ANNALS OF THE AMERICAN ASSOCIATION OF GEOGRAPHERS
https://doi.org/10.1080/24694452.2024.2433011

Segregation Histories, Wealth, and Community Engagement Shape Inequitable Burdens of Urban Greening

Dawn Biehler,[a] Shannon LaDeau,[b] Joel Baker,[c] Yinka Bode-George,[d] J. H. Pitas,[e] Rebecca C. Jordan,[f] Paul Leisnham,[g] and Sacoby Wilson[h]

[a]*Department of Geography and Environmental Systems, University of Maryland, Baltimore County, USA;* [b]*Cary Institute of Ecosystem Studies, USA;* [c]*American Conservation Experience, USA;* [d]*Sustain Our Future, USA;* [e]*Department of Social and Natural Sciences, Howard Community College, USA;* [f]*Department of Community Sustainability, Michigan State University, USA;* [g]*Department of Environmental Science and Technology, University of Maryland at College Park, USA;* [h]*Maryland Institute for Applied Environmental Health, University of Maryland at College Park, USA*

Incorporating vegetation into urban landscapes (hereafter, greening) has numerous ecological and social benefits. Not all greening processes are intentional, though, and not all nature conveys benefits to urban residents under conditions of uneven urban development, racial segregation, and unrecognized care work. We describe a framework for integrating multiple lines of evidence to explore the social contexts and socioecological impacts of urban greening. We assemble data (e.g., human surveys, Photovoice, spatial mapping, and ecological protocols) from neighborhoods in Baltimore City, Maryland, that were historically redlined and racially segregated but have subsequently experienced divergent paths of population and wealth accumulation, or continued official marginalization. Incorporating vegetation into cities offers both risk and benefit to local residents, and we demonstrate that the source of both initiative and resources matters. Greening initiatives that did not have local buy-in became local burdens. Although greening "vacant" properties in neighborhoods with population decline might convey city-scale benefits, local residents associated the greening with loss of valued human community, and they were unlikely to use or maintain such imposed or incidental green spaces. Local benefits, including heat amelioration, were not evident in our analysis. Discontent with greening was further associated with low expectations for help with other nature-based disamenities. In cities, reporting disamenities, such as mosquito nuisance, is often the trigger for directing resources toward management. In our study, residents with the greatest exposure to disamenities were least likely to initiate the processes that trigger external management. *Key Words: ecosystem services, environmental justice, urban greening, vector ecology, vegetation.*

This article explores the implementation and experience of urban greening within the context of uneven development pathways, structural power dynamics, and cultural perceptions. We examine ecological conditions and effects of greening alongside resident attitudes and practices across neighborhoods in Baltimore City, Maryland, through an integrated analysis of several types of evidence: ecological data, household survey data, and data from community-engaged methods including Photovoice. The focal neighborhoods all experienced racialized disinvestment and segregation historically, but their recent socioecological trajectories diverge. The research asks how perceived amenities or disamenities influence actions and practices associated with urban greening, while linking perceptions with biophysical exposures in green spaces. Our combination of biophysical and social methodologies is informed by critical physical geography. We understand inequality in urban green space through theories of uneven development shaped by racial segregation, environmental justice (particularly issues of participatory justice), and unequal value of greening labor.

Cities such as Baltimore are increasingly turning to urban greening (i.e., increasing vegetation cover, which we further define later) to address social,

ARTICLE HISTORY
Initial submission, November 2023; revised submission, June 2024; final acceptance, August 2024

CORRESPONDING AUTHOR Dawn Biehler dbiehler@umbc.edu

health, and ecological challenges associated with changing climate and shifting economies and human populations (Kondo, South, and Branas 2015; Volin et al. 2020; Eisenman et al. 2021; Flores et al. 2022; Lourdes et al. 2022; Hoover et al. 2023). Vegetation can mitigate urban heat; it can also counteract the effects of impervious surfaces by improving storm water infiltration (Imhoff et al. 2010; Davis et al. 2016; Ramamurthy and Bou-Zeid 2017; Zhou et al. 2021; Gallay et al. 2023). Urban green spaces have also been associated with reduced air pollution and other benefits for mental and physical health (Kondo, Low, et al. 2015; Kondo et al. 2020; Lafrenz 2022; Menconi et al. 2023; Y. Yang et al. 2023). Framing urban greening as inherently positive resonates with common sustainability mandates (Jennings and Gaither 2015; Hoover et al. 2023; Strbac et al. 2023), but this framing often discounts local variation in residents' experiences of greening (Lyytimäki and Sipilä 2009; Lyytimäki 2015; Roman et al. 2021). This variation is shaped by the ongoing influence and reinforcement of uneven urban development patterns.

Alongside the variation in residents' experience of greening, this research encompasses a broad range of urban green spaces, going beyond definitions that typically include formal parks, community gardens, and the like. Our working definition of green space includes such formal spaces, but also so-called "vacant" lots, street-side strips of trees and other vegetation, and informally claimed areas—any patch, parcel, or strip where vegetation grows in the ground. We include such spaces in part to encompass residents' own encounters with vegetation in the context of their neighborhoods. Furthermore, methods like remote sensing that can be used in conjunction with evaluating heat mitigation potential or wildlife habitat, for example, do not always discriminate between formal and informal spaces. Thus it makes sense to define green space inclusively from the viewpoints of both resident experiences and physical science.

Sustainable urban greening requires understanding how people experience the benefits and disamenities of investment in urban vegetation. Single methodologies are often inadequate to address such socioecological quandaries. Researchers have criticized conventional approaches to urban greening implementation, as well as the research methodologies used to uphold and promote such practices (Locke and Grove 2016; Carmichael and McDonough 2018; Angelo 2019; De Souza and Torres 2021; Triguero-Mas et al. 2022; Planas-Carbonell et al. 2023; Shcheglovitova and Pitas 2023). Thus we employ a critical physical geography framework (Lave et al. 2014) to speak across natural and social science methodologies and epistemologies to the urban greening literature. Lave et al. (2014) called critical physical geography an "integrative intellectual practice" that "combine[s] critical attention to relations of social power with deep knowledge of … biophysical science … in service of social and environmental transformation" (1-2, 4). Such work maintains a strong grounding in natural science techniques and ecological insights while emphasizing the way human values, ways of knowing, and power relations shape our understanding of biophysical processes.

Through this robust combination of techniques and epistemologies, we can speak to a variety of studies that question accounting of greening benefits (Kirkpatrick 2015; Pataki et al. 2021; Loughran 2022). Social and geographic theory offer broad concepts such as uneven development, environmental justice, and care work that shape our interpretation of ecological findings. Uneven development (Smith 1990) explains how capital shifts investments among different spaces (e.g., urban neighborhoods), leaving some bereft of jobs, infrastructure, and other needs. Uneven development creates a "churn" (Frickel and Elliott 2018) of land uses, including varied types of green spaces. The processes that shape urban green spaces grow out of distinct neighborhood histories and current socioecological conditions, which in turn are often rooted in racialized disinvestment, deindustrialization, and gentrification (Grove et al. 2018; L. Brown 2021; Anguelovski et al. 2022; Mullenbach et al. 2022; Triguero-Mas et al. 2022). The flip side of disinvestment is that greening initiatives have also been associated with a rise in property values in some neighborhoods. This trend also demands frameworks for better understanding of the drivers and consequences of "green gentrification" or "eco-gentrification" (Safransky 2014; Rigolon 2016; Cole et al. 2017; Anguelovski et al. 2022).

Early environmental justice literature often focused on distribution of green spaces, but a more complex understanding requires attention to the quality and experiences of such spaces, including experiences of those who work to maintain them. Sustaining citywide benefits of urban greening depends on material support for long-term

maintenance (de Guzman et al. 2018; de Guzman, Wohldmann, and Eisenman 2023; Solins et al. 2023). Neither costs nor benefits of vegetation cover, however, are experienced equitably across several urban scales or by the people whose labor sustains greening (Schwarz et al. 2015; Nesbitt et al. 2019; Saverino et al. 2021; Garrett 2023). Urban tree canopy cover, for example, has often been associated with neighborhood wealth (Pincetl 2010; Chuang et al. 2017; Lee et al. 2017; H. Brown et al. 2018; Grove et al. 2018; Anderson et al. 2023). Integrating biophysical analysis with social analysis helps us appreciate that ecological amenities provided by parks, forest remnants, and individual trees may be experienced locally, for example as increased shade, but benefits accrue as total vegetated cover increases relative to impervious (built) cover across larger municipal scales. For example, studies suggest 20 percent to 40 percent tree canopy cover might be required to counteract the heating effects of built, impervious surfaces at neighborhood to city scales (Ziter et al. 2019; Alonzo et al. 2021).

Furthermore, recent environmental justice research recognizes that community agency and positive perceptions drive sustainable greening (Jennings, Larson, and Yun 2016; de Guzman, Wohldmann, and Eisenman 2023; Planas-Carbonell et al. 2023; Thompson et al. 2023). Historical and ongoing racialized exclusion, however, along with negative experiences of working with outside environmental groups, can diminish residents' value and support for greening projects (D. Taylor 2014; Carmichael and McDonough 2018). Furthermore, the labor of caring for trees and green spaces is often devalued in terms of material compensation on the assumption of its high intangible rewards. Retired residents and others can with relative ease volunteer their time in affluent neighborhoods, but the labor demands of green space maintenance add to strains in communities where leaders and organizers already deal with multiple injustices (Garrett 2023). If local communities do not experience and perceive the benefits of increased vegetation cover or do not have the time or resources to maintain those benefits, greening can add to existing environmental and labor burdens (Biehler et al. 2018; Nesbitt et al. 2019; de Guzman, Wohldmann, and Eisenman 2023; Drew-Smythe et al. 2023).

Vacant lots and untended spaces can be rapidly colonized by weedy and invasive plant and animal species (Baak-Baak et al. 2014; Lewis et al. 2017; Peterson et al. 2020) and are also subject to illegal dumping (Little et al. 2017; Biehler et al. 2018). Trees planted or preserved in urban landscapes face unique challenges due to restrictive tree wells, poor soil quality, and higher risk of pests and disease (Landry and Chakraborty 2009; Pincetl 2010; de Guzman et al. 2018). In postindustrialized cities where human populations have declined (Gulachenski et al. 2016), infrastructure abandonment exacerbates the challenges of maintaining green spaces. In cities such as Detroit, Philadelphia, and Baltimore, a feedback between population loss and prioritization for locating greening projects in "shrinking" neighborhoods could serve citywide goals but can also perpetuate local burdens (Safransky 2014; Kirkpatrick 2015; Shokry, Connolly, and Anguelovski 2020; Ahmann 2022). Planners often see greening, instead of affordable housing, as the easiest development path in times of "duress" and "limited local resources"—such as fiscal strain amid declining tax bases (Angelo et al. 2024). Opportunistic ecological succession in abandoned lots could add significantly to the city's green canopy but also contributes to proliferation of unwanted species, such as poison ivy (*Toxicodendron radicans*) and tiger mosquitoes (*Aedes albopictus*; Lewis et al. 2017; Little et al. 2017; Berland et al. 2020). Our ecological data document levels of *A. albopictus* infestation to show one reason why residents avoid certain green spaces.

Furthermore, theoretical benefits of tree planting are often assumed without subsequent monitoring of the actual effects of greening on communities (Shcheglovitova 2020). Studies that rely solely on externally generated data such as census data and remote sensing instead of engaging genuine community participation are likely to misunderstand residents' interpretations and use of greening urban landscapes. By integrating robust social theory about multiple dimensions of uneven urban development, environmental injustice, and care work with ecological and social research techniques, we present a more holistic understanding of whether, how, and why residents are able to benefit from greening urban spaces.

Methods

Site Selection and Condition

The data were collected from five neighborhoods in Baltimore, Maryland, which were initially selected because they (1) consisted of row homes; (2) were

categorized as having household incomes either below (L1, L2), above (H1), or at (M1, M2) Baltimore's median household income ($41,000 in 2010); and (3) were near each other but also more than one kilometer from two large city parks (Druid Hill and Leakin Park) and the Inner Harbor (Table 1, Figure 1). Neighborhood boundaries and a priori demographics are from the Baltimore Neighborhood Indicators Alliance (http://bniajfi.org), accessed in fall 2011. All focal neighborhoods included at least one municipally managed public green space. Focal neighborhoods range in size (about fifteen blocks to about forty-five blocks total) but individual focal block areas are consistent across neighborhoods ($0.023\,km^2 \pm 0.008\,km^2$). Sixteen focal block pairs (—two to five per neighborhood) were selected from all blocks identified as predominantly residential (avoiding blocks with schools, large apartment complexes, and businesses), with the constraint that they were separated by at least one unsampled block. Researchers visited each focal block each growing season from 2012 to 2017, to conduct knowledge, attitudes, and practice (KAP) surveys. The number of individual parcels visited per neighborhood ranged from 211 to 532 (Table 1). Parcel condition and occupation status were recorded and updated annually. Each parcel was labeled as occupied if a building was present and inhabited, vacant if no buildings were present, and abandoned if the buildings present were uninhabitable (e.g., missing roof) or boarded up.

Vegetation cover, mosquito abundance, and temperature were examined on each focal block. Vegetation cover was estimated from a one-meter resolution land-use/land-cover data set (from satellite imagery from 2013–2014), accessed through the Chesapeake Bay Program Office (CBPO 2022). The data were extracted in ArcGIS for specific water and vegetation covers using the "Extract by Attributes" function. Vegetation cover was summarized by area classified as tree canopy over impervious, tree canopy over turf, tree canopy, turf, and other. Definitions of these classes can be found at the CBPO (2022) Web site. Total tree cover is the sum across the three tree categories. Total green vegetation is the sum of all tree, turf, and other classes. The mean percentage vegetation cover across blocks is shown for each neighborhood in Table 1.

Mosquitoes require a vertebrate blood meal to reproduce, and their propensity to bite makes them an outdoor environmental nuisance (and a measurable human–animal interaction) across urban neighborhoods. In this work we considered both researcher-led counts of female, host-seeking mosquitoes, as well as individual residents' experience and perception of mosquito–human interactions across focal neighborhoods. The abundance of female mosquitoes on each focal block was recorded by researchers using BG-Sentinel^{TM} traps baited with CO_2 and a 2.0 mL Octenol Lure (a mammal-derived attractant). Traps were deployed on twelve focal blocks dispersed across the five neighborhoods. Two

Table 1. Summary statistics from five focal neighborhoods categorized a priori as having median household incomes above (H1), below (L1, L2), or at median (M1, M2)

		H1	M1	M2	L1	L2
Income	Category	Above-median	Median	Median	Below-median	Below-median
Vegetation (*SD*)	% area	44 (16)	32 (11)	38 (0.2)	35 (7)	43 (11)
Temperature (*SE*)	°C	26.0 (0.06)	25.4 (0.08)	25.2 (0.06)	25.5 (0.06)	26.5 (0.07)
Parcel count	No.	234	251	211	432	532
Abandoned	% parcels	0	6	20	38	47
Vacant		1	1	1	14	5
KAP completed	No.	136	75	72	105	122
Income < $45,000	% responses	2	22	44	45	56
Income > $95,000		54	0	11	1	0
Owner		87	39	46	37	36
< High school		0	10	9	17	9
> High school		92	49	49	27	30
Use green space		67	33	40	24	13
Travel never		8	46	53	84	71
Travel more often than yearly		23	0	0	0	3

Note: KAP = knowledge, attitudes, and practice. Rows 1 through 6 summarize observed ecological or infrastructure conditions. Rows 7 through 15 summarize human survey responses.

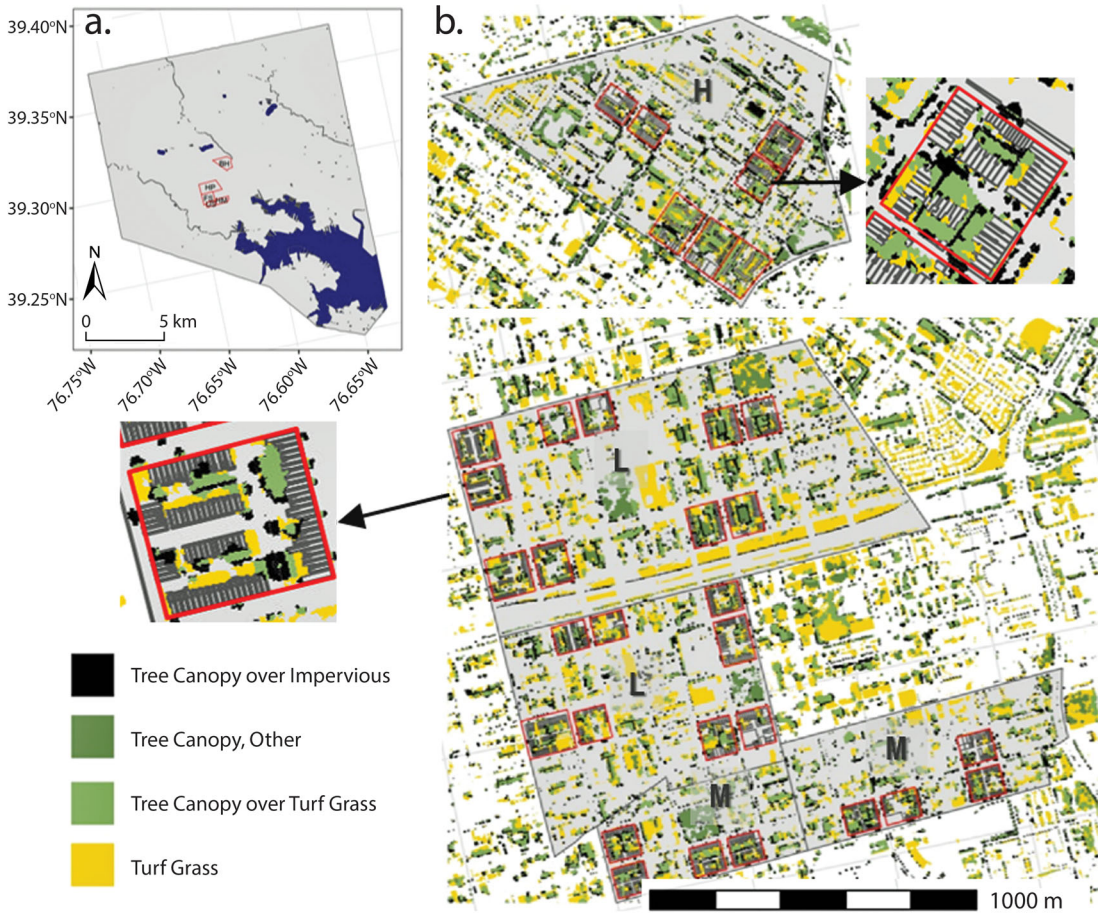

Figure 1. (A) Baltimore City boundary with focal neighborhoods highlighted in red. (B) Focal block clusters in red, shown with vegetation cover. Two enlarged blocks show vegetation and building details in one high- and one low-income neighborhood.

traps per block were placed to maximize distance between traps (> 50 m) and according to where researchers could establish property access. Traps were deployed for seventy-two hours every three weeks during the growing season (May–October). Batteries, dry ice, and catch bags were replaced every twenty-four hours. Mosquito catch bags were transported on dry ice and placed at −20 °C until processed. We use the mean abundances per trap night calculated at the block scale using data collected between 1 July and 30 August over the three years with consistent effort (2013–2015). Female mosquitoes from each trap were sorted by species and enumerated. For the purposes of this study, female abundance was summed across species (predominantly *Culex pipiens/restuans* and *Aedes* species) and also for just *A. albopictus* (tiger mosquito) females. The tiger mosquito is a predominant human-biting mosquito species found in temperate urban areas across the globe, including Baltimore City (Little et al. 2017; Rothman et al. 2021) and is a competent arboviral vector of dengue, chikungunya, and West Nile viruses (Turell et al. 2005; Delatte et al. 2008; McTighe and Vaidyanathan 2012; Vega-Rúa et al. 2014; Tsuda et al. 2016).

Data loggers (Thermocron IButton, 0.5dC resolution) were deployed in a five-meter radius of each mosquito trapping site and hourly temperature was recorded throughout the 2015 season. Each logger was secured one meter above the ground and data were downloaded roughly every sixty days. Our analyses consider daily, daytime, and nighttime mean temperatures, calculated from across all days between 1 July and 30 August 30.

Human KAP Surveys

The team designed a survey tool to evaluate KAP related to use of outdoor spaces, including experience with mosquito exposure in each neighborhood.

The KAP survey incorporated questions that were particularly useful in past survey work in the region (Dowling et al. 2013), was designed to take ten to fifteen minutes, and was optimized on a subset of volunteer resident participants in two neighborhoods in 2012 (LaDeau et al. 2013). Pairs of investigators visited each parcel on focal blocks across the five neighborhoods (Figure 1). In 2013, investigators approached all parcels across all focal blocks during the day (10:00 a.m.–4:00 p.m.) in July or August. A second round of visits was completed during July 2014 on specific focal blocks with less than 30 percent coverage from 2013 (Table 1). No individual parcel was sampled in both 2013 and 2014.

Perceived mosquito nuisance scores were generated from responses to four questions included in the KAP survey. The minimum score of 0 was increased by one for each positive answer to the following questions: "Are you ever bothered by mosquitoes?," "Are there mosquitoes on your property?," and "Do mosquitoes alter your outdoor activities?" Scores were increased by one if respondents ranked their level of concern about diseases carried by mosquitoes at 4 or 5 (on a 1–5 scale). Finally, scores were increased by four if respondents reported being bothered by mosquitoes every day, by three if they reported it as a weekly occurrence, two if monthly, and one if less than monthly. Nuisance scores could range from a low of 0 to a high of 8. We also asked residents who they thought should be responsible for managing mosquitoes, whether they had ever used the city's 311 line to report mosquito concerns, and to identify specific practices they engaged in to avoid or manage mosquito exposure when they were outside. As is the case for many U.S. cities, the 311 line is one of Baltimore City's most important sources of information for identifying where and when invasive and pest species are present.

The KAP tool was adjusted and redeployed on a subset of the focal blocks in 2016, using the protocols established in 2013. The initial survey asked respondents to identify whether anyone in their family spent time in a neighborhood park or community garden. In 2016, we revised this question to get more specific information about where people spend time outdoors: "Where do you or your family members spend the most time outside?" We also added a question to assess frequency of residents' international travel in 2016, in reference to growing concern with arboviral infections in the Caribbean at that time.

Both versions of the survey tool are available in the Supplemental Material. Our sampling design is likely to overrepresent participation by individuals who remain home during weekdays; we assume a similarly biased subsection of residents across neighborhoods. Only seven of the residents surveyed in 2016 self-identified as participants in 2013–2014, and we removed these seven resurveys from further analysis. We collected 374 unique resident surveys in the first round (2013–2014) and 131 additional surveys from new respondents in 2016, with coverage from 33.6 percent (±5.7 percent) and 14.8 percent (±5.2 percent) of the occupied parcels across our focal blocks in each time period.

Community-Engaged Activities

Photovoice is a research method that emerged from community-based participatory research and radical education (Wang and Burris 1994, 1997; Annang et al. 2016; Liebenberg 2018). Photovoice allows participants to become co-researchers documenting challenges and successes in their communities through visual reflection on concerns such as health and environmental justice (Aber et al. 2017; Brandt et al. 2017; Lam, Romses, and Renwick 2019; Lucke, Mamo, and Koenigstorfer 2019). Qualitative tools complement quantitative and geospatial approaches by eliciting residents' ground-level perspectives of hazards and the quality and lived experience of environmental amenities. Here we use Photovoice to investigate whether green features intended to benefit a community (amenities) actually do so and examine how residents perceived green spaces with different origins.

Many (150) residents who completed KAP surveys in 2013 indicated willingness to participate in further research activities. The research team contacted these residents by their preferred mode of communication (phone or e-mail) to recruit them for further activities. We also recruited participants through paid community liaisons and other known local contacts, by attending neighborhood association meetings, and with fliers posted in public locations. We offered three series of two sessions (orientation and photo sharing meetings) to accommodate participants. Digital cameras were loaned to all participants who needed one, and research personnel assisted participants in learning how to use the cameras and in uploading images and captions.

Participants were compensated with $15 for completing the orientation session and an additional $25 for completing the second session. Snacks and beverages were also served at the events. During the orientation session, personnel offered examples from past Photovoice projects in other locations and provided broad prompts to guide residents' selection of photo subjects. Participants were told to "Tell *your story* about where you live, work, and play and how this affects your health in good and bad ways," and asked, "How does your environment affect your health?" Participants also wrote a brief caption of one to two sentences for each photo and provided the location by parcel address or closest intersection. Participants took as many photos as they liked; all participants prepared at least ten captioned photos, but many shared more with or without captions.

At the second meeting, participants took turns sharing one photo and explaining why they selected it. The photo was projected on a large computer monitor. After each participant's explanation of their chosen photo, other participants discussed the photo and their own responses to it. Discussions of each photo averaged approximately fifteen minutes. Sessions were audio-recorded using digital equipment, and research personnel transcribed and coded the recordings using qualitative themes. Five themes were identified as appearing frequently both across different participants' photo sets and in the photo set overall.

Our research team further engaged nearly three dozen residents in non-Photovoice focus groups, attended community meetings to present about the research, contributed to summer camp and after-school programs for youth in our focal neighborhoods, funded neighborhood clean-up events, met monthly with paid community liaisons, and operated a citizen-science program that included free distribution of low-cost mosquito traps (Jordan, Sorensen, and Ladeau 2017; Biehler et al. 2018; Jordan et al. 2019). These activities provided us with thorough contextual understanding and sustained relationships with residents that aided in the interpretation of the data presented here.

We use the ecological data, survey data, Photovoice materials, and other community-oriented experiences to triangulate on the meanings and uses of green space in these neighborhoods. We employ visual and data summary tools to examine these different kinds of evidence and to synthesize understanding of how these communities experience green spaces in their neighborhoods. Negative binomial models (lme4 package) were used to compare mosquito abundances among neighborhoods while accounting for interannual variation and block-level sampling design. All data visuals and statistical summaries and analyses were completed in R (R Core Team). All data, raw or anonymized, are accessible through Cary Institute's Figshare repository (LaDeau et al. 2022).

Results

Neighborhood Demographics and Condition

Our a priori categorization of neighborhood incomes was generally supported by KAP survey responses (Table 1). For example, survey respondents from neighborhood H1 (above-median income) were most likely to (1) identify with the highest income category (> $95,000), (2) own their homes, (3) have attained more than a high school education; they were also more likely to (4) use local green spaces, and (5) travel internationally (Table 1). The two neighborhoods a priori categorized in the median income category differed from each other in proportions of respondents that reported receiving median-level incomes, however. Whereas 78 percent of responses from M1 were consistent with the median income categorization, fewer than half (45 percent) of households surveyed in M2 self-reported a median income, and a majority reported either the highest (11 percent) or lowest (44 percent) income category. Education and travel patterns were similar across M1 and M2, and were generally intermediate between reported levels from below-median and above-median income neighborhoods (Table 1). The percentages of residents having completed more than a high school education, using local parks and green spaces, and traveling internationally all declined with neighborhood income category (Table 1). There were also differences in racial identity composition of the populations across neighborhoods, reflecting different trajectories of segregation. Neighborhood populations in L1 and L2 were approximately 83 percent and 96 percent Black or African American, respectively, whereas M1 and M2 were both close to 76 percent, and H1 was 32 percent.

The vegetation (trees and turf) cover exceeded 30 percent in all focal neighborhoods, although it peaked at 44 percent and 43 percent in two neighborhoods at either end of the income gradient (Table 1). These two neighborhoods also had the highest tree canopy cover (H1 [35 percent, $SD = 13$] and L2 [30 percent, $SD = 9$]) and they represent both the lowest (0 percent of H1) and the highest (47 percent of L2) percentage of abandonment (parcels with boarded-up or roofless buildings; Table 1). Turf (grass) area peaked in L1 (16 percent, $SD = 5$), where the proportion of vacant (no building present) parcels was also high at 14 percent (Table 1). Increases in parcel abandonment were observed in three neighborhoods during the course of the study: M2 (+2 percent), L1 (+8 percent) and L2 (+10 percent). The percentage of abandoned parcels remained constant in H1 and M1.

The researcher-led sampling found mosquitoes present at all sampling dates and in all neighborhoods. Average female *Aedes* abundance per-trap-night in July and August (2013–2016) was 19 (± 1.3) in H1, 51 (± 3.73) in median, and 46 (± 2.4) in below-median household income neighborhoods. The mean per-trap-night abundance of female *Culex* was 7 (±0.7) in H1 and 8 (±8) and 12 (±1.2) across the median and below-median income neighborhoods, respectively. Female *Aedes* mosquito abundances were significantly higher in neighborhoods categorized as below-median versus either median ($z = 9.31$, $p < 0.001$) or above-median ($z = 9.11$, $p < 0.001$) income neighborhoods. Numbers of female *Culex* mosquitoes were also significantly higher in below-median versus median ($z = 2.12$, $p = 0.03$) and above-median ($z = 5.38$, $p < 0.001$) neighborhoods.

Many of the environmental measures were quite variable among blocks, even within income categories. Above-average temperatures for both daytime ($M = 27\,^{\circ}C$ across all blocks) and nighttime ($M = 24\,^{\circ}C$ across all blocks) were observed on only two of the thirteen focal blocks, one each from above-median and below-median income neighborhoods (Figure 2). Mean temperature, which was measured in a shaded location on all blocks, was not correlated with tree cover at the block scale (Pearson's correlation *ns*, 95 percent CI [−0.49, 0.65]). Tree cover was higher than average ($M = 27.5$ percent area) on five blocks, including two-thirds of blocks categorized as above-median, half of blocks categorized as median, and one-sixth of below-median income blocks. Hard tree canopy (tree canopy over impervious surface) was similarly distributed to total tree cover (Figure 2). Mosquito abundances were higher than average on the three lowest income blocks and on two higher income blocks located in each median income neighborhood (Figure 2). Mosquito numbers were consistently less than the regional mean on the three blocks categorized as above-median income. *Culex* species were a greater proportion of the observed mosquito abundance across the three highest income blocks (Figure 2).

Attitudes and Practices

Neighborhood income category was an important predictor of human use of spaces; residents from neighborhoods categorized at and above-median income were more likely to stay indoors to avoid mosquitoes, but also to report regular use of local parks and green spaces (Figure 3 A, 3B). Significantly lower percentages of households used neighborhood green spaces in below-median (80 percent fewer, $t = -6.64$, $p < 0.001$) and median (47% fewer, $t = -3.65$, $p < 0.001$) income neighborhoods. Respondents who reported household incomes less than $25,000 in 2016 were more likely to report spending time on the front stoop, a highly impervious, street-side location within these residential neighborhoods (-1.90, $z = -2.32$, $p = 0.02$, as compared to all respondents reporting income > $25,000). Wealth category was also negatively associated with the proportion of respondents who believed that vegetation (and not standing water) was an important source of nuisance mosquitoes (Figure 3C).

A majority of respondents from H1 (75 percent) reported that individual residents should be responsible for controlling mosquitoes, versus only 41 percent and 36 percent of respondents from median and below-median income neighborhoods, respectively. A greater proportion of residents living in H1 also reported taking action to remove or empty outdoor water containers to reduce juvenile mosquito habitat, relative to the rate of this reported practice in either median or below-median income neighborhoods (47 percent from above-median vs. 18 percent and 10 percent, respectively), $F(3, 10) = 34.6$, $p < 0.001$. This difference was not made up in the

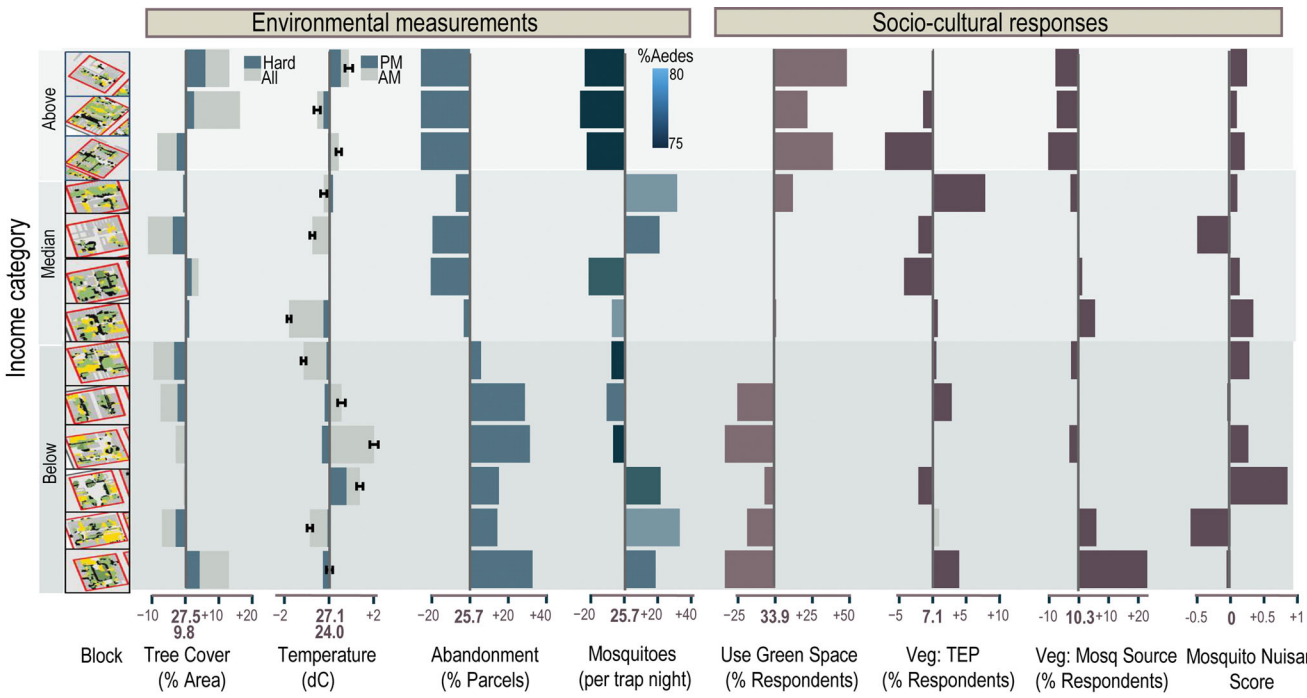

Figure 2. Environmental measurements and survey responses summarized at the scale of individual block clusters. All variables shown centered on mean values, shown in bold on *x*-axis. *Note:* TEP = Top Environmental Problem (see Figure 3d below).

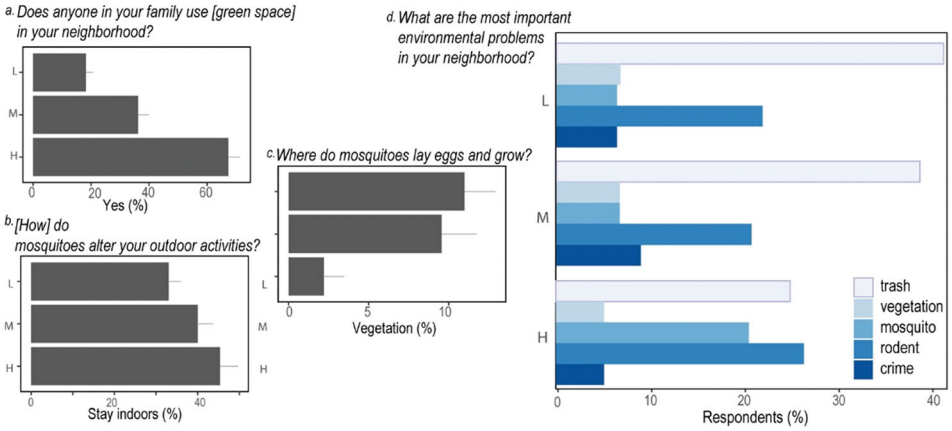

Figure 3. Answers to knowledge, attitudes, and practice (KAP) survey questions about (A) use of green spaces, (B) actions taken to avoid mosquitoes, (C) mosquito ecology, and (D) top environmental problems are summarized across respondents by income category: above ($n = 136$), median ($n = 178$), and below ($n = 264$).

proportion of respondents who expected city and state agencies to be responsible for mosquito management (ranging from 3 percent of responses from above-median to 12 percent from below-median income neighborhoods). A further 4 percent and 6 percent of respondents in below-median and median income neighborhoods, respectively, expressed the belief that only "nature" or "God" should be the arbiter of mosquito control.

Answers to the open survey question asking individuals to identify the most important environmental problems affecting their neighborhoods were associated into common themes, including abandoned buildings, crime, mosquitoes, rodents, trash, vegetation, and other. The problems that were most frequently cited across surveys were trash (37 percent of all respondents) and rodents (23 percent of all respondents). Ten percent of respondents listed

mosquitoes as a top environmental problem, although this was a more frequently cited issue at 20 percent for respondents in the above-median income neighborhood (Figure 3D). Crime was a top environmental problem reported by a maximum of 7 percent of respondents from median income neighborhoods and was less commonly cited by residents from neighborhoods in either the above- or below-median income categories (Figure 3D). Six percent of respondents cited vegetation as a top environmental problem, although frequency of this response was greater from both median and below-median income neighborhoods (Figure 3D).

Patterns in social perspectives across income categories were most evident at the scale of individual blocks. A majority of respondents (~80 percent) from the highest income block reported using public green spaces in their neighborhood and this declined to 0 percent of respondents on the lowest income block. Respondents from lower income blocks were more likely to identify vegetation as a primary source of mosquitoes (Figure 2; an observation supported by L. Yang et al. 2019). Respondents on four blocks reported mosquito nuisance with scores below average, although three of these were associated with higher than average mosquito abundances (Figure 2).

Photovoice and Participant-Observation and Community Activities

Sixteen community members completed the full, two-meeting Photovoice process. All participants except one were over the age of eighteen; there was one minor over age twelve who attended with a parent. Participants were evenly split between those who identify as Black (eight participants) and White (eight participants); four identified as male and twelve identified as female. These numbers reflect disproportionate representation of White residents, many of whom had moved to L1, M1, or M2 within the past ten years; most of the Black participants were part of families that had lived there for a few generations. Two participants were former residents who had recently moved out of the focal neighborhoods but remained active in community projects, returning to the neighborhood more than once per week to help run youth and church activities. Photovoice participants came from the L1, L2, M1, and M2 neighborhoods; no H1 residents responded to the invitation to participate.

We include only those photographs and quotations that address vegetation and green spaces in this article. Among the three sets of Photovoice workshops we held, participants submitted several dozen photographs encompassing varied subject matter, but a few themes emerged strongly. Other major topics of photographs and discussion included trash, empty buildings, and community resources. Where these topics overlapped with green space and vegetation, we included them here, but otherwise they will be included in a separate analysis and manuscript. We organize our discussion here according to participants' perceptions and narratives about green spaces, and three categories of green space based on intentions and community involvement in their creation. The three categories include green spaces that (1) were created intentionally but maintained inconsistently, (2) emerged through neglect or a lack of human intention, or (3) were created intentionally with resident involvement and maintenance.

Intentional Green Spaces with Inconsistent Investment. Several participants photographed green spaces or green infrastructure placed through intentional human activities, but where there was insufficient follow-through to achieve or maintain the intended outcome. The source of the intention matters; many of these spaces were initiated by entities from outside the community. A majority of participants in this study identified disappointment with specific projects and investments because of failures in maintenance. Many residents were keenly aware that well-intended projects require consistent maintenance and funding that their neighborhood had difficulty accessing but that have been sustained elsewhere. One such feature was a series of "man-made ponds that [were] erected in the mid-80s … now it's pretty much a pool of standing water and a bed of infestation for mosquitoes" (Figure 4A). These water features intended as amenities became hazards after decades of neglect. Two participants photographed an abandoned hoop house (a plant nursery structure for cold-season production) constructed on abandoned residential parcels by an urban greening advocate from outside the neighborhood. Instead of nurturing food for consumption by the community, the structure had deteriorated due to weather and vandalism. One participant commented,

> Someone with good intentions, they wanted to set up an area where people could farm and could grow some of their own food. And it pretty much looks

> abandoned at this point. There is a lot of trash strewn about, and the plastic sheeting is all ripped. It has looked this way for a long time. It was a nice idea but it doesn't look like it's been maintained.

Another resident who photographed the same hoop house noted, "This … was erected in 2013 and was viable until the funding bottomed out. Now it's abandon[ed] and rodent infested" (Figure 4B). This example illustrates the way greening can contribute to resident distrust due to insufficient funding and community consultation. (Later, a neighborhood-based group acquired this parcel, organized volunteers to clean it up, and gained sustainable funding for a youth farming enterprise.)

Participants believed the city was slow to send crews to trim or care for public trees across the focal neighborhoods, and residents themselves have limited funds to hire private arborists. Residents considered tree crowns as well as roots to be potential hazards. A longtime resident photographed trees that were outgrowing their street pits and causing sidewalks to buckle and crack. She stated, "To me this is an eyesore and something very irritating to me when I walk down a sidewalk. … I do most of my traveling by walking. … Not only is this dangerous and may be the cause of an injury, but I don't know how it can be fixed unless the tree is uprooted" (Figure 4C). One resident contributed a photo of the aftermath of a storm, with tree branches scattered in the street along with broken glass that, because of limited attention from sanitation services, might remain there indefinitely. The resident was worried about the hazard to children and pets who play or roam in the street. Other residents reported gathering branches after storms and worrying that the next storm would send a branch through their own windows (Figure 4D). Residents also noted other injuries to trees, including one impaled by a metal plate, which suggested to her that even trees faced high risk of injury in this community (Figure 4E).

In addition to the specific examples of intentional green spaces, participant-observation and community engagement revealed numerous instances in which residents experienced stress or suspicion related to green spaces. In a community association meeting, neighborhood leaders and other residents repeatedly questioned landscape architects presenting about a new tree-planting project regarding funding to maintain existing trees. A participant in a focus group compared vegetation in the study neighborhoods with vegetation she had seen in affluent Baltimore neighborhoods or suburban parks. "I know what trees are supposed to look like," she explained, indicating that other neighborhoods received more support to care for trees, leading to more inviting green spaces there. Another community association president requested assistance from one of the authors in cleaning up stormwater mitigation features that were installed as a green infrastructure project by a city

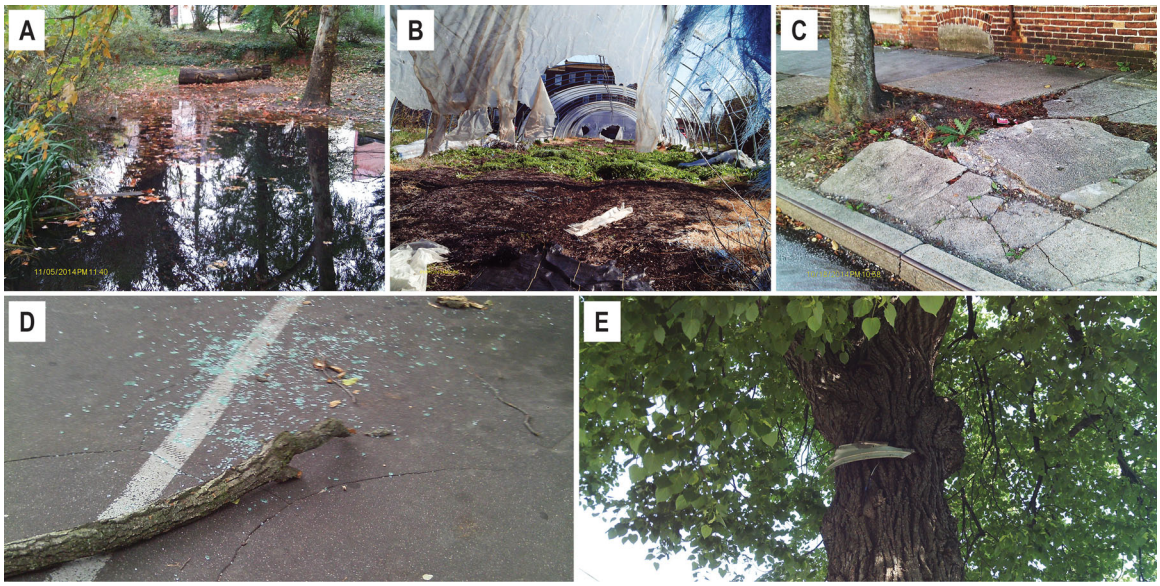

Figure 4. Intentional green spaces with inconsistent investment.

agency. It took about a dozen students from a university class an entire morning to complete required maintenance on these features, labor for which the community association is otherwise responsible.

Unintended Green Spaces. This section focuses on green spaces where vegetation has grown with limited or no human intention and management. Intentionally planted street trees could lead to cracks and other hazards on sidewalks as described earlier, but in some places neglect by city services was so severe that additional invasive plants encroached on sidewalks, leaving only a narrow passage (Figure 5A). Furthermore, whereas municipal and other community agencies do mow some vacant lots, other vacant lots are left to opportunistic plant establishment and growth. Neighborhood residents concerned about rats, mosquitoes, illicit drug activity, and other dangers avoid such areas. Some who photographed vacant lots focused on trash that collected in these green spaces, tossed by passersby, or dumped in larger quantities by haulers seeking to avoid waste disposal fees. Collectively, residents expressed a conventional wisdom that vacant lots that seemed managed and actively used would attract less littering and illegal dumping. A simple grass lot, even if mowed, was seen as an invitation for trash (Figure 5B).

In many cases, residents interpreted unmanaged vegetation as a constant and unwelcome signal of the city's neglect. For example, two participants, a longtime elderly resident and her adult daughter, took numerous photos of the fronts and backs of abandoned and boarded-up houses (e.g., Figure 5C and 5D). At the time they lived in a house the mother had inherited from her parents, where they hoped to stay, but in discussing their photos of houses, they expressed deep concern for the future of the neighborhood and local government's role in sustaining or abandoning the community: "What are the city's plans?" The photos of the backs of houses often showed trees outgrowing the buildings, vines wrapping around utility poles and wires, and dense shrubbery blocking backyards. These photos might resemble the "ruin porn" genre of documentary photography that romanticizes the depopulation and greening of cities such as Detroit, which geographers and other scholars have criticized, but these participants clearly did not consider such scenes aesthetically positive (Millington 2013; Safransky 2014; Arnold 2015). In addition to these two related individuals, several other participants also recorded abandoned, heavily vegetated spaces as disamenities (Figure 5E).

Green Spaces with Evidence of Long-Term Sustainability and Public Engagement or Individual Agency. Participants identified many green spaces that caused stress and detracted from their sense of control and comfort in the neighborhood, but they also highlighted what they considered positive greening activities that they found inviting and well maintained. Many of these greening activities responded to the demolition and deconstruction of

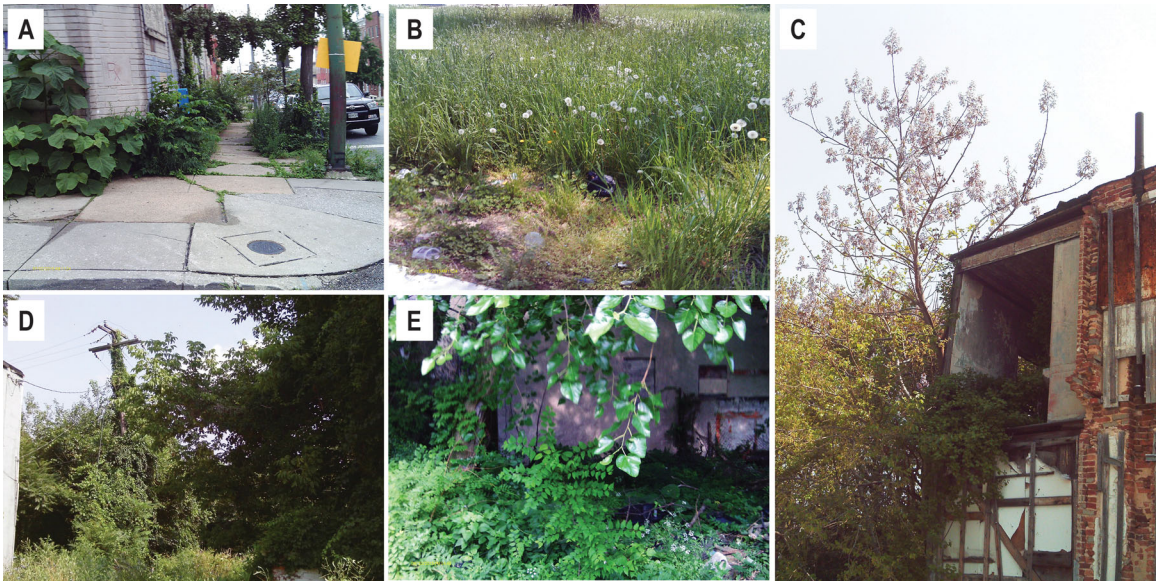

Figure 5. Unintentional green spaces.

existing residential buildings. The most often mentioned positive green space was a garden containing multimedia public art spanning three contiguous abandoned parcels across from the park in the L1 neighborhood. In addition to public sculpture and murals, a mix of annual and perennial vegetation grow along footpaths; small retention pools collect rainwater. It took the community association, the church across the street, faculty and students at the nearby arts college, and additional volunteers several years to secure permission to redesign these lots and to implement the design; it continues to require constant upkeep. A participant said of the garden, "The flower garden mural is such inspiration in the area and a joy to see as one passes each visit. Always a brightening moment in this community" (Figure 6A).

Alongside this highly visible garden and mural project, current residents and former residents with continuing ties to the neighborhood were positive regarding a new playground and youth development project in the middle of four blocks where most houses and businesses have been demolished. A participant who has since left the neighborhood but remains active in the church explained, "This area has been newly developed and has actually improved the neighborhood" by providing space for children and youth of many ages to congregate (Figure 6B). Participants also cited a community food garden that turned former residential parcels into a valuable and visually attractive community resource. "This is an open lot that used to be abandoned houses that were torn down. This is now a field with growing corn that benefits our community," explained a longtime resident about her photo of the garden (Figure 6C).

Participants also recognized spaces where individuals had made extra effort to beautify the neighborhood or transform spaces once seen as negative. One participant introduced her "photo of an open lot I am proud of in my community," explaining how the homeowner on the parcel next door had transformed the space. "The lawn is beautiful," she noted, "no trash, or junk throw[n] here. There was a time that this was rock, sand, and trash. I hope it stays this way" (Figure 6D). Another resident who focused on individual contributions to community beautification explained of one photo, "My favorite is this one, seeing the roses and the trees and the greenery." This photo showed the side yard of a row house where passersby could see and smell the fruits of the homeowner's labor in a small garden (Figure 6E). Another example of this pride and persistence came from community members who received small-grant funding through our project, which was awarded to support greening of a vacant lot in neighborhood L2. The creators of this garden stated:

> You see something decent going up and then what usually happens is the people disappear and funding runs out. So it was very important for us to be back and for people to see us back here. We ain't going nowhere. … It's important that we're from the neighborhood, we're Black men. Lower to middle class men of the neighborhood did this (Figure 6F).

It is possible, and important to note, that not all community-led greening activities were universally reviewed as amenities. Cultural meanings of green are nuanced and not unanimous even within a neighborhood. Participants seldom expressed disagreements about a green space, but sometimes individuals praised a green space that bore characteristics that others had criticized in another photo. For example, the participant who praised a rose bush also took pictures of unadorned lawns that she considered negative for their emptiness and sterility. To her, the roses conveyed planning and proactive aesthetic investment in the community in a way that simply mowing did not. Yet she did not make negative comments when other residents praised a lawn they photographed. Complete consensus about positive green spaces might not be possible in any community, but Photovoice discussions suggested willingness to compromise among residents as long as community agency was involved.

Discussion

Our integration of multiple lines of evidence across scales of individual blocks to broad income categories emphasizes the complexity and context of urban greening. For example, although there are clear physical laws governing how vegetation and impervious surfaces influence heat exchange, incrementally more green is not always associated with positive cooling impacts. Vegetation plays an important role in sustainable urban landscapes, but the process of intentionally maintaining green spaces is as critical to success as is the initial establishment and investment. Heat exposure and flooding are growing climate risks for urban residents, and

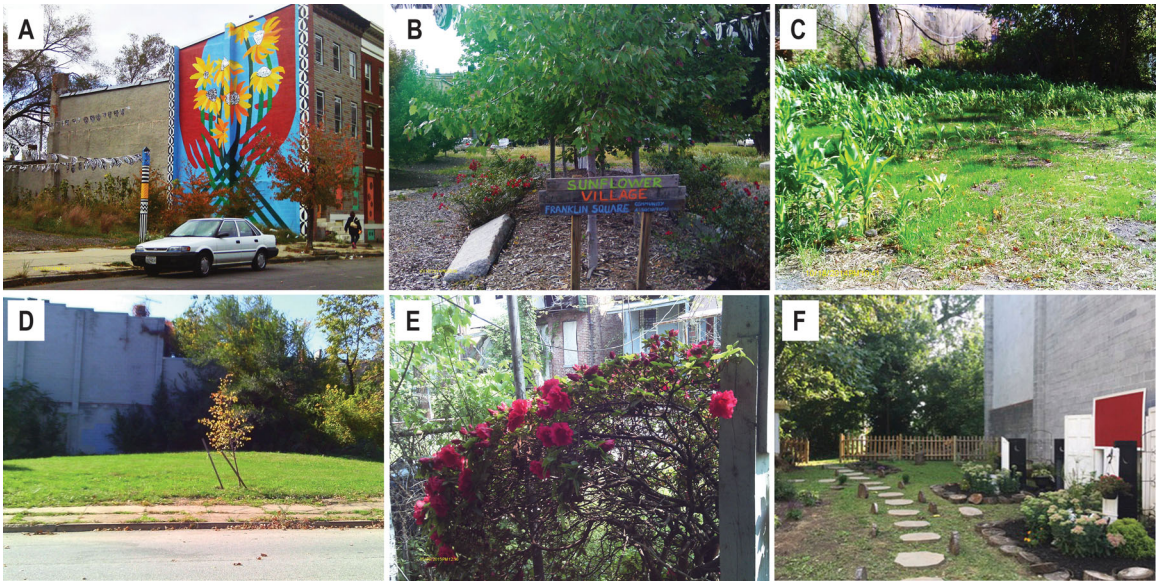

Figure 6. Green spaces with evidence of community engagement or individual agency.

replacing impervious surfaces with ecological function is critical (Wolf et al. 2020; Y. Yang et al. 2023). Removing impervious or built surfaces, however, leaves land vulnerable to opportunistic succession by locally present or rapidly dispersing species, which often perpetuates a community assemblage of weedy and nuisance organisms. Our data corroborate findings that invasive plants, rodents, and potential disease vectors and nuisance species are predominant components of opportunistic community assembly in disadvantaged urban neighborhoods (LaDeau et al. 2013; Lewis et al. 2017; Little et al. 2017; Ghersi et al. 2020; Peterson et al. 2020). In neighborhoods where the parcel abandonment rate was high, residents were less likely to identify parks and green spaces as local amenities, and were more likely to identify vegetation as either a top environmental problem or a source of mosquitoes and rodent pests. Survey respondents from wealthier neighborhoods and blocks with low rates of abandonment were more likely to take action to reduce mosquito populations locally and to report likely mosquito sources to the city. This is an important metric because pest control in Baltimore City, as in many cities across the United States, is performed only in response to reported nuisance (Baltimore City Department of Environmental Health, personal communication 2017).

Furthermore, our analysis supports some overarching conclusions that should guide further discussion and change across research, policy, and design audiences. Most broadly, those who advocate for greening must acknowledge that (re)incorporating self-sustaining vegetation communities into cities brings both risk and benefit to local residents. On the "risk" side, our examination of environmental data and residential experiences identifies both mental stressors and potential physical health risks when residents are exposed to opportunistic ecological succession and inadequate maintenance of urban vegetation. Also, the source of both initiative and resources for greening matters tremendously in shaping effects for humans. These characteristics of urban green spaces are most evident and persistent in urban neighborhoods with historical and continuing disinvestment by officials at multiple levels of government (Carmichael and McDonough 2018; Shcheglovitova 2020; Garrett 2023). In other words, green spaces created by uneven urban development and the resulting "churn" of land uses are part of the landscape of environmental injustice in cities (Smith 1990; Frickel and Elliott 2018).

We found that peoples' experiences with and perceptions of local vegetation features in their neighborhoods informed a suite of community priorities and actions. Residents surveyed in this study did not celebrate nature "reclaiming" the city but felt the loss of human communities. Such attitudes sometimes corresponded with accusations that the city was attempting to drive residents out by neglecting conditions there, which could lead to different land uses such as sale of parcels to private developers.

Indeed, many of the residents with whom we engaged intended to relocate. Survey respondents and Photovoice participants identified vegetation as an environmental stressor; even currently maintained vegetation was viewed as a source of potential future disorder. This suspicion was supported by overwhelming visual cues of neglect and abandonment. The Baltimore City residents with whom we engaged recognized inconsistent outside investment in well-intentioned green spaces.

Some responded to repeated failures by government and environmental nongovernmental organizations (NGOs) with a sense of resignation. Others expressed determination to invest their own time, energy, and funds to create meaningful green spaces; this care work is vital to what positive outcomes these communities enjoy, and it is seldom recognized in discussions of expanded tree canopy or other ecological amenities (Kotsila et al. 2020; Shcheglovitova 2020; Garrett 2023). Research on both public parks and private green spaces indicates similar reliance on the unpaid or poorly paid labor of Black or Latinx workers under current regimes of land management (Park and Pellow 2011; Krinsky and Simonet 2017), but in this case there is an element of self-reliance, prompted under the duress of neglect and insensitive management of outsiders. Many residents in our study opposed outside greening projects (including some by academic institutions) as undermining homegrown efforts.

Some community members shared vivid memories of various features—from recreation centers to gardens to street trees—that were historically meaningful and useful, but now detract from the neighborhood. The degradation of these features constantly reminded residents of their lower status and priority level for city planners compared to areas that enjoyed the privilege of well-maintained green spaces (Park and Pellow 2011). Residents believed that municipal government *should* bear responsibility for health and environmental conditions, but they perceived that city government focused its resources in more affluent neighborhoods (Jordan et al. 2019). Furthermore, in many cases degraded features became a hindrance to mobility, as in the case of unmaintained street trees whose roots disrupted walkways. Residents compared current hazards to new infrastructure proposals and projects when judging likely benefits for the community. Their reflections on such experience tell them that many proposed "improvements" will fail and become eyesores and even dangers. Similarly, residents' experiences with nuisance species, including mosquitoes, influenced their perception and use of the local environment, but social contexts had a large impact on how they prioritized and acted on concerns about mosquito exposure and abundance. Survey respondents were less likely to prioritize mosquitoes as a nuisance in the places where the mosquitoes were just one of many, often more persistently visible, hazards or disamenities, whereas respondents in environmentally privileged areas focused their self-advocacy on mosquito abatement. On blocks where deteriorating infrastructure and crime were visible cues of the local social condition, respondents were more likely to consider mosquitoes as an acceptable or "natural" exposure risk. In many cities, early detection and management of nuisance species often depends on resident complaints, and entire mosquito control programs could be designed around the spatial distribution of nuisance reports. Thus, concern and perception of risk have important implications for potential detection and control of emergent health risks, such as vector-borne disease. Likewise, the perception that outdoor spaces are dangerous due to pest exposure and or issues with dense or destructive vegetation growth influences what people expect from and are willing to contribute to sustainable greening efforts.

An ongoing sustainable city movement has heralded widespread investment to increase tree and vegetation cover in cities across the globe. Yet, this movement has grown without a clear map for assessing the multidimensional outcomes of greening, including the integrated social and ecological impacts experienced by local residents also dealing with systemic racism in urban planning. We address this need with a framework for assembling diverse types of evidence to triangulate on the social contexts and impacts of greening processes, residents' experiences and use of green space, and the way greening intersects with other ecological changes such as establishment of undesired species. All lines of evidence reinforce the conclusion that all green spaces are not the same. Tree canopy and total vegetation cover was near or above 30 percent of area across our focal neighborhoods but how that vegetation functions was influenced by associated cues of maintenance and care. Despite the well-documented cooling potential of urban tree canopy (Ramamurthy

and Bou-Zeid 2017; Alonzo et al. 2021), this was not an amenity that we were able to document at the scale of our residential urban blocks.

Evaluation of urban greening must pay greater attention to both the multidimensional indicators of impact and to how outcomes relate to specific neighborhood contexts and greening processes. Such assessment requires greater attention to the multiple social and ecological metrics of impact, within specific neighborhood contexts and greening processes. Ecological outcomes such as water infiltration might be similar across intentional and unintentional green spaces of similar areas, and yet the process shaping that green space could have very different impacts on residents' value perceptions or experienced health outcomes. These perceptions are likely to have lasting impact on sustainability of effective investment in green infrastructure. Property abandonment is particularly high in neighborhoods with long histories of racial segregation, where discrimination in credit and investment lead to low wealth accumulation and local population decline. Plants rapidly reclaim abandoned spaces, new vegetation is dominated by opportunistic and often less desirable species, such as invasive tree species like tree-of-heaven (*Ailanthus altissima*) and weedy nuisances like poison ivy (*Toxicodendron radicans*) and thistle (*Cirsium* spp; Lewis et al. 2017). Abandoned property is also an opportunity for targeted investment in NGO and municipal tree-planting and green infrastructure goals, which most often target benefits for function at citywide spatial scales (Rosan 2012; Wachsmuth and Angelo 2018; Angelo et al. 2024). Whereas planners, scholars, and sustainability advocates see potential benefits of vacant land for making urban nature more accessible, people who live amidst unintentional or unmanaged greening have varied experiences.

In addition to addressing varied outcomes, the urban greening movement must also grapple with the history of environmental racism, including the use of green spaces and trees as part of racial segregation and displacement activities, or as a "fix" for capital in shrinking neighborhoods (D. Taylor 1999; Merse, Buckley, and Boone 2008; Baltimore Heritage 2018; Loughran 2022). Many sustainability advocates and urban planners treat neighborhoods with high rates of abandonment as "blank slates" for greening (Safransky 2014; D. Taylor 2014). In the United States, such places are often majority-Black communities where long histories of official neglect and segregation by government agencies and other would-be investors have fueled property abandonment. Recent scholarship has linked urban environmental conditions with historical redlining practices, often relying on 1937 Home Owners' Loan Corporation maps. The historical moment of redlining is a mere snapshot, though, and relying on redlining alone to explain segregation deemphasizes earlier policies through which government officials, realtors, banks, and homeowners' associations established segregation patterns, such as racial covenants, outright bans on selling homes to Black buyers in certain neighborhoods, and even threats by White residents. Explanations focused on redlining also overlook ongoing activities that continue to limit opportunities for racially excluded and marginalized communities to experience benefits of urban greening (Hillier 2003; Jesdale, Morello-Frosch, and Cushing 2013; Berland et al. 2020; Black and Richards 2020; Philips de Lucas 2020; L. Brown 2021; Winling and Michney 2021; Gioielli 2022; Planas-Carbonell et al. 2023). Indeed, the 1937 redlining maps overlaid and reinforced the preexisting geography of race, justified through the appearance of decline ensured by earlier policies and actions (Reid 1934). City planners have since then justified further decisions to disinvest or seize land on the basis of conditions created by prior rounds of disinvestment, as in the use of "urban renewal" for housing demolition with replacement by unmanaged "parks" in these neighborhoods in the 1960s (Baltimore Heritage 2024). Furthermore, areas redlined in 1937 (including ones in this study) have experienced varying degrees of reinvestment, resulting in quite different trajectories toward environmental privilege versus growing environmental injustice (Merse, Buckley, and Boone 2008; K.-Y. Taylor 2019; Pickett and Grove 2020). When programs place green spaces and trees in historically marginalized neighborhoods without deep, authentic engagement of local communities, they risk repeating historic injustices.

As states such as Maryland set benchmarks and allocate millions of dollars for urban tree planting, there is much promise and peril in our current moment of urban greening. Not only state-level policies, but also the federal Justice 40 framework, aim to distribute resources to communities that have been subjected to racist harm for decades. While these larger scale initiatives gain prominence, city officials continue to operate under powerful disincentives against supporting community management by ongoing residents. Officials often cite falling property values and stagnant housing markets as reasons

not to invest in longtime residents' planning efforts, a rationale that builds on decades of disinvestment, just as redlining in the 1930s built on previous uneven development by racial segregation. Meanwhile, the search for higher property tax revenues motivates city infrastructure funding for neighborhoods deemed more promising for growth, reinforcing patterns of green privilege.

This research has aimed to emphasize the importance of gathering and analyzing multiple strands of evidence, including aligned ecological data and resident-generated responses, to understand community experiences of green spaces. Green spaces are a vital environmental justice issue for residents of disinvested neighborhoods. Adequate external support for resident development and maintenance of such spaces is a form of empowerment that can alleviate stress and promote meaningful food production, community gathering and recreation, and aesthetic control and expression. Official neglect of such spaces, or creation of green spaces without adequate ongoing support, however, entrenches existing stresses and limits the many potential positive uses of open space. Such insights would not be accessible to researchers without collection of multiple types of data that include opportunities for residents to express values and judgements. Similar deep, iterative, and community-driven forms of development and evaluation will be necessary to sustain environmentally just urban greening.

Acknowledgments

The authors thank the residents and community leaders of West and Southwest Baltimore for giving so much time and insight. Heather Goodman provided invaluable organization and leadership on the ground. We acknowledge several graduate and undergraduate students who helped collect data and engage with community groups throughout the duration of this project, including Danielle Bodner, Eliza Little, Megan Saunders, and Amanda Sorensen. Thanks to Steward Pickett for helpful feedback. Thanks also to the editors and anonymous reviewers.

Funding

This work was made possible through funding from the National Science Foundation (LTER and former CNH programs), the University of Maryland, and the Cary Institute of Ecosystem Studies.

Disclosure Statement

No potential conflict of interest was reported by the authors.

References

Aber, A., N. Waxman, A. Khatib, A. Bamfo, D. Simon-Ogan, and S. Wilson. 2017. Use of photovoice to highlight environmental justice issues: The power of photography in buzzard point, Washington, DC. *Environmental Justice* 10 (2):36–42. doi: 10.1089/env.2016.0042.

Ahmann, C. 2022. Postindustrial futures and the edge of the frontier. *Anthropological Quarterly* 95 (2):277–309. doi: 10.1353/anq.2022.0016.

Alonzo, M., M. E. Baker, Y. M. Gao, and V. Shandas. 2021. Spatial configuration and time of day impact the magnitude of urban tree canopy cooling. *Environmental Research Letters* 16 (8):084028. doi: 10.1088/1748-9326/ac12f2.

Anderson, E. C., D. H. Locke, S. T. A. Pickett, and S. L. LaDeau. 2023. Just street trees? Street trees increase local biodiversity and biomass in higher income, denser neighborhoods. *Ecosphere* 14 (2):e4389. doi: 10.1002/ecs2.4389.

Angelo, H. 2019. Added value? Denaturalizing the "good" of urban greening. *Geography Compass* 13 (8):e12459. doi: 10.1111/gec3.12459.

Angelo, H., K. MacFarlane, J. Sirigotis, and A. Millard-Ball. 2024. Missing the housing for the trees: Equity in urban climate planning. *Journal of Planning Education and Research* 44 (3):1415–30. doi: 10.1177/0739456X211072527.

Anguelovski, I., J. J. T. Connolly, H. Cole, M. Garcia-Lamarca, M. Triguero-Mas, F. Baró, N. Martin, D. Conesa, G. Shokry, C. P. Del Pulgar, et al. 2022. Green gentrification in European and North American cities. *Nature Communications* 13 (1):3816. doi: 10.1038/s41467-022-31572-1.

Annang, L., S. Wilson, C. Tinago, L. Wright Sanders, T. Bevington, B. Carlos, E. Cornelius, and E. Svendsen. 2016. Photovoice: Assessing the long-term impact of a disaster on a community's quality of life. *Qualitative Health Research* 26 (2):241–51. doi: 10.1177/1049732315576495.

Arnold, S. 2015. Urban decay photography and film: Fetishism and the apocalyptic imagination. *Journal of Urban History* 41 (2):326–39

Baak-Baak, C. M., R. Arana-Guardia, N. Cigarroa-Toledo, M. A. Loroño-Pino, G. Reyes-Solis, C. Machain-Williams, B. J. Beaty, L. Eisen, and J. E. García-Rejón. 2014. Vacant lots: Productive sites for *Aedes* (Stegomyia) *aegypti* (Diptera: Culicidae) in Merida City, Mexico. *Journal of Medical Entomology* 51 (2):475–83. doi: 10.1603/me13209.

Baltimore Heritage. 2018. Preston Gardens. Accessed June 6, 2024. https://explore.baltimoreheritage.org/items/show/71.

Baltimore Heritage. 2024. Harlem Park. Accessed June 6, 2024. https://baltimoreheritage.org/programs/harlem-park/.

Berland, A., D. H. Locke, D. L. Herrmann, and K. Schwarz. 2020. Beauty or blight? Abundant vegetation in the presence of disinvestment across residential parcels and neighborhoods in Toledo, OH. *Frontiers in Ecology and Evolution* 8:566759. doi: 10.3389/fevo.2020.566759.

Biehler, D., J. Baker, J. H. Pitas, Y. Bode-George, R. Jordan, A. Sorensen, H. Goodman, S. Wilson, M. Saunders, D. Bodner, et al. 2018. Beyond "the mosquito people": The challenges of engaging community for environmental justice in infested urban spaces. In *The Palgrave handbook of critical physical geography*, ed. R. Lave, C., Biermann, and S. Lane, 295–318. Cham, Switzerland: Palgrave Macmillan.

Black, K. J., and M. Richards. 2020. Eco-gentrification and who benefits from urban green amenities: NYC's High Line. *Landscape and Urban Planning* 204:103900. doi: 10.1016/j.landurbplan.2020.103900.

Brandt, H., V. Haynes, E. Venice, L. Rice, D. Campbell, E. Williams, S. Wilson, and S. Glover. 2017. Using Photovoice as a tool for community engagement to assess the environment and explore environmental health disparities. *Journal of Health Disparities Research and Practice* 10 (3):68–86.

Brown, H., K. Proust, B. Newell, J. Spickett, T. Capon, and L. Bartholomew. 2018. Cool communities—Urban density, trees, and health. *International Journal of Environmental Research and Public Health* 15 (7):1547. doi: 10.3390/ijerph15071547.

Brown, L. 2021. *The black butterfly: The harmful politics of race and space in America*. Baltimore, MD: Johns Hopkins University Press.

Carmichael, C., and M. McDonough. 2018. The trouble with trees? Social and political dynamics of street tree-planting efforts in Detroit, Michigan, USA. *Urban Forestry & Urban Greening* 31:221–29. doi: 10.1016/j.ufug.2018.03.009.

Chesapeake Bay Program Office (CBPO). 2022. One-meter resolution land use/land cover dataset for the Chesapeake Bay Watershed, 2013/14. CBPO, Annapolis, MD.

Chuang, W. C., C. G. Boone, D. H. Locke, J. M. Grove, A. Whitmer, G. Buckley, and S. N. Zhang. 2017. Tree canopy change and neighborhood stability: A comparative analysis of Washington, DC and Baltimore, MD. *Urban Forestry & Urban Greening* 27:363–72. doi: 10.1016/j.ufug.2017.03.030.

Cole, H. V. S., M. G. Lamarca, J. J. T. Connolly, and I. Anguelovski. 2017. Are green cities healthy and equitable? Unpacking the relationship between health, green space and gentrification. *Journal of Epidemiology and Community Health* 71 (11):1118–21. doi: 10.1136/jech-2017-209201.

Davis, A. Y., J. H. Jung, B. C. Pijanowski, and E. S. Minor. 2016. Combined vegetation volume and "greenness" affect urban air temperature. *Applied Geography* 71:106–14. doi: 10.1016/j.apgeog.2016.04.010.

de Guzman, E., R. Malarich, L. Large, and J. A. Danoff-Burg. 2018. Inspiring resident engagement: Identifying street tree stewardship participation strategies in environmental justice communities using a community-based social marketing approach. *Agriculture and Urban Tree Forestry* 44 (6):291–306.

de Guzman, E., E. Wohldmann, and D. Eisenman. 2023. Cooler and healthier: Increasing tree stewardship and reducing heat-health risk using community-based urban forestry. *Sustainability* 15 (8):6716. doi: 10.3390/su15086716.

De Souza, D. T., and P. H. C. Torres. 2021. Greening and just cities: Elements for fostering a south–north dialogue based on a systematic literature review. *Frontiers in Sustainable Cities* 3:669944. doi: 10.3389/frsc.2021.669944.

Delatte, H., C. Paupy, J. S. Dehecq, J. Thiria, A. B. Failloux, and D. Fontenille. 2008. *Aedes albopictus*, vector of Chikungunya and dengue viruses in Reunion Island: Biology and control. *Parasite* 15 (1):3–13. doi: 10.1051/parasite/2008151003.

Dowling, Z., P. Armbruster, S. L. LaDeau, M. DeCotiis, J. Mottley, and P. T. Leisnham. 2013. Linking mosquito infestation to resident socioeconomic status, knowledge, and source reduction practices in suburban Washington, DC. *EcoHealth* 10 (1):36–47. doi: 10.1007/s10393-013-0818-6.

Drew-Smythe, J. J., Y. C. Davila, C. M. McLean, M. C. Hingee, M. L. Murray, J. K. Webb, D. W. Krix, and B. R. Murray. 2023. Community perceptions of ecosystem services and disservices linked to urban tree plantings. *Urban Forestry & Urban Greening* 82:127870. doi: 10.1016/j.ufug.2023.127870.

Eisenman, T. S., T. Flanders, R. W. Harper, R. J. Hauer, and K. Lieberknecht. 2021. Traits of a bloom: A nationwide survey of US urban tree planting initiatives (TPIs). *Urban Forestry & Urban Greening* 61:127006. doi: 10.1016/j.ufug.2021.127006.

Flores, S., C. Van Mechelen, J. P. Vallejo, and K. Van Meerbeek. 2022. Trends and status of urban green and urban green research in Latin America. *Landscape and Urban Planning* 227:104536. doi: 10.1016/j.landurbplan.2022.104536.

Frickel, S., and J. Elliott. 2018. *Sites unseen: Uncovering hidden hazards in American cities*. New York: Russell Sage Foundation.

Gallay, I., B. Olah, V. Murtinová, and Z. Gallayová. 2023. Quantification of the cooling effect and cooling distance of urban green spaces based on their vegetation structure and size as a basis for management tools for mitigating urban climate. *Sustainability* 15 (4):3705. doi: 10.3390/su15043705.

Garrett, C. L. 2023. Greenwork: The devaluation of labor when caring for nature. *City & Community* 22 (4):330–51. doi: 10.1177/15356841231182071.

Ghersi, B. M., A. C. Peterson, N. L. Gibson, A. Dash, A. Elmayan, H. Schwartzenburg, W. H. Tu, C. Riegel, C. Herrera, and M. J. Blum. 2020. In the heart of the city: *Trypanosoma cruzi* infection prevalence in rodents across New Orleans. *Parasites & Vectors* 13 (1):577. doi: 10.1186/s13071-020-04446-y.

Gioielli, R. 2022. The tyranny of the map: Rethinking redlining. The Metropole. https://themetropole.blog/2022/11/03/the-tyranny-of-the-map-rethinking-redlining/#_edn23.

Grove, M., L. Ogden, S. Pickett, C. Boone, G. Buckley, D. H. Locke, C. Lord, and B. Hall. 2018. The legacy effect: Understanding how segregation and environmental injustice unfold over time in Baltimore. *Annals of the American Association of Geographers* 108 (2):524–37. doi: 10.1080/24694452.2017.1365585.

Gulachenski, A., B. M. Ghersi, A. E. Lesen, and M. J. Blum. 2016. Abandonment, ecological assembly and public health risks in counter-urbanizing cities. *Sustainability* 8 (5):491. doi: 10.3390/su8050491.

Hillier, A. E. 2003. Redlining and the Home Owners' Loan Corporation. *Journal of Urban History* 29 (4):394–420. doi: 10.1177/0096144203029004002.

Hoover, F. A., S. Meerow, E. Coleman, Z. Grabowski, and T. McPhearson. 2023. Why go green? Comparing rationales and planning criteria for green infrastructure in US city plans. *Landscape and Urban Planning* 237:104781. doi: 10.1016/j.landurbplan.2023.104781.

Imhoff, M. L., P. Zhang, R. E. Wolfe, and L. Bounoua. 2010. Remote sensing of the urban heat island effect across biomes in the continental USA. *Remote Sensing of Environment* 114 (3):504–13. doi: 10.1016/j.rse.2009.10.008.

Jennings, V., and C. J. Gaither. 2015. Approaching environmental health disparities and green spaces: An ecosystem services perspective. *International Journal of Environmental Research and Public Health* 12 (2):1952–68. doi: 10.3390/ijerph120201952.

Jennings, V., L. Larson, and J. Yun. 2016. Advancing sustainability through urban green space: Cultural ecosystem services, equity, and social determinants of health. *International Journal of Environmental Research and Public Health* 13 (2):196. doi: 10.3390/ijerph13020196.

Jesdale, B. M., R. Morello-Frosch, and L. Cushing. 2013. The racial/ethnic distribution of heat risk-related land cover in relation to residential segregation. *Environmental Health Perspectives* 121 (7):811–17. doi: 10.1289/ehp.1205919.

Jordan, R. C., A. E. Sorensen, D. Biehler, S. Wilson, and S. LaDeau. 2019. Citizen science and civic ecology: Merging paths to stewardship. *Journal of Environmental Studies and Sciences* 9 (1):133–43. doi: 10.1007/s13412-018-0521-6.

Jordan, R. C., A. E. Sorensen, and S. Ladeau. 2017. Citizen science as a tool for mosquito control. *Journal of the American Mosquito Control Association* 33 (3):241–45. doi: 10.2987/17-6644R.1.

Kirkpatrick, L. 2015. Urban triage, city systems, and the remnants of community: Some "sticky" complications in the greening of Detroit. *Journal of Urban History* 41 (2):261–78. doi: 10.1177/0096144214563503.

Kondo, M. C., S. C. Low, J. Henning, and C. C. Branas. 2015. The impact of green stormwater infrastructure installation on surrounding health and safety. *American Journal of Public Health* 105 (3):E114–E121. doi: 10.2105/AJPH.2014.302314.

Kondo, M. C., N. Mueller, D. H. Locke, L. A. Roman, D. Rojas-Rueda, L. H. Schinasi, M. Gascon, and M. J. Nieuwenhuijsen. 2020. Health impact assessment of Philadelphia's 2025 tree canopy cover goals. *The Lancet Planetary Health* 4 (4):E149–E157. doi: 10.1016/S2542-5196(20)30058-9.

Kondo, M. C., E. C. South, and C. C. Branas. 2015. Nature-based strategies for improving urban health and safety. *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 92 (5):800–14. doi: 10.1007/s11524-015-9983-y.

Kotsila, P., K. Hörschelmann, I. Anguelovski, F. Sekulova, and Y. Lazova. 2020. Clashing temporalities of care and support as key determinants of transformatory and justice potentials in urban gardens. *Cities* 106:102865. doi: 10.1016/j.cities.2020.102865.

Krinsky, J., and M. Simonet. 2017. *Who cleans the park? Public work and urban governance in New York City*. Chicago: University of Chicago Press.

LaDeau, S., D. Biehler, R. Jordan, P. Leisnham, and S. Wilson. 2022. Public data archive for: Ecological complexity, mosquito production and disease risk. https://caryinstitute.figshare.com/articles/dataset/Public_data_archive_for_Ecological_complexity_mosquito_production_and_disease_risk/7418027.

LaDeau, S. L., P. T. Leisnham, D. Biehler, and D. Bodner. 2013. Higher mosquito production in low-income neighborhoods of Baltimore and Washington, DC: Understanding ecological drivers and mosquito-borne disease risk in temperate cities. *International Journal of Environmental Research and Public Health* 10 (4):1505–26. doi: 10.3390/ijerph10041505.

Lafrenz, A. J. 2022. Designing multifunctional urban green spaces: An inclusive public health framework. *International Journal of Environmental Research and Public Health* 19 (17):10867. doi: 10.3390/ijerph191710867.

Lam, V., K. Romses, and K. Renwick. 2019. Exploring the relationship between school gardens, food literacy and mental well-being in youth using photovoice. *Nutrients* 11 (6):1354. doi: 10.3390/nu11061354.

Landry, S. M., and J. Chakraborty. 2009. Street trees and equity: Evaluating the spatial distribution of an urban amenity. *Environment and Planning A: Economy and Space* 41 (11):2651–70. doi: 10.1068/a41236.

Lave, R., M. W. Wilson, E. S. Barron, C. Biermann, M. A. Carey, C. S. Duvall, L. Johnson, K. M. Lane, N. McClintock, D. Munroe, et al. 2014. Intervention: Critical physical geography. *Canadian Geographer/Geographe Canadien* 58 (1):1–10.

Lee, S. J., T. Longcore, C. Rich, and J. P. Wilson. 2017. Increased home size and hardscape decreases urban forest cover in Los Angeles County's single-family residential neighborhoods. *Urban Forestry & Urban Greening* 24:222–35. doi: 10.1016/j.ufug.2017.03.004.

Lewis, J. A., W. C. Zipperer, H. Ernstson, B. Bernik, R. Hazen, T. Elmqvist, and M. J. Blum. 2017. Socioecological disparities in New Orleans following Hurricane Katrina. *Ecosphere* 8 (9):e01922. doi: 10.1002/ecs2.1922.

Liebenberg, L. 2018. Thinking critically about Photovoice: Achieving empowerment and social change. *International Journal of Qualitative Methods* 17 (1). doi: 10.1177/1609406918757631.

Little, E., D. Biehler, P. T. Leisnham, R. Jordan, S. Wilson, and S. L. LaDeau. 2017. Socio-ecological mechanisms supporting high densities of *Aedes albopictus* (Diptera: Culicidae) in Baltimore, MD. *Journal of Medical Entomology* 54 (5):1183–92. doi: 10.1093/jme/tjx103.

Locke, D. H., and J. M. Grove. 2016. Doing the hard work where it's easiest? Examining the relationships between urban greening programs and social and ecological characteristics. *Applied Spatial Analysis and Policy* 9 (1):77–96. doi: 10.1007/s12061-014-9131-1.

Loughran, K. 2022. *Parks for profit: Selling nature in the city*. New York: Columbia University Press.

Lourdes, K. T., P. Hamel, C. N. Gibbins, R. Sanusi, B. Azhar, and A. M. Lechner. 2022. Planning for green infrastructure using multiple urban ecosystem service models and multicriteria analysis. *Landscape and Urban Planning* 226:104500. doi: 10.1016/j.landurbplan.2022.104500.

Lucke, S., E. Mamo, and J. Koenigstorfer. 2019. Exploring the meaning of growing food in community gardens to South African township residents: A Photovoice study. *Health & Place* 55:165–76. doi: 10.1016/j.healthplace.2018.11.009.

Lyytimäki, J. 2015. Ecosystem disservices: Embrace the catchword. *Ecosystem Services* 12:136. doi: 10.1016/j.ecoser.2014.11.008.

Lyytimäki, J., and M. Sipilä. 2009. Hopping on one leg—The challenge of ecosystem disservices for urban green management. *Urban Forestry & Urban Greening* 8 (4):309–15. doi: 10.1016/j.ufug.2009.09.003.

McTighe, S. P., and R. Vaidyanathan. 2012. Vector competence of *Aedes albopictus* from Virginia and Georgia for Chikungunya virus isolated in the Comoros Islands, 2005. *Vector Borne and Zoonotic Diseases* 12 (10):867–71. doi: 10.1089/vbz.2012.0978.

Menconi, M., R. Abbate, L. Simone, and D. Grohmann. 2023. Urban green system planning insights for a spatialized balance between PM10 dust retention capacity of trees and urban vehicular PM10 emissions. *Sustainability* 15 (7):5888. doi: 10.3390/su15075888.

Merse, C. L., G. L. Buckley, and C. G. Boone. 2008. Street trees and urban renewal: A Baltimore case study. *The Geographical Bulletin* 50:65–81.

Millington, N. 2013. Post-industrial imaginaries: Nature, representation, and ruin in Detroit, Michigan. *International Journal of Urban and Regional Research* 37: 279–96.

Mullenbach, L. E., B. Breyer, B. B. Cutts, L. Rivers, III, and L. R. Larson. 2022. An antiracist, anticolonial agenda for urban greening and conservation. *Conservation Letters* 15 (4):e12889. doi: 10.1111/conl.12889.

Nesbitt, L., M. J. Meitner, C. Girling, and S. R. J. Sheppard. 2019. Urban green equity on the ground: Practice-based models of urban green equity in three multicultural cities. *Urban Forestry & Urban Greening* 44:126433. doi: 10.1016/j.ufug.2019.126433.

Park, L., and D. Pellow. 2011. *The slums of Aspen: Immigrants vs. the environment in America's Eden*. New York: NYU Press.

Pataki, D. E., M. Alberti, M. L. Cadenasso, A. J. Felson, M. J. McDonnell, S. Pincetl, R. V. Pouyat, H. Setälä, and T. H. Whitlow. 2021. The benefits and limits of urban tree planting for environmental and human health. *Frontiers in Ecology and Evolution* 9:603757. doi: 10.3389/fevo.2021.603757.

Peterson, A. C., B. M. Ghersi, R. Campanella, C. Riegel, J. A. Lewis, and M. J. Blum. 2020. Rodent assemblage structure reflects socioecological mosaics of counter-urbanization across post-Hurricane Katrina New Orleans. *Landscape and Urban Planning* 195:103710. doi: 10.1016/j.landurbplan.2019.103710.

Philips de Lucas, A. K. 2020. Producing the "Highway to Nowhere": Social understandings of space in Baltimore, 1944–1974. *Engaging Science Technology and Society* 6:351–69.

Pickett, S., and J. Grove. 2020. An ecology of segregation. *Frontiers in Ecology and the Environment* 18 (10):535. doi: 10.1002/fee.2279.

Pincetl, S. 2010. Implementing municipal tree planting: Los Angeles million-tree initiative. *Environmental Management* 45 (2):227–38. doi: 10.1007/s00267-009-9412-7.

Planas-Carbonell, A., I. Anguelovski, E. Oscilowicz, C. Pérez-del-Pulgar, and G. Shokry. 2023. From greening the climate-adaptive city to green climate gentrification? Civic perceptions of short-lived benefits and exclusionary protection in Boston, Philadelphia, Amsterdam and Barcelona. *Urban Climate* 48:101295. doi: 10.1016/j.uclim.2022.101295.

Ramamurthy, P., and E. Bou-Zeid. 2017. Heatwaves and urban heat islands: A comparative analysis of multiple cities. *Journal of Geophysical Research: Atmospheres* 122 (1):168–78. doi: 10.1002/2016JD025357.

Reid, I. 1934. *The negro community of Baltimore: A social survey*. Baltimore, MD: Urban League.

Rigolon, A. 2016. A complex landscape of inequity in access to urban parks: A literature review. *Landscape and Urban Planning* 153:160–69. doi: 10.1016/j.landurbplan.2016.05.017.

Roman, L. A., T. M. Conway, T. S. Eisenman, A. K. Koeser, C. Ordóñez Barona, D. H. Locke, G. D. Jenerette, J. Östberg, and J. Vogt. 2021. Beyond 'trees are good': Disservices, management costs, and tradeoffs in urban forestry. *Ambio* 50:615–30.

Rosan, C. D. 2012. Can PlaNYC make New York City "greener and greater" for everyone? Sustainability planning and the promise of environmental justice. *Local Environment* 17 (9):959–76. doi: 10.1080/13549839.2011.627322.

Rothman, S. E., J. A. Jones, S. L. LaDeau, and P. T. Leisnham. 2021. Higher West Nile virus infection in *Aedes albopictus* (Diptera: Culicidae) and Culex (Diptera: Culicidae) mosquitoes from lower income neighborhoods in urban Baltimore, MD. *Journal of Medical Entomology* 58 (3):1424–28. doi: 10.1093/jme/tjaa262.

Safransky, S. 2014. Greening the urban frontier: Race, property, and resettlement in Detroit. *Geoforum* 56:237–48. doi: 10.1016/j.geoforum.2014.06.003.

Saverino, K. C., E. Routman, T. R. Lookingbill, A. M. Eanes, J. S. Hoffman, and R. Bao. 2021. Thermal inequity in Richmond, VA: The effect of an unjust evolution of the urban landscape on urban heat islands. *Sustainability* 13 (3):1511. doi: 10.3390/su13031511.

Schwarz, K., M. Fragkias, C. G. Boone, W. Zhou, M. McHale, J. M. Grove, J. O'Neil-Dunne, J. P. McFadden, G. L. Buckley, D. Childers, et al. 2015. Trees grow on money: Urban tree canopy cover and environmental justice. *PLoS ONE* 10 (4):e0122051. doi: 10.1371/journal.pone.0122051.

Shcheglovitova, M. 2020. Valuing plants in devalued spaces: Caring for Baltimore's street trees. *Environment and Planning E: Nature and Space* 3 (1):228–45. doi: 10.1177/2514848619854375.

Shcheglovitova, M., and J. H. Pitas. 2023. Haunting natures: The politics of green reparations in Baltimore, MD. In *Urban natures living the more-than-human city*, ed. F. Edwards, L. A. Popartan, and I. N. Pettersen, 251–63. New York: Berghahn Books.

Shokry, G., J. J. T. Connolly, and I. Anguelovski. 2020. Understanding climate gentrification and shifting landscapes of protection and vulnerability in green resilient Philadelphia. *Urban Climate* 31:100539. doi: 10.1016/j.uclim.2019.100539.

Smith, N. 1990. *Uneven development: Nature, capital, and the production of space*. Athens: University of Georgia Press.

Solins, J. P., A. K. Phillips de Lucas, L. E. G. Brissette, J. Morgan Grove, S. T. A. Pickett, and M. L. Cadenasso. 2023. Regulatory requirements and voluntary interventions create contrasting distributions of green stormwater infrastructure in Baltimore, Maryland. *Landscape and Urban Planning* 229:104607. doi: 10.1016/j.landurbplan.2022.104607.

Štrbac, S., M. Ķašanin-Grubin, L. Pezo, N. Stojić, B. Lončar, L. Ćurčić, and M. Pucarević. 2023. Green infrastructure designed through nature-based solutions for sustainable urban development. *International Journal of Environmental Research and Public Health* 20 (2):1102. doi: 10.3390/ijerph20021102.

Taylor, D. 1999. Central Park as a model of social control. *Journal of Leisure Research* 31 (4):420–77. doi: 10.1080/00222216.1999.11949875.

Taylor, D. 2014. *The state of diversity in environmental organizations*. Ann Arbor, MI: Green 2.0 Working Group.

Taylor, K.-Y. 2019. *Race for profit: How banks and the real estate industry undermined Black homeownership*. Chapel Hill: University of North Carolina Press.

Thompson, A., K. Bunds, L. Larson, B. Cutts, and J. A. Hipp. 2023. Paying for nature-based solutions: A review of funding and financing mechanisms for ecosystem services and their impacts on social equity. *Sustainable Development* 31 (4):1991–2066. doi: 10.1002/sd.2510.

Triguero-Mas, M., I. Anguelovski, J. J. T. Connolly, N. Martin, A. Matheney, H. V. S. Cole, C. Pérez-Del-Pulgar, M. García-Lamarca, G. Shokry, L. Argüelles, et al. 2022. Exploring green gentrification in 28 Global North cities: The role of urban parks and other types of greenspaces. *Environmental Research Letters* 17 (10):104035. doi: 10.1088/1748-9326/ac9325.

Tsuda, Y., Y. Maekawa, K. Ogawa, K. Itokawa, O. Komagata, T. Sasaki, H. Isawa, T. Tomita, and K. Sawabe. 2016. Biting density and distribution of *Aedes albopictus* during the September 2014 outbreak of dengue fever in Yoyogi Park and the vicinity of Tokyo Metropolis, Japan. *Japanese Journal of Infectious Diseases* 69 (1):1–5. doi: 10.7883/yoken.JJID.2014.576.

Turell, M. J., D. J. Dohm, M. R. Sardelis, M. L. O. Guinn, T. G. Andreadis, and J. A. Blow. 2005. An update on the potential of North American mosquitoes (Diptera: Culicidae) to transmit West Nile virus. *Journal of Medical Entomology* 42 (1):57–62. doi: 10.1093/jmedent/42.1.57.

Vega-Rúa, A., K. Zouache, R. Girod, A.-B. Failloux, and R. Lourenço-de-Oliveira. 2014. High level of vector competence of *Aedes aegypti* and *Aedes albopictus* from ten American countries as a crucial factor in the spread of Chikungunya virus. *Journal of Virology* 88 (11):6294–6306. doi: 10.1128/JVI.00370-14.

Volin, E., A. Ellis, S. Hirabayashi, S. Maco, D. J. Nowak, J. Parent, and R. T. Fahey. 2020. Assessing macroscale patterns in urban tree canopy and inequality. *Urban Forestry & Urban Greening* 55:126818. doi: 10.1016/j.ufug.2020.126818.

Wachsmuth, D., and H. Angelo. 2018. Green and gray: New ideologies of nature in urban sustainability policy. *Annals of the American Association of Geographers* 108 (4):1038–56. doi: 10.1080/24694452.2017.1417819.

Wang, C., and M. A. Burris. 1994. Empowerment through Photo Novella: Portraits of participation. *Health Education and Behavior* 21 (2): 171–86.

Wang, C., and M. A. Burris. 1997. Photovoice: Concept, methodology, and use for participatory needs assessment. *Health Education & Behavior* 24 (3):369–87. doi: 10.1177/109019819702400309.

Winling, L. C., and T. M. Michney. 2021. The roots of redlining: Academic, governmental, and professional networks in the making of the new deal lending regime. *Journal of American History* 108 (1):42–69. doi: 10.1093/jahist/jaab066.

Wolf, K. L., S. T. Lam, J. K. McKeen, G. R. A. Richardson, M. van den Bosch, and A. C. Bardekjian. 2020. Urban trees and human health: A scoping review. *International Journal of Environmental Research and Public Health* 17 (12):4371. doi: 10.3390/ijerph17124371.

Yang, L., K. J. Turo, C. B. Riley, E. A. Inocente, J. X. Tian, N. C. Hoekstra, P. M. Piermarini, and M. M. Gardiner. 2019. Can urban greening increase vector abundance in cities? The impact of mowing, local vegetation, and landscape composition on adult mosquito populations. *Urban Ecosystems* 22 (5):827–39. doi: 10.1007/s11252-019-00857-7.

Yang, Y., Y. Xu, Y. Duan, Y. Yang, S. Zhang, Y. Zhang, and Y. Xie. 2023. How can trees protect us from air pollution and urban heat? Associations and pathways at the neighborhood scale. *Landscape and Urban Planning* 236:104779. doi: 10.1016/j.landurbplan.2023.104779.

Zhou, L., G. Shen, C. Li, T. Chen, S. Li, and R. Brown. 2021. Impacts of land covers on stormwater runoff and urban development: A land use and parcel based regression approach. *Land Use Policy* 103:105280. doi: 10.1016/j.landusepol.2021.105280.

Ziter, C. D., E. J. Pedersen, C. J. Kucharik, and M. G. Turner. 2019. Scale-dependent interactions between tree canopy cover and impervious surfaces reduce daytime urban heat during summer. *Proceedings of the National Academy of Sciences of the United States of America* 116 (15):7575–80. doi: 10.1073/pnas.1817561116.

DAWN BIEHLER is Associate Professor in the Department of Geography and Environmental Systems at University of Maryland, Baltimore County, Baltimore, MD 21250. E-mail: dbiehler@umbc.edu. Her research interests include urban political ecology and environmental history, focusing on health, housing, green space, and more-than-human geography.

SHANNON LADEAU is a Senior Scientist and G. Evelyn Hutchinson Chair in Ecology at the Cary Institute of Ecosystem Studies, Millbrook, NY 12545. E-mail: ladeaus@caryinstitute.org. Her research interests include disease ecology, biodiversity, and resilience in socio-ecosystems, focusing on arboviruses, urban greening, and science-based responses to social-ecological challenges.

JOEL BAKER is National Director of EPIC programs at American Conservation Experience, Flagstaff, AZ 86001. E-mail: baker.joel@gmail.com. He holds a Master of Science from University of Maryland, Baltimore County, and his work focuses on natural resource management, community engagement, and organizational development.

YINKA BODE-GEORGE is founder and CEO of the Sustain Our Future Foundation, Washington, DC 20006. E-mail: yinka@sustainourfuture.org. She holds a Master of Health Science from the Johns Hopkins School of Public Health, and promotes participatory philanthropy focused on environmental justice and sustainable development.

J. H. PITAS is Assistant Professor of Geography in the Division of Liberal Studies at Howard Community College, Columbia, MD 21044. E-mail: jpitas@howardcc.edu. His research interests include more-than-human urban geographies and discard studies.

REBECCA C. JORDAN is Professor in the Department of Community Sustainability at Michigan State University, East Lansing, MI 48824. E-mail: jordanre@msu.edu. Her research interests include citizen-science and science education, focusing on how people reason with data about human–environment interactions.

PAUL LEISNHAM is Professor in the Department of Environmental Science and Technology at University of Maryland, College Park, College Park, MD 20742. E-mail: leisnham@umd.edu. His research interests include invasion and control of medically important mosquitoes and watershed health and sustainability.

SACOBY WILSON is Professor in the Department of Global, Environmental, and Occupational Health and Director of the Center for Community Engagement, Environmental Justice, and Health at University of Maryland, College Park, College Park, MD 20742. E-mail: swilson2@umd.edu. His research interests include environmental justice science and community-based participatory research.