces of co-production is critical if we hope to weave together multiple ways of knowing and doing to create solutions to the wicked problems of the Anthropocene.

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[1] ufsarts.com/
[2] nationalparksartsfoundation.org/
[3] ecologicalreflections.com/
[4] jensen-projects.com/category/tree-love:-street-trees-and-stewardship-in-New-York-City
[5] forestforall.nyc/
[6] Based on ongoing conversations with the artist.
[7] theundergroundsoundproject.com/
[8] As acknowledged in All Hands and other presentations.
[9] thenatureofcities.com/if-the-trees-speak-to-us-how-will-we-reply/
[10] As acknowledged in All Hands and other presentations.
[11] nlindt.com/about1
[12] swalenyc.org/
[13] bronxriver.org/about/foodway
[14] Multiple authors were involved in these processes.
[15] nrs.fs.usda.gov/stew-map/
[16] thenatureofcities.com/friec/wtcony-2020/
[17] bit.ly/2TekPNk
[18] There are many social science and qualitative methods that also engage emotions, subjectivity, and embodiment, presenting opportunities for further collaboration between arts and social sciences.

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Declaration of Interest

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Chris Fremantle is a researcher and producer working with artists in public contexts including environment and health. He was born in New York and now lives and works in Scotland. He lectures at Gray's School of Art, Robert Gordon University, Scotland. He is a practice-led researcher combining 'live' project activity with reflections on exemplary practices. One of his key areas of research, in collaboration with his colleague Professor Emeritus Anne Douglas, focuses on the practice of the pioneers of art and ecology, Helen Mayer Harrison and Newton Harrison. Both Chris and Anne also worked with the Harrisons on projects including 'Greenhouse Britain: Losing Ground, Gaining Wisdom' (2006-08) and 'On the Deep Wealth of this Nation, Scotland' (2017-18). He is Research Associate with the Urban Field Station Arts Program.

David Maddox loves urban spaces and nature. He loves creativity and collaboration. He loves theatre and music. He has practiced in all of these. After a PhD in ecology and statistics at Cornell he spent 10 years at The Nature Conservancy working on climate change and environmental stewardship. In 2012, David founded The Nature of Cities and remains its Executive Director. TNOC is a transdisciplinary essay and discussion site —with 1100 writers from around the world, from scientists to activists, designers to artists — on cities that are better for nature and all people. He has published over 60 journal articles and books chapters, and has edited six books, both in fiction and non-fiction. David is also a composer, musician, playwright. As a theatre artist he has created various recordings and eight produced works of musical theatre; with commissions from the Kennedy Center, Signature Theatre, and others. David has created sound designs and scores to over 150 productions around the U.S., and has worked in dance, museum design, and documentary film. He has received

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Sarah Hines has spent her career in the Forest Service linking research with practice at local and regional scales to inform holistic stewardship of natural infrastructure and communities, ranging in scale from National Forests to the local parks and forests in our communities.

Mary Mattingly creates sculptural ecosystems in urban spaces. Mary Mattingly's work has been exhibited at the Brooklyn Museum, International Center of Photography, the Museo Nacional de Bellas Artes de la Habana, Storm King, the Bronx Museum of the Arts, and the Palais de Tokyo.

Matthew López-Jensen is an interdisciplinary artist whose rigorous explorations of landscape combine walking, collecting, photography, mapping and extensive research. His projects investigate the relationships between people and local landscapes.

Nikki Lindt, born in the Netherlands, is a New York City-based artist working primarily in the mediums of painting, video and (underground) sound. She often works in collaborations, among others with scientists, philosophers and sociologists to examine climate change at the intersection of art, science and culture. MFA from Yale and her BFA from Gerrit Rietveld Academie in Amsterdam.

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Figure Captions

Figure 1: Matthew López-Jensen, ‘Tree Love: Street Trees and Stewardship in NYC’. Courtesy Matthew López-Jensen.

Figure 2: Nikki Lindt, ‘The Underground Sound Project’; Sound recorded in ‘Soil under Wildflowers’, video still, 2021. Courtesy Nikki Lindt.

Figure 3: ‘Swale’. Courtesy Mary Mattingly. Image credit: Subhram Reddy.

Figure 4: (above) Stewardship story wall. Data from USFS STEW-MAP. Map by SAVI. Courtesy of USDA Forest Service and Can Sucuoğlu, Pratt SAVI Lab(visit https://www.thenatureofcities.com/friec/wtcony-2020/ to explore the graphics); (below)

‘Whole Queens Catalog’ available from https://www.magaliduzant.com/whole-queens-catalog. Courtesy Magali Duzant.

Figure 5: (above) Stewardship network map. Data from USFS STEW-MAP. Map by SAVI. Courtesy of USDA Forest Service and Can Sucuoğlu, Pratt SAVI Lab (visit https://www.thenatureofcities.com/friec/wtcony-2020/ to explore the graphics); (below) Still from performance ‘The Picnic - Harvest of the Stew’. Courtesy Jodie Lyn-Kee-Chow.

Figure 6: (above) Climate change and stewardship. Data from USFS STEW-MAP. Map by SAVI. Courtesy of USDA Forest Service and Can Sucuoğlu, Pratt SAVI Lab (visit https://www.thenatureofcities.com/friec/wtcony-2020/ to explore the graphics); (below) ‘Beaver Village - Undiscovered City series’. Courtesy Julia Oldham.