



How the Nonhuman World Influences Homeowner Yard Management in the American Residential Macrosystem

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Published online: 23 June 2020

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Abstract

Although the yard is a hybrid social and material landscape, much social science research emphasizes the socio-cultural factors and has mostly neglected the potentially important influence of plants, animals, and the nonliving material world on homeowners' decision-making. Using interviews across six metropolitan areas in the United States, we investigated the ways residential yards' nonhuman context is perceived to influence homeowners' relationships with and planning for their yards. We found that nonhuman dynamics establish boundaries of yard-related decision-making, and that homeowners described their relations with the nonhuman context of the yard as cooperative, oppositional, and negotiable. We call for social science in urban spaces to be more explicitly informed by a consideration of nonhuman agency, and offer an ethical reflection of who or what is considered to have a right to cohabit in homeowners' yards.

Keywords Nonhuman agency · Interspecies cosmopolitanism · Residential yards · Urban greening · Actor-network theory United States

Introduction

Scholarship on the ecological and social dynamics of the North American residential macrosystem has attempted to capture the unique scalar properties of this emergent landscape. The ecological implications of homeowner yard management in urban ecosystems reach beyond the local scale (Groffman *et al.* 2017). Compared to the ecological systems that they have replaced, these urban systems are relatively homogeneous assemblages of built infrastructure and

vegetation (Groffman *et al.* 2014; Pearse *et al.* 2016; Wheeler *et al.* 2017). Yard management practices, such as planting vegetation and maintenance, affect biodiversity (Aronson *et al.* 2017). Yard management also influences carbon and nitrogen sequestration and erosion control (Bertonecini *et al.* 2012; Trammell *et al.* 2016). In order to understand homeowners' yard management decisions and to improve future urban planning and policy decisions¹ it is critical to understand the full suite of factors – including the

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nonhuman entities, such as plants, animals, and the nonliving material world.

Traditional social science approaches to understanding homeowner yard management decisions in the context of U.S. urban ecosystems have emphasized the relative ecological uniformity across urban, suburban, and exurban space in the U.S. is largely explained by individual preferences (Goddard *et al.* 2013), shared homeowner values (Larson *et al.* 2016; Robbins 2007), shared community norms (Goddard *et al.* 2013; Locke *et al.* 2018; Robbins 2007), codified yard ordinances (Sisser *et al.* 2016), and standard yard management practices (see e.g., Groffman *et al.* 2016; Polsky *et al.* 2014). In two notable exceptions to the focus on social-psychological and governance factors in explaining homeowner yard management decisions, Larson *et al.* (2010) found that preexisting land and vegetation cover can influence yard management decisions, such as the use of chemical inputs and water. Trammell *et al.* (2019) unsurprisingly found that residents' yard management decisions were also influenced by the climatic context in which they were situated. Thus, homeowners to some extent manage what already exists in their yards. In another exception, Robbins (2007) showed that yard management choices take place within the larger political economy of building construction, landscaping companies, fertilizer and herbicide manufacturers, and the "needs" of resource-intensive turfgrass and the materiality of the lawn itself, creating what he calls "lawn people" (see also Robbins *et al.* 2001). Such findings speak to the potentially important influence of non-traditional constructs on individuals' yard management decisions. Despite these examples, the dominant scholarship has mostly neglected the simple and obvious powerful influence that the nonhuman world of plants and animals and the material context of the yard itself likely have on homeowner decision-making.

Relational Approaches to Decision-Making

In order to understand the full suite of factors that affect homeowner yard management decisions, we must employ theoretical frameworks that treat the effects of nonhuman and material entities within the yard landscape as having analytical importance similar to the social-psychological characteristics of the homeowners themselves.

Here, we employ insights from Actor Network Theory (ANT), which was originally developed as an attempt to understand knowledge construction through the interactions of actors and their situated networks (e.g., Latour and Woolgar 1979; Law and Lodge 1984)¹. As a key approach in relational philosophy in which researchers analytically "concentrate on middles, links, chains, networks and associations" between human and nonhuman actors (Murdoch 1997: 322), ANT

theorizes that nothing exists outside of relations, or that beings and things *become* in relation. Human actions are informed, mediated, and, in many ways, constrained by the material world. Researchers using an ANT framework often emphasize the interactions and relations between humans and nonhumans and focus on these to clarify these multifaceted nexuses.

Scholars are increasingly examining the relation between human and organic nonhuman life using ANT. For instance, Jones and Cloke (2008) argue that trees in a cemetery exert agency by seeding themselves and growing in places and ways unexpected and unplanned by humans. When land planners attempt to use management practices, the trees both "act upon" and are "acted upon" by the human agents (Jones and Cloke 2008: 80). Other scholars have applied such relational thinking to yard and garden contexts, e.g., in a study on lawns in the U.S., Robbins (2007) found that "individual and community desires respond most directly to the *demands of turfgrass*" (133). Further, Robbins, referencing Haraway (2003), argued that turfgrass and humans "are *companion species*, constantly subjecting and resubjecting one another" (2007:135). Hitchings (2003) found the relationship between gardeners and plants was largely collaborative in creating low-maintenance and aesthetically pleasing spaces by mutually acting upon and interacting with one another. Conversely, Power (2005: 39) found that rather than only working together, human and nonhumans relations in the garden entail: "collaboration, negotiation, challenge, and competition." These findings from small-scale case studies in the United Kingdom and Australia, respectively, convey the complexities of gardener-plant relations.

Robbins (2007: 135) argued that to understand the lawn in the U.S. we must consider the "intimate influences of nonhuman 'objects' on our daily life." In non-U.S. garden contexts, others have described the diverse assemblages constructed and constantly reconstructed through the relations between humans and nonhumans and that "people, objects, plants, animals, and ideas all jostle against each other, and it is through these interactions that society takes shape" (Hitchings 2003: 100; see also Power 2005). Our analytical focus is on the articulated relationship between human actors seeking to manage the yard and the nonhuman actors that compose the yard itself. Although our analysis predominantly includes living nonhuman actors, we also examine the ways in which nonliving elements, such as soil-type, landscape features, or the built environment, which we refer to collectively as the "nonhuman context of the yard," affect homeowner decision-making. We

¹ Although we are explicitly influenced by ANT, other in threads of contemporary social theory consider the importance of the relationality between humans and nonhumans, such as post-humanist theory and object-oriented philosophy. This scholarship shares a commitment to understanding the contingent relations of humans and nonhumans, with particular focus on the agency of nonhumans in these relations.

focus on the influence of the nonhuman world in the context of homeowners' yard management choices and actions, and thus this research complements both scholarship on human–nonhuman relations of the yard and existing social science research on yard management decisions in urban contexts.

We address the questions of (1) how the nonhuman context of the yard influences homeowner planning and management decisions and (2) how homeowners interpret their relations with the nonhuman context of the yard through an analysis of the relations that homeowners describe between themselves and the nonhuman context of the yard – either the nonhuman actors that inhabit the yard or its material context. With an empirical focus on how homeowners latently describe such relations, we present a framework to better understand yard management decisions and discuss related implications regarding the practice of social science, urban planning and policy, as well as the ethics of cohabitation in the U.S. yard.

Methods

The data used for this research were collected as part of a social-ecological study investigating the social factors contributing to and the ecological implications of the ecological homogenization of urban America (Groffman *et al.* 2017). Our analysis is based on 137 qualitative interviews conducted in the summer of 2012 and spring of 2013 in six U.S. Census Bureau-designated metropolitan statistical areas (MSAs) representative of different ecosystems in the U.S.: Baltimore, MD, Boston, MA, Miami, FL, Minneapolis-Saint Paul, MN, Los Angeles, CA, and Phoenix, AZ (Fig. 1). Within each of these MSAs, our sample included 20–30 interviews with homeowners across urban, suburban, and exurban locations. Respondents to an earlier telephone survey volunteered to participate in these in-person household interviews (see Polsky *et al.* 2014 for details on sampling and findings). To

determine our sample for the telephone survey, we randomly selected households within each MSA that were stratified to represent a diversity of residential neighborhoods based on urban density, socioeconomic status, and age from Claritas PRIZM classes. Of the 9480 survey respondents, 5797 (61%) agreed to be contacted for follow-up household interviews. Those agreeing to in-person visits were sent information letters and were later contacted by phone until we obtained a sample of 20–30 households from each city. We conducted a semi-structured interview at each household, including accompanying the homeowner around their yard to discuss and describe their management choices. The demographics of our interview participants were skewed in particular ways that may limit our findings: they were 'Whiter' (as defined by the U.S. Census Bureau (2018)) and wealthier than the general population (Table 1).

We designed semi-structured interview protocol to elicit homeowners' perspectives on their previous and future yard management decisions, using questions such as: "What changes have you made [to your yard]?", "What motivates the choices you are making [in your yard]?", "What changes, if any, are you planning to make to your yard in the next few years?", and "If you could change your yard, how would you change it?" We used follow-up questions intended to explore the rationale of their responses, while the context of the interview provided a place of cohabitation that activated the presence of nonhuman actors (see Hitchings 2003, and Power 2005, for similar approaches to data collection). Interviews were fully transcribed by research team members.

We conducted a thematic analysis on our transcribed interviews (Braun and Clarke 2006). Following pre-planned phases of analysis to identify themes within the data set, we first familiarized ourselves with the data by conducting active and repeated readings of the interviews to search for unanticipated patterns in participants' responses to our interview questions. Next, we generated initial codes related to our

Fig. 1 Map of MSAs included in the study



Table 1 Descriptive information of sample

Metropolitan Statistical Area		
Baltimore	19	13.9
Boston	25	18.2
Phoenix	30	21.9
Los Angeles	21	15.3
Miami	21	15.3
Minneapolis-Saint Paul	21	15.3
Density		
Urban	42	30.7
Suburban	54	39.4
Exurban	41	29.9
Income (per year)		
Less than \$35,000	9	6.6
\$35,000-50,000	10	7.3
\$50,000-75,000	24	17.5
\$75,000-100,000	24	17.5
\$100,000-150,000	26	19.0
More than \$150,000	20	14.6
No response	24	17.5
Age		
Under 35	4	2.9
35–44	22	16.1
45–54	50	36.5
55–64	37	27.0
65+	21	15.3
No response	3	2.2
Race/ethnicity		
White	117	85.4
Black	5	3.6
Hispanic	9	6.6
No response	6	4.4

documentation of unexpected patterns (Saldaña 2016), which we used to identify themes and create a visual model and discrete definitions of the thematic elements to ensure *internal homogeneity* and *external heterogeneity* and thus meaningful coherence with and distinctions between our themes (Patton 2002) (see Fig. 2 below). Although ANT did not explicitly guide the design and content of our research instrument or influence our repeated reading or coding, our defining of themes was influenced by a reading of ANT literature coupled with a focus on the articulated relations between homeowners and the nonhuman context of the yard (Hitchings 2003; Power 2005). In this paper, we build rather than deductively test theory through an inductive exploration of our data. Thus, we do not present quantitative analyses or compare quantitative differences among MSAs, which we believe would require an *a priori* approach involving the development and administration of a theoretically-informed research instrument to deductively test operationalized constructs within ANT.

Results

In nearly all the interviews across all six metropolitan areas, the nonhuman context of the yard was discussed as (1) having influenced the plans homeowners had for their yards, and (2) affecting homeowners' relations with their yards. Homeowners described the various ways the nonhuman context of the yard influenced their yard management plans in similar ways across and within the six metropolitan areas. They also described similar relational states between themselves and the constitutive nonhuman components of their yards.

How Does the Nonhuman Context of the Yard Influence Homeowner Yard Planning and Management Decisions?

Homeowners thought that the nonhuman context of the yard influenced their yard management planning decisions in two predominant ways (Fig. 2). First, the nonhuman context of the yard rendered particular options possible. Second, it forbids specific options. To demonstrate each of these findings, the following examples include illustrative and representative quotes from research participants.

The yard's Nonhuman Context Rendered Possible Particular Plans

Homeowners across the metropolitan areas reported that they chose yard management planning options in the material context of the yard and its parts. For instance, one participant described the way in which the land rendered possible particular plans: “the contours of the land kind of dictated a lot of what we did here with the walks and the way the house sits into the land and then the various plantings, all kind of work off of that” (Household (hereafter HH)_7786). Another participant's spouse similarly reported: “my husband has a big dream about putting in a water feature over by the driveway because the land naturally has a depression there” (HH_7477). In addition to the shape of the land, the surrounding infrastructure was also reported as influencing particular options, such as in the case of canals in Arizona: “one reason that we can [have greenery in the yard] is that we have flood irrigation, that's the biggest issue; if we didn't have flood irrigation there's no way we could afford the grass, the lawn, the trees” (HH_11942). Another participant consulted a garden center professional to determine what was possible given the material context of the yard: “We took a photograph to [her] and [she] asked was it shaded, sunny, what the area was like. And, she actually took me around the garden center and said what she thought would be good. ... and you know they are still alive” (HH_13967). In particular, participants often focused on the ways topography and microclimate shaped decisions

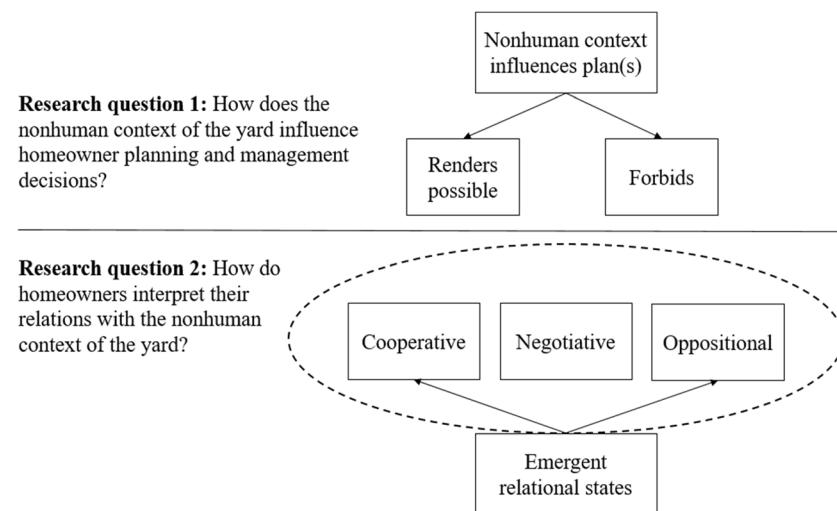


Fig. 2 Visual model of the influence of nonhumans on homeowner yard management planning decisions and the perceived relational states between homeowners and the nonhuman context of the yard. According to participants, the nonhuman context of the yard *rendered possible* certain management plans while *forbidding* others. Further,

about what facilitated appropriate plans and less so about how animal life shaped these decisions.

The yard's Nonhuman Context 'Forbids' Particular Plans

The nonhuman context of the yard was also seen as *forbidding* particular yard planning options. A common refrain homeowners articulated was that either sunlight availability or soil type or quality influenced their plans. For example, one participant stated that their plans were affected because: “our soil is basically sand; so, you really can't plant anything. It stays alive for as long as the soil stays wet and then poof, it's gone” (HH_10042). Similarly, another participant stated: “I don't know, we could never make that [plant] grow either. I don't [know] if it was the soil; we kept adding lime to that all the time for years, and I don't know if that pine tree has an effect, but it was always difficult to get so we kind of minimized our gardening to a few potted tomatoes zucchinis things like that” (HH_1195).

Discussing the limitations of establishing specific desired vegetation, one participant explained how the neighborhood's unique microclimate limited their plant choices: “So, the other issue in this house is that we really are close to the beach, so what would work – seriously half a mile inland from here – doesn't work here. So you've got salty, foggy air coming in through all the time. This got to be a different kind of plant” (HH_4575).

Many participants also discussed how specific nonhuman entities influenced their plans based on their experience with – or knowledge of – a particular plant or animal species. For instance, one homeowner stated: “and then the raccoons

participants described relations with the nonhuman context of the yard as *cooperative* and *oppositional*, but that their relationship could change in a *negotiative* manner over time between these two dominant relational states

come, and I'll never plant sod again because they love to pull it over” (HH_3303). Other participants mentioned a variety of species that ‘forbid’ certain choices, from fauna such as deer or aphids to invasive plants, such as ivy or buckthorn. Thus, in contrast to factors that facilitated plans, which were primarily the non-living elements of the landscape, participants often, but not always, evoked the presence of plant and animal species as forbidding their yard management plans.

How Do Homeowners Interpret their Relations with the Nonhuman Context of the Yard?

Homeowners interpreted their relations with the nonhuman world of the yard in two predominant ways (Fig. 2). First, they felt that nonhuman actors sometimes opposed the control the homeowners sought to exert over them (i.e., *oppositional* state). Second, they also felt that in some ways they were in a cooperative relationship with nonhuman entities in the yard (i.e., *cooperative* state). As shown below, these relational states are plastic in that they may change from one to the other over time through a process of negotiation between homeowners and the nonhuman context of the yard (i.e., a *negotiative* state that fluctuates between *cooperative* and *oppositional*).

Homeowners and the Nonhuman World in Opposition

According to homeowners, the relationship they have with the nonhuman context is often *oppositional* requiring that they seek to control nonhuman actors through management actions because the nonhumans were acting in ways that deviated from their ideal plans. In some instances, the nonhuman actors

were different animal species that consumed plants that homeowners wanted to maintain. For example, one participant stated: “we planted a lot of ice plants on this side, but the little birds would come and eat it. It was like food for them. It was killing us” (HH_3602). In many other instances, homeowners described the ongoing oppositional relationship with invasive – and/or undesired – plants. In one example, a participant described their challenge with a plant: “there’s a lot of poison ivy, so I kind of capped that so I hope that they don’t grow back” (HH_5669). Another participant stated: “neighbors have a lot of crabgrass and dandelions and all of that, so it’s a constant effort to try and keep that out of my front yard” (HH_5257). The conflict with tree roots in the yard was also a common concern. One participant said that on their patio, they “get all those tree roots that grow up in between the bricks. ... I’m torn because I like the look of the brick and when it’s cleaned up it looks beautiful, [but] it’s hard to maintain” (HH_3925). As these examples show, homeowners sometimes perceived their relations with the yard and its parts as opposed to their plans and sought to control nonhumans with management actions, such as maintenance.

Homeowners and the Nonhuman World in Cooperation

Homeowners reported that the relationship they had with the nonhuman context of their yard was often *cooperative* and that they benefitted from their relationship with their yard and its constituent parts. Homeowners generally only articulated if and how often they benefited, but did not specify how particular nonhuman actors benefitted. However, because a nonhuman actor was allowed to exist and persist within the yard, we view this relationship as cooperative because both entities arguably benefit. Some participants described specific benefits that aided in the overall management of the yard. For example, one stated: “The birch clump that’s there now has really started to help [with a previous water oversaturation problem]. It’s that and the hostas around, so this year we haven’t had nearly the water problem, so it’s beginning to soak up that” (HH_2589).

In addition to taking advantage of the properties of flora to aid in yard management, many participants discussed the multiple benefits they experienced because of the nonhuman entities in their yard. For example, one participant said the plants that were in their yard were: “edible and drought-resistant plants; edible, and also, a plant that is a tree that’s drought resistant, low water, but [that] creates a good privacy screen” (HH_10317). Other homeowners, benefitting from the aesthetics of particular plants, recognized their value to a variety of nonhuman life. In this regard, one participant stated: “I’ve got a bee-friendly first [sic] from the start saying that we tried plant flowers that’s probably for the bee and butterfly especially we are trying to get bring [sic] some carpenter bees

around too because they are endangered as a lot of bees” (HH_1663).

Additionally, some homeowners plant particular plants or install certain items to attract wildlife. One participant said: “I wanted a red plant on the deck, but not necessarily a red flowering [plant], like a gabber or you know what have you, because you know I want the humming birds” and went on to say that:

We bought a couple little bird baths this weekend, just to put out there this weekend, I said, ‘you know that’s nice to have it’s I love being able to see the birds and nature’ and all of that. We don’t have as many deer as we used to, [but] we get a lot of rabbits, we have chipmunks, and I guess it’s just so relaxing, you know? (HH_92).

Thus, homeowners often felt that they benefitted from the nonhuman context of the yard in a variety of ways.

Homeowners and Nonhumans in Negotiation

Lastly, homeowners sometimes described the *negotiative* relations they had with nonhuman context of the yard, i.e., instances in which their relationship with the nonhuman context of the yard changed from oppositional to cooperative or vice versa over time. For example, one participant expressed a desire for native plants in their yard. However, they could not control an invasive plant: Bermuda grass:

I can’t get rid of the Bermuda grass in some of the areas.. . So, like, there’s a little patch of turf back there that I just put in and it’s like my new experiment to see, instead of, like, fighting the Bermuda grass, if I could just, like, work with it and put a grassy area in, plus the dogs truthfully like grassy areas.. . So that, I’m just trying that out. (HH_10322).

Referencing an area where they tried, but failed, to plant vegetation “because of the shade and the oak tree chemicals and stuff,” and went on to say that: “when our boys were really small that was the shade area where we put the swing set and the huge sandbox and stuff cause nothing else would grow there” (HH_419). Thus, such relations are plastic in that their character may fluctuate and are largely dependent on the homeowners’ yard management goals in relation to the perceived characteristics of the nonhuman context of the yard (Fig. 2).

Discussion

Our results have implications that will be of interest across several disciplines. Environmental psychologists may be interested in how homeowners actively negotiate and interact with landscapes to co-construct yards with the nonhuman

entities that yield psychological benefits and harms. Related to this, landscape architects may be interested in how homeowners perceive their relations with specific types of nonhuman entities within the yard to assist in the development of preferred designs. Urban ecologists may be interested in the ecological implications of which types of nonhuman entities are eradicated or allowed to cohabit in peoples' yards. However, we have decided to confine ourselves to three primary discussion points because our focus is on factors that influence homeowner decision-making and yard management. Our results show the importance of nonhumans in homeowners' decision-making, are salient to the practice of social science, have clear implications for urban land-use planning and policy, and have ethical implications related to how humans' regard nonhuman agency.

Much previous scholarship related to yard management decisions in the U.S. has focused on the social-psychological and governance factors that influence decision-making (Goddard *et al.* 2013; Groffman *et al.* 2016; Larson *et al.* 2016; Martini *et al.* 2015; Nassauer *et al.* 2009; Polsky *et al.* 2014; Robbins 2007; Sisser *et al.* 2016; Visscher *et al.* 2016). However, an explicit focus on traditional social science constructs, such as norms and values, can obfuscate context in which these social processes play out. Thus, when the nonhuman world is not included in study design and/or bracketed from analysis, social science research that focuses on urban social-ecological systems not only loses explanatory power, it also ignores the dynamic and diverse ways that the nonhuman world is both acted upon by and acts on humans (Jones and Cloke 2008). Consequently, we borrowed salient aspects of ANT to guide and orient our analysis and situate our findings. Our results indicate that homeowners perceive the nonhuman context of the yard to influence their plans and management decisions by both rendering certain plans possible and forbidding others. Thus, our approach yielded insights into the role of perceived human-nonhuman relations in homeowners' decision-making.

Homeowners in our sample viewed their relations with nonhuman context of the yard as *cooperative* and *oppositional*, with the potential of *negotiating* between the two. Our research supports the findings of Hitchings (2003) and Power (2005) that humans and the nonhuman actors of the garden had such relations in the United Kingdom and Australia, respectively. Expanding the geographical breadth, we show that such relations also exist across six metropolitan areas in the U.S., within a variety of ecological contexts, and across different types of developed environments (i.e., urban, suburban, and exurban) and climatic regions (i.e., arid and mesic). Given the relative racial and economic homogeneity of our sample, our findings may be most representative of a privileged class able to expend time and/or money on yard management. Thus, it may be that homeowners included in our limited sample likely have consistent views of their

perceived relations with the nonhuman context of their yards that are likely consistent across space; however, the nonhuman context of the yard that is described by homeowners may take different forms depending on the place. We also identified specific characteristics of nonhumans that may influence homeowners' plans. For instance, homeowners often referred to the abiotic and geophysical elements of their yards when discussing what *renders possible* particular plans, while discussing the biotic and organic world of plants and animals when describing what *forbids* particular plans. For example, depressions in the yard were sometimes seen as opportunities for certain types of landscaping decisions while the presence of certain animals was seen to limit such opportunities. In terms of homeowners' articulated relations with nonhumans, it was often the case that when nonhumans exerted their agency in ways that deviated from homeowners' yard management goals, homeowners either mitigated the perceived problem through maintenance or changed their plans in a process of negotiation. As discussed below, it is essential to develop a research instrument to deductively test the validity of our findings through asking specific questions about what nonhuman entities *render possible* and *forbid* plans, as it is likely that abiotic factors, such as limited water availability in arid cities, may also be seen as *forbidding* plans.

Our findings also contribute to a more robust understanding of what it means that humans and the myriad nonhuman components of the yard are *companion species* (Haraway 2003) and that humans are "lawn people" (Robbins 2007). As we found, lawn people – or perhaps "yard people" to encapsulate the complexity of the American yard beyond humans' relationship to the political ecology of turfgrass – negotiate, conflict, and cooperate with nonhumans that cohabit the yard. We explored yard peoples' "ecological labor" on behalf of the yard (Robbins 2007), which takes place within and is in part formed by these relational contexts and the material reality of the yard and its parts.

Thus, urban social-ecological scientists, when appropriate to the research question(s) and context, should design their research instruments, collect data, and conduct their analyses in ways that epistemologically engage the agency of the nonhuman world. We are not advocating the field ignore social-psychological, governance, and other social factors in explaining decision-making. Rather, we argue for the potential value of integrating a relational understanding of human agency that explicitly considers the influence of nonhumans and materiality on decision-making in research.

Researchers can operationalize the nonhuman world in several ways. First, they may explicitly include nonhuman actors across the stages of the research process through expanding social worlds under examination to include nonhuman actors in ways that attempt to understand their agency in their own terms (e.g., Kohn 2013). This could also mean that we should include constructs related to the material world in our research

instruments when trying to explicate decision-making. Either approach could be co-developed with ecologists, biologists, or other biophysical scientists, as such collaboration could inform social science research instruments given the unique insights that such disciplines bring to bear. An approach that integrates the nonhuman – either as an actor understood in its own terms or as an entity that influences humans – lays bare the limits of human agency and, as Whatmore (1999) and Latour (2004) argue, renders a relational view of human agency more apt for explaining social phenomena.

ANT-influenced social science research can help inform urban planning and policy decisions as it can provide a more robust understanding of human behavior than other approaches. Related to planning, some architects feel the built environment can help facilitate biodiversity and urban animal populations, such as those promoting design of the built environment in ways to contribute to the well being of a desired animal species (Weisser and Hauck 2017). In this case, it is essential to understand human perceptions of their relationships with nonhuman actors prior to the design of the project. In a policy example, at least one state in the U.S. provides money and training for residents to convert their traditional turfgrass lawns to pollinator lawns that specifically benefit native pollinator species and populations (e.g., the Lawns to Legume program in Minnesota (Minnesota Board of Water and Soil Resources 2019). Understanding homeowners' perceptions of the limitations and affordances of the yard itself can help researchers or state agency personnel understand the household-level barriers and opportunities to the design and implementation of this and similar policies.

Our findings have ethical implications regarding who or what homeowners allow to cohabit in their yards. "Cosmopolitanism" is the belief that, to behave ethically, communities should reject the exclusion of people based on difference (Delanty 2012). Mendieta (2010, 2012) further argues that ethically oriented communities should be inclusive of nonhumans (see also Haraway 2003; Braun *et al.* 2010). However, as our results suggest, homeowners often only include specific nonhuman entities among those in their yard. This practice of exclusion is especially apparent in the discussion of what homeowners may or may not describe as pests thought to be harmful or nuisances that sometimes prevent achievement of their yard management goals. Further, the seemingly benign practice of maintenance, for example, weeding out unwanted plants, is a form of exclusion from cohabitation. Thus, homeowners, rather than practicing a form of interspecies cosmopolitanism, often wield their power in exclusive and inclusive ways based on perceived characteristics of specific nonhuman actors. This raises the question of whether and how urban land-use planning and policies in general, and yard planning and ordinances models in particular, can be formulated to promote an interspecies cosmopolitanism rooted in responsible actions towards nonhuman

members of our urban communities who exhibit agency on their own terms (see Hampton *et al.* 2019, Ramp and Bekoff 2015, Schlaepfer *et al.* 2010, and Wallach *et al.* 2018 for a further detailed discussion of the ethics of inclusion and exclusion of non-native species).

Limitations and Future Research

Our previously noted limited socio-demographic respondent pool may bias our findings in particular ways. Importantly, marginalized populations may articulate their relationships with nonhuman contexts of their yards and their management plans for their yards in different ways than our sample that could yield more generalizable insights. Further, our omission of renters overlooks an important and growing segment of the population that may have a distinct relationship with the non-human context of green spaces or rental housing yards. Despite these shortcomings, our sample is representative of a large social component of urban residential greenspaces in the U.S. and whose material impact has profound implications for nonhumans in urban contexts.

Future research could not only focus on marginalized populations but could also deductively test our potential theoretical contributions. Co-design of research instruments and co-generation of empirical data, perhaps through in-depth interviews and focus groups, could potentially lead to the emergence of salient themes that are more representative of the diverse urban populations in the U.S. Research to test constructs that emerged through our analysis could potentially build a more robust theoretical framework to better understand yard management decision making in the U.S. urban ecosystem. Future research might also address further and more explicitly the perceived nature of nonhuman actors.

Conclusion

Our findings suggest the nonhuman world influences homeowner yard management. By explicitly recognizing the agency and autonomy of nonhumans while also documenting their perceived influence on human action, these findings could cultivate a more inclusionary awareness of the nonhuman world in planning and policy decisions.

It is important to consider the dynamic relations between humans and nonhumans and the extent to which the material reality of the yard practically affects homeowner decision-making. Yard futures, and thus the future of U.S. urban ecosystems, are influenced by what yards consist of today: the rocks, the soil type, the trees that are planted and those that are kept, the animals that pass through and those that stay, the built environment, along with global-scale changes and future socially-acceptable ideas about yard management. Groffman *et al.* (2014) argue for the development of theories of urban

ecology that would be especially salient for urban planners and policymakers. Necessary to the development of such theories is integrating salient social theory constructs. As we have shown, it is likely that integrating the insights of ANT will lead to the development of more robust explanations of the social-ecological worlds humans and nonhumans mutually inhabit.

Acknowledgements This research is supported by the Macrosystems Biology Program (US NSF) under Grants EF- 1638648, -1638519, -1638639, -1638725, -1638606, and -1638676 and the NIFA McIntire-Stennis 1000343 MIN-42-051. The work arose from research funded by grants from the NSF LTER program for Baltimore (DEB-0423476); Phoenix (BCS-1026865, DEB-0423704, and DEB-9714833); Plum Island, Boston (OCE-1058747 and 1238212); Cedar Creek, Minneapolis-St. Paul (DEB-0620652); and Florida Coastal Everglades, Miami (DBI-0620409). The USDA Forest Service Northern Research Station also provided support. Anonymous reviewers supplied constructive feedback that helped to improve this paper. The findings and opinions reported here do not necessarily reflect those of the funders of this research.

Data Availability The datasets generated during and/or analyzed during the current study are not publicly available because we did not explicitly receive institutional review board approval to publically share them, but are available from the co-author Dr. Kristen Nelson on reasonable request.

Compliance with ethical standards

Conflict of Interest The authors declare that they have no conflict of interest.

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