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Urban green equity on the ground: Practice-based models of urban green equity in three multicultural cities

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ABSTRACT

Urban green equity, broadly defined as equitable access to and governance of urban forests, mediates urban residents' ability to derive ecosystem services from urban forests. This article explores conceptions of, barriers to, and strategies for urban green equity as understood by urban forestry and related green practitioners in three multicultural cities in the US. Practitioners identified two principle dimensions of urban green equity: (1) distributional equity, and (2) recognitional equity. The key barrier to distributional equity was the perception of urban forests as amenities, while the key barrier to recognitional equity was multiple identities and urban forest priorities, reflecting existing theories of political ecology and social justice. The research identified and systematized additional sub-barriers to urban green equity and strategies used to overcome barriers in practice. While similar themes of urban green equity emerged across the study cities, key areas of disagreement provide important insights. Interestingly, practitioners identified and discussed distributional equity twice as frequently as recognitional equity, indicating a potential gap in understanding and use of the concept. As cities become increasingly aware of ecosystem services and urban green equity, this research can inform urban forestry and sustainability strategies.

1. Introduction

Urban forests, defined as urban trees and associated vegetation (Konijnendijk et al., 2006), offer a range of ecosystem services to urban dwellers (Lottrup et al., 2013; McPherson et al., 1997; Ulrich et al., 1991; Ward Thompson and Aspinall, 2011) and are clearly important to their well-being. The distribution of urban forests, and recognition in urban forest governance, are key dimensions of urban green equity that influence the ecosystem services urban residents receive from urban forests and the power those residents exercise in managing them (Nesbitt et al., 2018). These dimensions are conceived of here as distributional equity and recognitional equity. Distributional equity refers to the fair distribution of urban forests, while recognitional equity refers to the fair representation of stakeholders within and equitable power over urban forest decision processes (Dobson, 1998; Rawls, 1999; Schlosberg, 2007; Young, 1990). Some environmental justice scholars also use the terms "procedural justice" and "procedural equity" interchangeably with recognitional equity (Dale and Newman, 2009; Paavola and Adger, 2006; Schwarz et al., 2015).

Urban green equity is an emerging field of research in the literature on urban forestry, ecological economics, political ecology, and social-ecological systems. As the body of literature on urban green equity has developed, the term has been explored and defined in different ways. A growing body of studies has employed spatial approaches to assess the distribution of urban forest resources according to socioeconomic factors such as race, culture, income, and education (Barbosa et al., 2007; Landry and Chakraborty, 2009; Nesbitt et al., 2019; Schwarz et al., 2015). These analyses reflect distributional theories of equity and justice, as proposed by John Rawls and subsequent researchers (Rawls, 1999; Schlosberg, 2007). Others have begun to analyze equitable urban forest governance and inclusive, multi-stakeholder approaches to urban forest decision making and stewardship (Adger et al., 2005; Brink et al., 2016; Buijs et al., 2016; Gulsrud et al., 2018; Lawrence et al., 2013). These analyses focus on the role and ability of citizens to influence the urban forest, and grow out of recognitional theories of equity first proposed by Iris Young and developed by further research on power, oppression, and domination in multicultural societies (Gould, 1996; Taylor, 1994; Young, 1990). Theories of the political ecology of urban forests have subsequently developed, bringing together theories of distributional and recognitional equity and highlighting the importance of capitalist power in the production of green inequity across both dimensions in urban spaces (Heynen, 2003; Heynen et al., 2006;

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Sandberg et al., 2015). While research to date has helped clarify the state of urban green equity in some contexts, and has helped elucidate factors that should be considered in its analysis, it remains unclear how key practitioners involved in urban forest management understand urban green equity and operationalize it through their work on the ground.

The dimensions of urban green equity obtain their meaning when applied in local contexts. While the theory and philosophy of equity can set the frame for urban green equity analysis, the practice of urban forest management informs the definition of the term through its operation. Urban green equity takes place at the local level, and thus an analysis of equity at the local level, through an exploration of urban green equity conceptions and practices, is an important part of research to understand the concept. Urban forestry practitioners are closely engaged in managing urban forests, and thus serve an important role in influencing urban green equity on the ground (Conway and Vander Vecht, 2015). Urban forestry and other green practitioners include those involved in program and service delivery related to urban forests, whether they are in government, non-governmental organizations (NGOs), private business, academia, or volunteers. Their conceptions of green equity, barriers to achieving it, and the strategies they employ to overcome those barriers, influence factors such as when and where tree planting and maintenance take place, how stewardship activities are designed and who they involve, how public engagement processes are structured, and what information shapes urban forest management and engagement activities (D'Amato et al., 2002; Fontaine and Larson, 2016). Practitioners' experience in the field of urban forestry also situates them well to provide important insights into the theory and practice of urban green equity. Practitioners must regularly consider green equity in managing competing urban forestry objectives and can thus provide a nuanced view of urban green equity and its application. However, there is some evidence that green equity is still an emerging concept in urban forestry practice. A recent survey of 125 urban forestry organizations in 110 cities in the US found that 32% of respondents did not consider "proximity to low income neighbourhoods" when making management decisions, while it was one of the top three priorities for only 13% of respondents (Pregitzer et al., 2019).

This article explores how practitioners understand the concept of urban green equity, their experience of barriers to achieving green equity, and strategies they employ to overcome those barriers, via semi-structured interviews with urban forestry and related green practitioners in three multicultural cities in the United States (US): New York, NY; Phoenix, AZ; and Portland, OR. The research identified themes and sub-themes related to definitions of, barriers to, and strategies for urban green equity, and systematized the results to produce models of urban green equity as understood and used by local urban forestry practitioners. Practitioner definitions of and perceived barriers to urban green equity are the focus of this analysis, and are explored and assessed in relation to existing theories of environmental and social justice. The analysis of strategies to overcome barriers to urban green equity is more exploratory in nature. This research does not seek to assess the effectiveness of green equity strategies employed by practitioners but identifies them, and their relationships to green equity barriers, as areas for future research. To the best of our knowledge, this is the first analysis of practitioner conceptions of urban green equity. It can be used to guide equitable urban forest planning and management and help ensure that all residents benefit from urban forests in complex, multicultural urban environments.

2. Materials and methods

2.1. Study sites

The study sites were three cities in the US (Fig. 1) that represent a range of population sizes, population densities, precipitation levels, average temperatures, and socioeconomic characteristics (Table 1) (National Oceanic and Atmospheric Administration, 2017; US Census Bureau, 2018), and include two cities that have explicitly considered equity in their urban forest management policies (New York, NY and Portland, OR).

2.1.1. New York

New York City is a municipality in the state of New York, along the east coast of the US (Fig. 1). It is one of the most populous cities in the country and is highly racially diverse, with a relatively well-educated population (Table 1). The primary agency responsible for urban forestry in New York City is the New York City Department of Parks and Recreation (NYC Parks). NYC Parks partners with external organizations, such as the Bette Midler Foundation, Central Park Conservancy, Trees New York, and the New York Restoration Project to deliver urban forestry services and influence urban forest management on private land (NYC Parks, 2017a). While New York City does not have a strategic urban forest management plan, NYC Parks has a Framework for an Equitable Future that sets out NYC Parks' goals and strategies to promote urban green equity through park management (NYC Parks, 2014). The flagship program under the Framework is the Community Parks Initiative, a program to invest $130 million in under-resourced parks and sustain the capital investment with ongoing maintenance and programming (NYC Parks, 2014). Another key equity program in New York is the Parks without Borders program, an initiative to remove physical boundaries from public parks and make park entrances more welcoming (NYC Parks, 2017b).

2.1.2. Phoenix

Phoenix is a municipality in the state of Arizona, in the southwestern US (Fig. 1). It is a populous, low-density city with a large Latinx[1] population and a lower level of educational attainment than the other study cities (Table 1). The primary agency responsible for urban forestry in Phoenix is the Parks and Recreation Department. Phoenix Parks and Recreation is responsible for public parks and street trees on public land. Phoenix Parks and Recreation partners with municipalities in the Phoenix metro area to share information and best practices, and with external organizations such as Trees Matter, Arizona State University, and Downtown Phoenix Inc. to deliver urban forest management services. Downtown Phoenix Inc., through the Downtown Phoenix Partnership, is responsible for street tree planting and maintenance in downtown Phoenix, reflecting the importance of public-private partnerships in urban forest management in Phoenix (City of Phoenix, 2010). Urban forest management in Phoenix takes place under the City of Phoenix Tree and Shade Master Plan, reflecting the focus on heat mitigation in urban forest management (City of Phoenix, 2010). Based on conversations with Phoenix Parks and Recreation, and various internet searches, Phoenix Parks and Recreation does not appear to have urban green equity policies or plans.

2.1.3. Portland

Portland is a municipality in the state of Oregon, in the western part of the state (Fig. 1). It is a mid-sized, relatively low-density city with a primarily Caucasian and highly-educated population (Table 1). The primary agencies responsible for urban forestry in Portland are Portland Parks and Recreation, the Bureau of Environmental Services, and the Bureau of Planning and Sustainability. These municipal agencies work together and with external organizations, such as Friends of Trees and Portland State University, to deliver urban forestry services, influence urban forests on private lands, and conduct research on urban forest resources and ecosystem services (Portland Parks and Recreation, 2017a). Portland Parks and Recreation also works with the Portland Urban Forestry Commission, a group of 11 volunteers that serves as an

[1] Latinx is a gender-neutral, non-binary alternative to Latino, Latina, and Latin@.

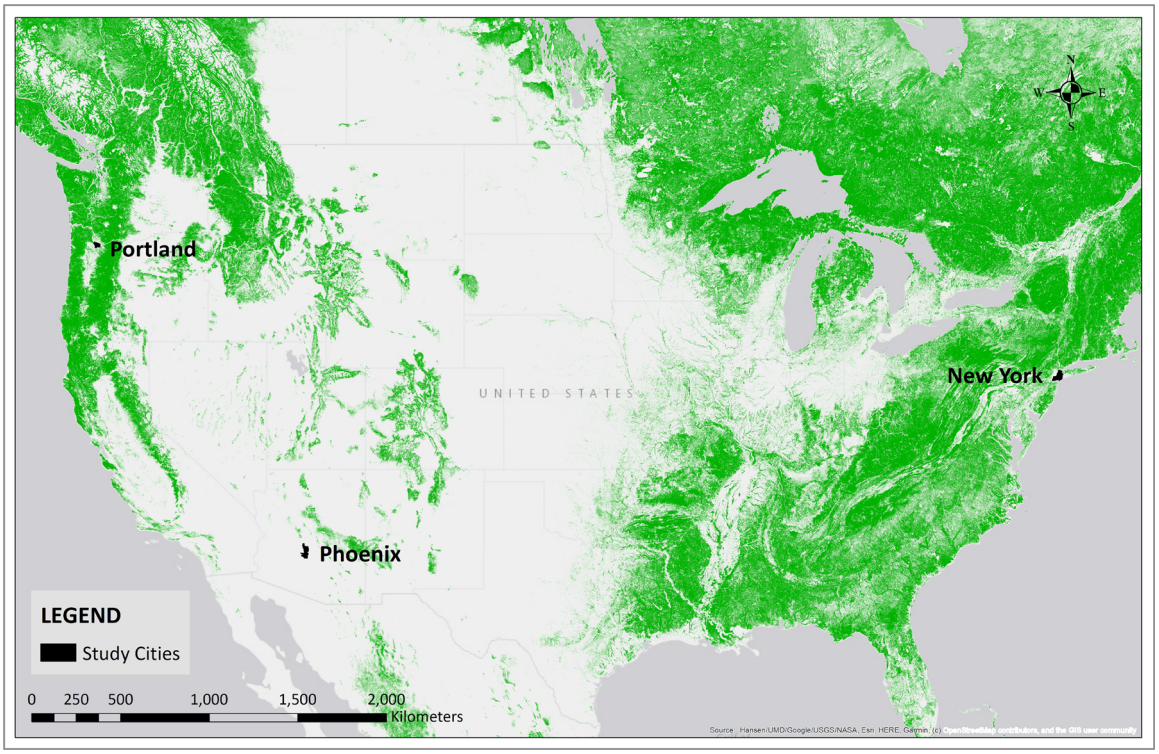

Fig. 1. Map of study cities and tree cover.

Table 1
A. Municipal population, population density, average annual precipitation, average annual temperature, and B. socioeconomic characteristics for each city in 2017.

A

City	Population	Population/km^2	Average annual precipitation (mm)	Average annual temperature (°C/°F)
New York, NY	8,560,072	10,921.2	1,086	12.5/54.5
Phoenix, AZ	1,574,421	1,174.3	203	23.9/75.0
Portland, OR	630,331	1,678.6	915	12.5/54.5

B

City	% White	% Black	% Am. Indian	% Asian	% Latino	Median household income (USD)	% No high school diploma	% Bachelor's degree or higher
New York, NY	42.8	24.3	0.4	14.0	29.1	$57,782	18.9	36.7
Phoenix, AZ	71.9	6.9	2.0	3.6	42.5	$52,080	18.8	27.8
Portland, OR	77.4	5.7	0.8	7.8	9.7	$61,532	8.2	48.2

advisory group to the Portland Parks and Recreation Director and the City Urban Forester (Portland Parks and Recreation, 2017b). Urban forest management in Portland is driven by the city's Urban Forest Management Plan (Portland Parks and Recreation and Urban Forestry Management Plan Technical Advisory Committee, 2004) and associated urban forest action plans and a new tree planting strategy (Portland Parks and Recreation, 2018, 2015). Distributional equity policies, focused on low-canopy, low-income, and racialized neighbourhoods, are clearly articulated in the action and planting plans, and the new planting strategy references recognitional equity via a focus on culturally-specific outreach and participation in planting (Portland Parks and Recreation, 2018). Portland Parks and Recreation has also developed an Equity Statement (Portland Parks and Recreation, 2017c) and a Five-Year Racial Equity Plan that aligns with the City of Portland's racial equity goals and vision (Hendricks et al., 2017). The Racial Equity Plan contains goals on equitable hiring and outreach practices, and equitable access to city services. The Plan focuses on race and acknowledges the need to consider additional forms of diversity in equity planning.

2.2. Researcher position and participants

The first author is a 35-year-old white female researcher in urban forestry and socioecological systems. The research adopted an essentialist/realist position within this study, that is, that language reflects and allows people to articulate meaning and experience (Braun and Clarke, 2006). The methodology reflects this position through the minimization of bias or influence over the outcomes by using a lightly structured interview format, and acknowledgment and consideration of researcher position throughout data collection and analysis, including the use of credibility checks.

Participants were 34 urban forestry key informants across the three case study cities. This included 12 participants from New York, 11 from Portland, and 11 from Phoenix. Key informants were defined as urban forestry or related green professionals and volunteers with at least six months of experience in the field of urban forestry. Participants represented a diversity of urban forestry actors typically involved in urban forest management and decision making, such as municipal, regional, and state governments, NGOs, private corporations, citizen volunteers, and academics (Table 2). Table 2 is provided to clarify the

Table 2
Number of participants by organization type in each city.

City	Municipal government	Regional / state government	NGO	Community member	Academia	Private business
New York	9	0	4	1	1	0
Phoenix	6	1	1	1	1	2
Portland	8	1	1	1	1	0

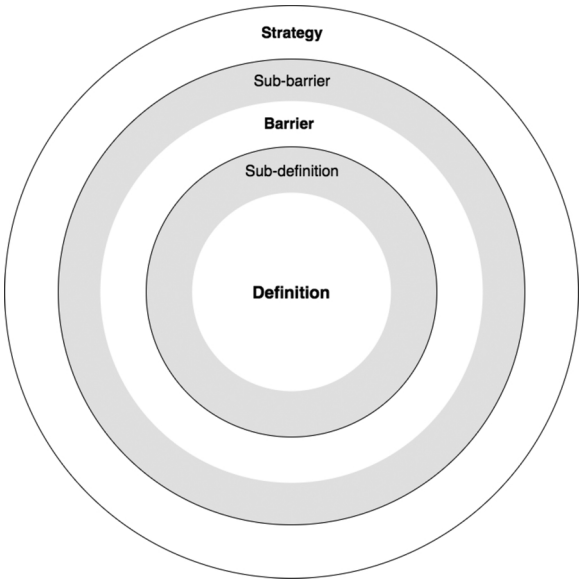

Fig. 2. Conceptual representation of relationships among the principal themes that emerged from the analysis: definitions (and sub-definitions), barriers (and sub-barriers), and strategies.

breadth of perspectives gathered; it is important to note that this research does not attempt to represent or summarize views by organization type. Participants were counted twice in the table if they represented more than one perspective, due to their personal and professional activities. Participants ranged in age from 28 to 67. Seventeen identified as female and 17 as male. Participants' racial identity was not collected as this was not the focus of this study.

2.3. Sampling procedures

The study was approved by the Behavioural Research Ethics Board of the University of British Columbia (Approval Certificate Number: H16-02583-A002). The municipal staff member tasked with research projects and partnerships in each city was the initial point of contact. As the authors sought information-rich cases, participants were identified using a purposive snowball sampling method starting with the urban forestry municipal staff member generally responsible for research collaborations within each city. Participants were chosen to represent a wide range of organizations and departments typically involved in urban forest management and decision making, with a focus on the municipal urban forestry agency in each city. To protect participants' confidentiality, participants are referred to by their assigned subject numbers in this article.

2.4. Instruments

Each participant completed one semi-structured interview (45–120 minutes). Thirty-three participants were interviewed in person and one was interviewed over the phone. The interview protocol (Appendix A) was developed based on a literature review and discussions among the research team members. It was reviewed by experts in semi-structured interview methods and piloted with an expert in urban forest governance research. Participants were given the flexibility to express their unique experiences as urban forestry and green practitioners. Follow-up questions varied and were guided by the material provided by each participant.

2.5. Data collection and analysis procedures

Interviews were digitally recorded and transcribed verbatim. Data analysis followed the six phases described in Braun and Clarke (2006). Both inductive and deductive thematic analyses were used to explore the content of the interviews, drawing on theories of social and environmental justice, political science, and planning (Braun and Clarke, 2006). The units of analysis were the interview responses by urban forestry key informants. Coding was completed with NVivo 11 Pro Software (QSR International Pty Ltd., 2017). Credibility checks were conducted throughout to ensure that the development of codes and themes at each phase was valid and reflected the research questions and the data set. Credibility checks consisted of reviewing codes and themes with the research team and re-examining their relationships to coded extracts and the full data set.

3. Results

The analysis is organized according to three major themes within the concept of urban green equity: 1. definitions of urban green equity; 2. barriers to urban green equity; and 3. strategies employed to overcome barriers and promote urban green equity. The relationships of these themes to each other are described by Fig. 2, with definitions of urban green equity forming the centre of the analysis and the associated themes emerging from and informing those definitions. Definitions of urban green equity are represented at the centre of Figs. 2–4 because they are the core of the topic. Barriers surround definitions of green equity to represent their role in preventing societies from achieving green equity. Strategies are represented surrounding the barriers, and are specifically associated with relevant barriers (Figs. 3 and 4), to represent their role in potentially overcoming barriers and moving closer to achieving urban green equity, at the centre of the models.

Two principle dimensions emerged in the definitions of urban green equity that correspond to the dimensions described in the Introduction: 1. distributional equity, and 2. recognitional equity. The relationships between the specific themes and sub-themes within each dimension are described by Figs. 3 and 4. Results are presented according to the two dimensions of urban green equity and the major themes explored by the analysis. The presentation of results focuses on each major theme and provides brief descriptions of key subordinate themes with selected participant quotations to illustrate themes. Supplementary results, including extensive excerpts from participant interviews to demonstrate theme meaning, are presented in Appendix B.

3.1. Distributional green equity

Distributional green equity was the primary focus of most participants' responses, with all participants addressing distributional equity at least once during their interview. The three major themes, and their sub-themes, are presented below as they relate to distributional green equity (Fig. 3). Themes and their relationships are arranged according to the conceptual arrangement proposed in Fig. 2. Table 3 presents the

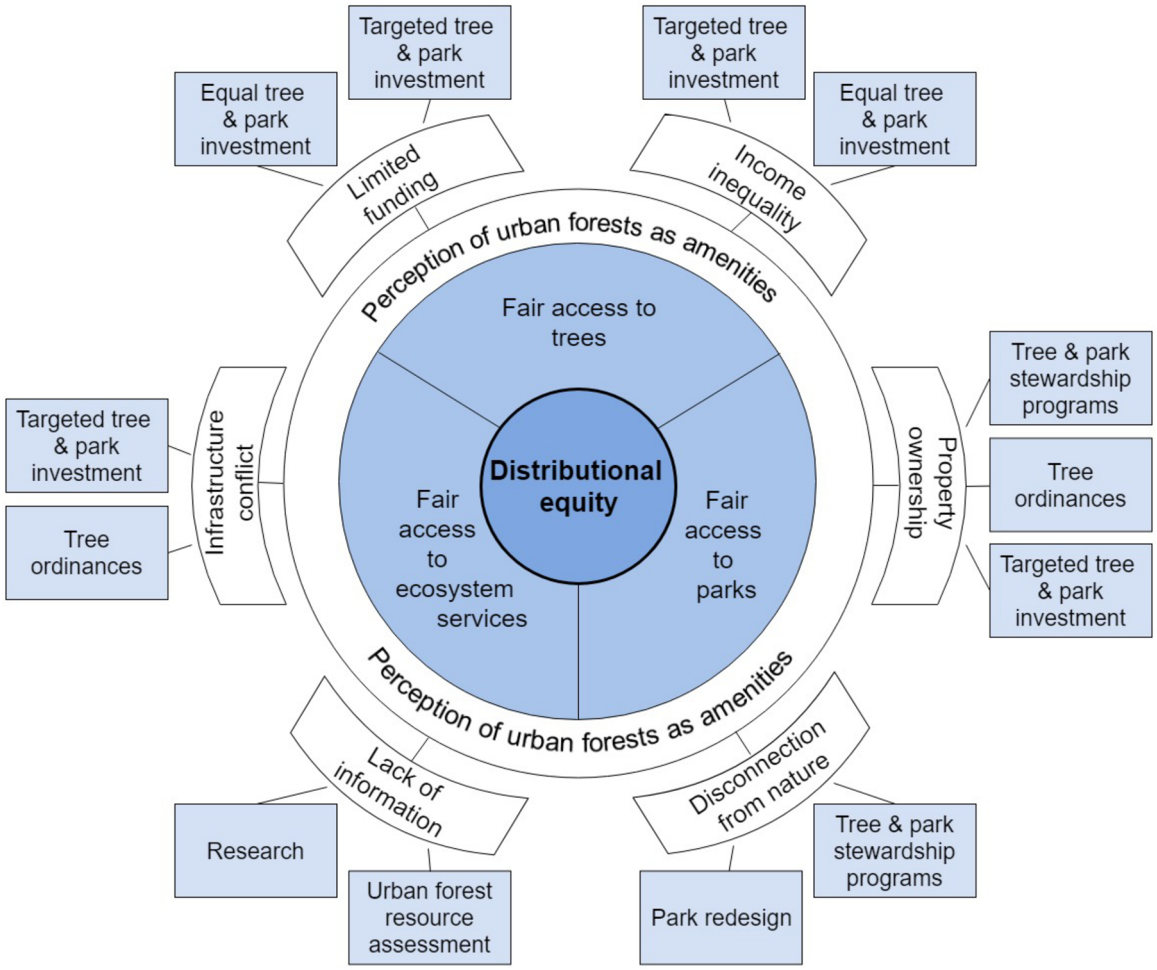

Fig. 3. Relationships among themes and sub-themes in the distributional equity analysis.

number of interview participants that discussed each sub-theme of distributional equity by city.

3.1.1. Definitions of distributional green equity

Participants' conceptions and definitions of distributional green equity emerged as three sub-themes: 1. fair access to trees, 2. fair access to parks, and 3. fair access to ecosystem services.

3.1.1.1. Fair access to trees. According to most of the interview participants, fair opportunities to access urban trees was a key aspect of urban green equity (n = 27). This was often expressed as having similar canopy cover levels across the various neighbourhoods of the city, or as street tree or private tree distribution.

3.1.1.2. Fair access to parks. Many interview participants viewed park access as central to urban green equity and spoke about the concept in relation to public parks (n = 33). For these participants, park accessibility included proximity to parks, recreational opportunities within parks, and safe access to parks.

3.1.1.3. Fair access to ecosystem services. Some interview participants conceived of green equity as the fair distribution of ecosystem services provided by urban forests, including primarily regulating and cultural ecosystem services (n = 24).

> In Portland… it literally means that all residents of the city receive the same level of services from the urban forest. And by services, I suspect you know what I mean, we could talk a lot about what the services of trees are, but you know that, right? Think clean air, heat mitigation… (PD-2)

3.1.2. Barriers to distributional green equity

Barriers to distributional green equity emerged as one overarching theme and related sub-themes that were caused by and reinforced the overarching theme.

3.1.2.1. Perception of urban forests as an amenity. The perception of urban forests as amenities was the overarching barrier to distributional green equity that emerged from the analysis (n = 33). Interview participants described the societal view that urban forests are amenities and, as such, are not seen as essential assets that should be equitably distributed and to which everyone should have access, or are seen by some as nuisances rather than as indispensable goods.

3.1.2.2. Limited funding. The perception of urban forests as amenities was identified as a key driver of limited funding, a barrier commonly discussed by participants (n = 34). Participants felt that the perception of urban forests as amenities contributed to inadequate levels of funding for urban forest establishment and maintenance.

> Because we undervalued trees, we under fund them… We have, historically in this culture, seen them as amenities, as niceties, and not as necessities, and as a result, we don't take care of them the way we take care of other infrastructure. (PD-7)

Limited funding was a commonly-mentioned barrier to providing adequate access to urban forests for all residents. With limited funding, municipalities and other urban forestry actors reported that it was

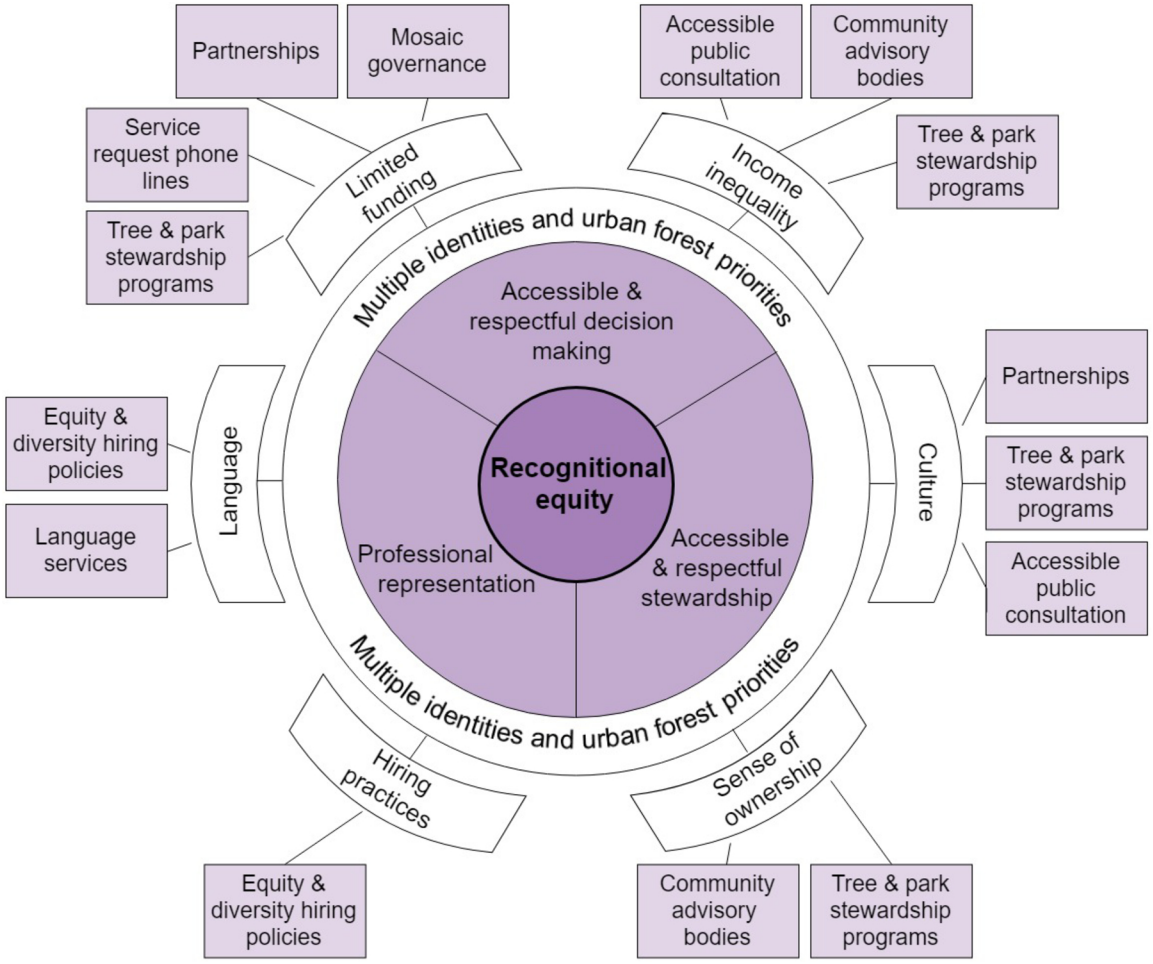

Fig. 4. Relationships among themes and sub-themes in the recognitional equity analysis.

challenging to adequately maintain urban forests across the wide variety of neighbourhoods they serve.

3.1.2.3. Income inequality. Income inequality was another commonly-discussed barrier to urban green equity related to the perception of urban forests as amenities (n = 27). Those with lower incomes were considered to face more difficulties accessing urban forests, either because they could not afford to live in green neighbourhoods or because they could not afford to care for urban forests in their neighbourhoods.

> You can only afford to live in a certain neighbourhood, right? Depending on your income level. And in general, the lower the income the less trees or less canopy you're likely to have. So, I would say the barrier is your economic mobility. (PD-3)

This barrier was also discussed in relation to limited funding. Participants described the challenges they faced providing adequate access to urban forests in low-income, low-canopy neighbourhoods

Table 3
Number of participants that discussed each sub-theme related to distributional equity.

Themes	Sub-themes	New York (N = 12)	Phoenix (N = 11)	Portland (N = 11)	Total (N = 34)
Definitions	Fair access to trees	8	9	10	27
	Fair access to parks	12	10	11	33
	Fair access to ecosystem services	7	8	9	24
Barriers	Perception of urban forests as amenities	11	11	11	33
	Limited funding	12	11	11	34
	Income inequality	9	7	11	27
	Infrastructure conflict	8	10	8	26
	Property ownership	5	8	9	22
	Lack of information	7	5	10	22
	Disconnection from nature	8	10	7	25
Strategies	Targeted tree and park establishment and maintenance	11	7	10	28
	Equal tree and park establishment and maintenance	1	4	1	6
	Tree ordinances	5	6	8	19
	Tree and park stewardship programs	7	5	7	19
	Park redesign	4	3	1	8
	Research	7	2	6	15
	Urban forest resource assessment	5	3	11	19

when their organizational budgets were insufficient, particularly given high levels of private investment in urban forests in high-income neighbourhoods.

> There's one city budget and that city budget through the Parks Department is supposed to be distributed city-wide. [We] do our best job to make sure that that money is equitably spent. But the neighbourhoods that can form their own NGOs and their own conservancies that then raise money are going to inevitably be better off than others. (N-2)

3.1.2.4. Infrastructure conflict. Conflict with infrastructure deemed to be more necessary than urban forests was cited as a common barrier to urban green equity on both public and private property (n = 26). Participants explained that on public property, infrastructure conflict can prevent municipalities from planting additional street trees in low-canopy neighbourhoods, while private properties, residents may be unable or unwilling to plant trees, or may remove them due to current or potential future infrastructure conflict.

3.1.2.5. Property ownership. Property ownership, and the division of responsibility for urban forests on public and private lands, was a commonly-discussed barrier to green equity (n = 22). Participants discussed the limited ability of public actors to influence urban forest management on private property, particularly in highly-privatized landscapes where urban forests are mostly managed as private amenities.

> So, I wanted to just go in and plant trees on both sides of that street, 'cause kids walk to school, kids go to the park, parents as well… But there's a property line somewhere in that 5 feet. (PX-5)

In addition, the cost to private citizens of maintaining trees on private property and, in the case of Portland, in the right-of-way in front of their property, was often cited as a barrier to distributional green equity in low-income neighbourhoods, where residents may not have the financial means to adequately care for trees on or in front of their property.

A further barrier related to property ownership that was occasionally mentioned was difficulty engaging renters in tree-planting activities, as they were perceived to have little incentive or limited authority to plant trees on properties that they do not own.

3.1.2.6. Lack of information. Some participants identified lack of information as a barrier to green equity, because without information, it is difficult to know how to address distributional inequity (n = 22).

> And then third would be probably a major barrier to trees is information… That's part of what our lab is doing is, what information do we have about the distribution, the services being provided, the disservices being provided and how do we actually capture that in a narrative that would be compelling for us to really evaluate whether trees are needed or not needed in some areas. (PD-6)

3.1.2.7. Disconnection from nature. Some participants identified disconnection from nature as a barrier to urban green equity (n = 25). Participants described disconnection from nature as a lack of experience with and knowledge of natural urban elements, such as trees and parks, potentially resulting in urban residents placing low value on urban forests and their proper management or in lower park use and a lack of feelings of ownership for urban forests.

3.1.3. Strategies to promote distributional green equity

Participants identified seven principle strategies for overcoming barriers to and promoting distributional urban green equity:

1 Targeted tree and park establishment and maintenance
2 Equal tree and park establishment and maintenance
3 Tree ordinances
4 Tree and park stewardship programs
5 Park redesign
6 Research
7 Urban forest resource assessment

The relationships between strategies for and barriers to distributional green equity are described in Fig. 3. To avoid repetition, each strategy is described once below, rather than in relation to each barrier.

3.1.3.1. Targeted tree and park establishment and maintenance. Targeted tree planting and park establishment and maintenance were the primary strategies employed by participants to promote distributional green equity (n = 28). Targeted interventions were most often used to overcome barriers such as income inequality, limited funding, property ownership, and infrastructure conflict, and were generally focused in low-canopy, historically under-served neighbourhoods, including low-income and racialized neighbourhoods. Targeted interventions could take the form of planting additional street trees in underserved neighbourhoods, establishing or upgrading parks in park-poor neighbourhoods, focusing private tree planting programs in low-canopy neighbourhoods, and opportunistically planting trees and establishing parks in available areas without infrastructure conflicts or in association with infrastructure development.

3.1.3.2. Equal tree and park establishment and maintenance. In some cases, participants employed strategies of *equal* tree and park establishment and maintenance in an effort to ensure distributional green equity (n = 6). For example, tree planting and maintenance programs were distributed equally among neighbourhoods, regardless of existing canopy cover or socioeconomic status. Attempts at equal interventions were most often used to overcome barriers such as limited funding and income inequality.

3.1.3.3. Tree ordinances. Some participants described how tree ordinances and similar bylaws have been used to prevent and manage conflicts with infrastructure and help influence the management of trees on private property (n = 19).

3.1.3.4. Tree and park stewardship programs. Tree and park stewardship programs were discussed as a key strategy to overcome barriers such as property ownership and disconnection from nature in some cases (n = 19). Participants described using stewardship programs to educate urban residents on the value of urban forests and on proper tree care and maintenance.

> And then, over the past five or six years, we've really shifted from planting, to overall stewardship, bringing people in to work in the young forests that they may have planted two years ago and now need some continuing care. (N-9)

3.1.3.5. Park redesign. Park redesign was another strategy that was sometimes employed by participants to overcome disconnection from nature (n = 8). Participants described removing barriers from park edges, upgrading trails, and providing shade trees and structures to encourage residents to use parks more frequently.

3.1.3.6. Research. Some participants discussed the role of research in providing more information on where and how tree planting could improve distributional equity (n = 15). Given the dearth of plantable spaces in some cities, this information was seen as critical to increasing canopy cover in low-canopy neighbourhoods that would survive long term.

Table 4
Number of participants that discussed each sub-theme related to recognitional equity.

Themes	Sub-themes	New York (n = 12)	Phoenix (n = 11)	Portland (n = 11)	Total (n = 34)
Definitions	Accessible and respectful decision making	4	3	6	13
	Accessible and respectful stewardship	7	4	6	17
	Professional representation	2	2	4	8
Barriers	Multiple identities and urban forest priorities	6	6	7	19
	Limited funding	5	4	2	11
	Income inequality	4	3	5	12
	Culture	5	4	5	14
	Language	4	3	4	11
	Hiring practices	2	1	2	5
	Sense of ownership	6	6	5	17
Strategies	Tree and park stewardship programs	7	4	6	17
	Accessible public consultation	2	1	4	7
	Community advisory bodies	2	1	5	8
	Partnerships	6	3	6	15
	Mosaic governance approaches	4	3	1	8
	Language services	4	2	3	9
	Service request phone lines	10	7	9	26
	Equity and diversity hiring policies	2	1	2	5

3.1.3.7. Urban forest resource assessment. A related strategy that participants used to address limited information on urban forest distribution was urban forest resource assessment (n = 19). This most often took the form of street and park tree inventories and canopy cover mapping, sometimes in association with socioeconomic data to target planting in low-canopy and socioeconomically disadvantaged neighbourhoods.

3.2. Recognitional green equity

Recognitional green equity was an important focus of participants' responses but was secondary to distributional green equity, with about half of participants addressing recognitional equity at least once during their interview. The three major themes, and their sub-themes, are presented below as they relate to recognitional green equity (Fig. 4). Themes and their relationships are arranged according to the arrangement proposed in Fig. 2. Table 4 presents the number of interview participants that discussed each sub-theme of recognitional equity by city.

3.2.1. Definitions of recognitional green equity

Recognitional green equity was conceived of and defined by participants according to three sub-themes: 1. accessible and respectful decision making, 2. accessible and respectful stewardship, 3. professional representation.

3.2.1.1. Accessible and respectful decision making. According to some participants, accessible and respectful decision making was a key aspect of urban green equity (n = 13). This was often expressed as decision making processes that respected local values and gave residents equal opportunities to contribute to urban forest decision making, regardless of socioeconomic status.

> But I think, coming into a neighbourhood and planting trees everywhere without the assistance or consent of the people that live in that community, can add to a sense of disenfranchisement and loss of control, and also begs the question, "Who are we improving the city for?" So I think it's a double edged sword. (N-6)

3.2.1.2. Accessible and respectful stewardship. Many participants viewed accessible and respectful stewardship as central to urban green equity (n = 17). These participants spoke about green equity in relation to stewardship programs that were welcoming of diversity and respectful of local values and customs.

3.2.1.3. Professional representation. Some participants included professional representation as a core element of recognitional equity (n = 8). This aspect of recognitional equity was often addressed by describing policies and practices, rather than as a central principle in and of itself. Participants described efforts to make the urban forestry profession more diverse through policies that support equity and inclusion in hiring.

> And we've also changed our hiring practices, mostly recruitment practices, to try to get more diverse staff who can better represent the residents we serve, and that's been successful. We've had more people of color on staff, although we have a ways to go. And we've also got a nascent trainee, arborist trainee program, that has the same goals. It's like the pilot program for a wider, bureau trainee program to add diversity to our staff. (PD-2)

3.2.2. Barriers to recognitional green equity

Barriers to recognitional green equity emerged as one over-arching theme with related sub-themes that were caused by and reinforced the overarching theme.

3.2.2.1. Multiple identities and urban forest priorities. The presence of multiple identities among urban residents and the resulting diversity of urban forest priorities was identified by some participants as the overarching barrier to recognitional green equity (n = 19). This barrier was sometimes explicit and often implicit in participants' discussions of barriers to urban green equity. Participants described the reality of multiculturalism and multiple viewpoints in a large city, and discussed the challenges associated with inviting, including, and managing for those diverse viewpoints. While this reality was described as a barrier, it was not discussed as a negative reality. Rather, it was seen as an equity challenge to be overcome through good urban forest management.

> There's such income inequality, there's so much cultural diversity here, there's so… There are differing political views. I'm imagining this never-ending bleeding out diagram or chart of who you could be as a person. Gender roles, gender identification, everything. The diversity of all of those categories is so huge that it's like this never-ending page of where everybody plots, which I think makes New York really cool and interesting, and strong in that diversity. At the same time, it's hard to manage for everyone. It's like how do you be everything to everyone, especially when the everyone is literally everyone. Every type of person from every country, every language, every religion, every economic income level, etc., etc. (N-12)

3.2.2.2. Limited funding. Multiple identities and urban forest priorities were seen by participants as the drivers for another key barrier to urban green equity: limited funding (n = 17). According to participants, multiple identities and priorities have meant that not everyone cares about or values urban forests in the same way, leading to limited advocacy for urban forests and limited funding for urban forest management.

> And I think a lot of people care about trees, but… It's not one of those things that they go to City Hall for and say, "I want… " And so that's our goal is to create that culture of thinking about trees more. (PX-2)

Participants described how limited funding has limited their ability to engage in equitable outreach and stewardship activities and in truly community-based projects, which require additional time and resources to support participation by diverse groups of urban residents.

Participants discussed how limited funding also presents a barrier to community engagement in urban forest management when residents begin to see trees dying as a result of mismanagement or lack of management.

> So, then you have a kind of this terrible effect of the community, saying, "This tree's dying," and just thinking that trees can't survive here because we don't invest in it, and then thinking that not expecting trees and not wanting them because they're not like you've seen… (PX-2)

3.2.2.3. Income inequality. Income inequality was another commonly-identified barrier to recognitional green equity, particularly in the context of limited public funds for urban forest management and engagement (n = 12). Participants explained that those neighbourhoods with higher incomes were better able to influence urban forestry in their areas through partnerships with external organizations and leveraging additional funds with which to influence and engage in urban forest management.

Participants also described how income inequality creates barriers to engagement in urban forest stewardship and planning activities, such as public meetings and tree planting events.

> Because if you're working two jobs and you have a big family to support on Saturday morning you might not have time, or you might wanna spend time with your family. (PD-4)

3.2.2.4. Culture. Another identified barrier was culture (n = 14). Participants discussed how culture influenced residents' expectations as to how they should be engaged in urban forestry and whether engagement and stewardship opportunities were meaningful for them. Participants also discussed the importance of culture in motivating residents to engage in urban forest stewardship opportunities.

3.2.2.5. Language. Participants identified language as a barrier that was closely linked to culture in perpetuating recognitional inequity (n = 11). Participants described the wide range of languages spoken within their cities, and the challenges associated with making urban forest decision making processes and stewardship activities accessible to residents with multiple first languages other than English. This barrier also linked with limited funding, as providing language translation services or outreach materials in multiple languages is generally more costly for municipalities and partner organizations.

> I see a huge barrier being language. Friends of Trees has struggled to connect with those that don't have English as a first language or don't speak English. We can get to a certain place with those populations, but then our process is pretty complex in terms of how to plant a tree in a specific location and how to go through that process is hard. (PD-5)

3.2.2.6. Hiring practices. Hiring practices were implicitly discussed by some participants as a barrier to recognitional equity (n = 5). Participants described the current demographics of urban forestry agencies, and policies and strategies to improve equity in hiring and engagement that implicitly identified hiring as a barrier to recognitional equity.

3.2.2.7. Sense of ownership. The final barrier discussed by participants was sense of ownership: the sense, or lack thereof, among residents of having ownership over urban forests and a sense of place within them and within the urban forest decision-making process (n = 17). A low sense of ownership was described by participants as manifesting as low levels of engagement with urban forestry officials at public events or consultations, infrequent use of service-request phone lines, and low levels of engagement with stewardship events or political activities. Participants described how this lack of ownership and disengagement can result in fewer efforts being made to engage those populations and provide high-quality urban forests in those neighbourhoods.

> And so there's not always the political will to invest in the areas that quite often aren't the ones who are the most vocal or who come out to vote or these are people who are working multiple jobs supporting families in meager living situations where they could really benefit from connections to parks or more greenery right in their front yards or people who take transit a lot more. (PX-6)

3.2.3. Strategies to promote recognitional green equity

Participants identified nine principle strategies for overcoming barriers to and promoting recognitional urban green equity:

1 Tree and park stewardship programs
2 Accessible public consultation
3 Community advisory bodies
4 Partnerships
5 Mosaic governance approaches
6 Language services
7 Service request phone lines
8 Equity and diversity hiring policies

The relationships between strategies for and barriers to recognitional green equity are described in Fig. 4. To avoid repetition, each strategy is described once below, rather than in relation to each barrier. Equity and diversity hiring policies are not discussed below as they have already been addressed in previous sections.

3.2.3.1. Tree and park stewardship programs. Developing and offering tree and park stewardship programs were key strategies employed by participants to promote recognitional green equity (n = 17). Tree and park stewardship programs were used to welcome residents with diverse identities and urban forest priorities into the practice of urban forestry, overcome funding limitations by including the public in tree and park care, address income inequality by involving lower-income residents in accessible stewardship, overcome cultural barriers through culturally-relevant stewardship programming, and increase residents' sense of ownership for urban forests by helping them engage with and understand urban forests.

> We are missing the 30 to 45 age demographic and probably the people with young, young kids. So looking to make our programming more family friendly, for instance, my tree steward class, I'm looking into offering daycare, I'm looking to offer maybe a small stipend for participants from some communities… Also, there are cultural, I think there are cultural differences in terms of what we expect of volunteers and what volunteers can provide so working with our Latino community partners, family is important, family is huge and so you will prioritize visiting with family and getting

together as opposed to just going out singly into the community, so you can make it a family project, maybe that would help. (PD-4)

3.2.3.2. Accessible public consultation. Accessible public consultation was a strategy employed by some participants to overcome barriers such as income inequality and culture (n = 7). Participants described public consultation methods that were designed to be accessible to a range of urban residents, such as mapping exercises at public meetings, individual consultations around tree planting, and financial support for attending consultation events. This strategy also relates to language services, described below. Language services are described as a separate strategy as they go beyond accessible public consultation.

3.2.3.3. Community advisory bodies. Community advisory bodies were another strategy used to overcome barriers such as income inequality and sense of ownership (n = 8). Participants described how community advisory bodies have helped bring local residents in lower-income neighbourhoods into the decision-making process and have grounded urban forest management in the local community, helping community members feel a greater sense of ownership over urban forests and a more developed sense of place in urban green spaces.

3.2.3.4. Partnerships. Partnerships with local community organizations or NGOs were discussed by participants as a strategy to overcome limited funding and cultural barriers (n = 15). Partnerships were used to leverage additional funding for urban forest stewardship and engagement, and to engage with communities in a culturally-sensitive way through organizations that represented their local interests.

3.2.3.5. Mosaic governance approaches. Some participants described using mosaic governance approaches to overcome funding limitations to recognitional green equity (n = 8). Participants did not use the term "mosaic governance" but described allowing local neighbourhoods or communities to take their own approaches to urban forestry, by allowing individual community-based projects to employ novel urban forest management and outreach approaches, or allowing local residents to co-create their local urban green spaces free from municipal regulation.

There's this little small district where Phoenix has basically… the city basically suspended their control and allowed people to do what they want… People went eclectically crazy… People started having coffee shops in their front yards and planting all this stuff, and you start seeing gardens pop up everywhere in people's front yards. And it's very, very cool to see when a municipality just steps back and gives people freedom to make choices and express what pops up. Yeah, suddenly "I can do that, it's okay." And people of like minds start gathering and there becomes a movement, a grassroots movement emerges from that. (PX-3)

3.2.3.6. Language services. Language services were sometimes discussed by participants as a strategy to overcome language barriers (n = 9). Participants described translating outreach materials, hiring staff with knowledge of non-English languages, and providing stewardship activities in multiple languages, as appropriate to the local community. Some participants noted that they have not yet overcome the language barrier, but that language services were a priority strategy for them.

3.2.3.7. Service request phone lines. Service request phone lines were one of the most commonly-discussed strategies employed to engage residents in urban forest decision making while helping to overcome funding limitations (n = 26). Service request phone lines were described as 311 lines that residents could call to get information about urban forestry, report a tree in need of maintenance or removal, or find out about urban forest engagement or stewardship activities. While most participants didn't consider the use of 311 lines to be a highly sophisticated strategy to overcome recognitional equity barriers, it was generally described as a low-barrier strategy that fit within constrained municipal budgets.

4. Discussion

The definitions of, barriers to, and strategies for distributional and recognitional equity offered by practitioners help identify how these two equity dimensions operate in an urban forest context. Urban forests are a diverse resource composed of multiple types of vegetation, in different arrangements and under both public and private ownership. This diversity affects how urban residents experience and influence urban forests and calls for models of distributional and recognitional urban green equity that reflect the realities of the resource and how it is governed. The practitioner conceptions described in this paper help develop these models. It is important to note that this research was situated within democratic, capitalist governance systems, and should be interpreted in this context. Definitions and practices of equity can vary according to context.

4.1. Definitions of distributional and recognitional equity

Distributional equity definitions focused on three ways in which urban forestry practitioners conceive of urban forests and their distribution: 1) trees, 2) parks, and 3) the ecosystem services provided by both. These three conceptions of distributional equity highlight three key elements and functions of urban forests on which practitioners focus their professional activities and that should be considered in distributional green equity analyses. Likewise, recognitional equity definitions focused on three ways in which practitioners and urban residents can influence urban forest governance and decision making: 1) decision-making processes, such as urban forest planning, 2) urban forest stewardship, where residents influence urban forests through their direct management, and 3) representation in the urban forestry profession. These are three key areas within which recognitional green equity may be explored in future research.

Given the emphasis by practitioners on distributional over recognitional green equity, the recognitional green equity models presented in this paper may require further testing and development, and should be interpreted in this context. While this research does not seek to evaluate the relative importance of these various definitions, it provides a framework for future research on distributional and recognitional urban green equity.

4.2. Definitions of fair

One of the most striking findings of the thematic analysis, that informs the definitions of equity presented above, was the seemingly contradictory use by some participants of *targeted* tree and park establishment and maintenance to promote distributional green equity while other participants used *equal* tree and park establishment and maintenance to do the same. Targeted strategies refer to investing additional time and money in urban forests in low-canopy or low-park neighbourhoods while equal strategies refer to investing equal time and money in urban forests in all neighbourhoods, regardless of the current canopy or park coverage. These strategies would appear to be in opposition to one another. One seeks to change the current distribution of urban forests while the other seeks to maintain the status quo.

While both strategies were present in each city, targeted intervention was more commonly discussed in Portland and New York, while equal intervention was more commonly discussed in Phoenix (Table 3). Pragmatically, the observed variation may simply reflect variation in funding constraints. In a highly-constrained funding environment where much of the city is in need of tree planting or maintenance, equal

urban forest management achieves a minimum standard of service delivery across the city. Targeted intervention would require additional resources beyond those used to ensure that regular maintenance can continue.

While funding constraints may be the proximal cause of equal urban forest interventions as a strategy to promote equity, it is important to recognize the role of funding priorities in creating those funding constraints. The observed variation in perspective may in fact reflect local variations in the definition of 'fair', driven by local political economies and public-private property relations. The commodification of urban forests according to neoliberal capitalist practices produces urban forests that reflect structural processes of inequity in urban political economies, such as income inequality and uneven property ownership, and that are mirrored in the equity barriers identified in this paper (Heynen et al., 2006; Smith, 2008; Swyngedouw et al., 2002). Local cultures that are strongly influenced by neoliberal capitalist philosophy and practice are more likely to accept the erosion of funding for public resources, such as urban forests, and begin to see the capitalist approach to resource allocation as the only acceptable or available alternative (Swyngedouw et al., 2002). Thus, while the position that distributional green equity is best supported by maintaining the status quo may appear to be a pragmatic response to funding limitations, this response may be driven by a more philosophical adherence to capitalist practices or a misunderstanding of the difference between equality and equity. Notably, this approach was most commonly described by participants in Phoenix, a city with high levels of private property ownership and private involvement in managing public goods (Martin et al., 2003). Moreover, the urban forest in Phoenix is almost entirely human-constructed, given the highly-arid local environment, contributing to the perception of urban forests as amenities and an acceptance of the commodification of urban forests.

4.3. Barriers to equity

The perception of urban forests as amenities was identified as the principal barrier to distributional urban green equity. This barrier reflects current political ecological theories of the effects of capitalism on the unjust distribution of goods in society. As discussed above, neoliberal capitalism is based on the commodification of goods and resources, including social or public goods, such as urban forests, leading to the unjust distribution of resources according to societal power relationships (Heynen, 2003; Sandberg et al., 2015; Swyngedouw and Heynen, 2003). The perception of urban forests as amenities allows for the commodification of urban forests according to capitalist principles and their subsequent unjust distribution. The additional sub-barriers systematized in this research also reflect and flow from the perception of urban forests as amenities, under the capitalist paradigm. Underfunding of public goods and inequitable urban forest access according to income levels and uneven property ownership are commonly found in equity analyses in capitalist societies, leading to additional equity barriers, such as conflict with infrastructure deemed more necessary than urban forests, lack of investment in information about urban forests, and ultimately, disconnection from nature (Campbell, 2014; Grove et al., 2014; Nesbitt et al., 2019; Schwarz et al., 2015).

Urban residents, particularly those in positions of power, and the social, ecological, and economic systems of which they are a part, perpetuate or operationalize capitalism and the inequitable distribution of resources in cities (Carmichael and McDonough, 2018). It is thus through the acceptance of the capitalist paradigm and the perception of urban forests as amenities that distributional green inequity develops. As discussed above, when urban forests are seen and managed as amenities, rather than social goods, it becomes accepted as fair for those with greater power to accrue them to themselves in greater numbers, preventing those with less power from accessing these resources with the same frequency or in the same numbers.

Multiple identities and urban forest priorities were identified as the principal barrier to recognitional urban green equity. Multiple identities and urban forest priorities are realities of urban societies. However, they can become barriers to equity in societies structured by domination and oppression as theorized by Iris Young and others (Gould, 2014, 1996; Taylor, 1994; Young, 1990). Only in a society which structures itself according to domination and oppression do multiple identities and urban forest priorities become a source of inequity rather than strength or creative complexity. According to Young, oppression constrains self-development, or the development and expression of unique identities, and domination constrains self-determination, or the fulfillment of urban forest priorities in an urban forest context (Young, 1990). In a diverse society, then, the existence of multiple unique identities that have differing urban forest priorities becomes a barrier to equity within a system that perpetuates domination and oppression (Donovan and Mills, 2014; Poe et al., 2013). The additional sub-barriers systematized in this research also reflect and perpetuate the barrier of multiple identities and urban forest priorities under systems of domination and oppression. Limited funding for diverse, local urban forest management priorities, the intersectionality of income inequality, culture, and language, and unfair hiring practices perpetuate and are reinforced by the barrier of multiple identities and urban forest priorities and ultimately lead to a lack of a sense of ownership over and relationship with urban forests (Campbell, 2014; Heynen, 2018, 2016; Nesbitt et al., 2018; Young, 1990).

Participants discussed multiple strategies used to overcome barriers to urban green equity in their cities. While this research identifies those strategies that were most commonly employed by practitioners, such as targeted tree and park establishment and maintenance, tree and park stewardship programs, and service request phone lines, it cannot comment on the effectiveness of these strategies to overcome barriers to equity. Strategies for urban green equity are a clear area for future green equity research and this research has identified specific strategies that deserve further study.

4.4. Distributional vs. recognitional equity

The findings presented above offer insights into how practitioners understand, encounter, and address urban green equity in their urban forestry practice. While both distributional and recognitional urban green equity emerged from the interview data analysis, distributional equity was the dominant conception of and approach to urban green equity. All interview participants articulated an understanding and use of distributional equity in their approaches to urban forest management, while only half of participants identified recognitional equity as an important aspect of urban green equity. In addition, most participants were able to clearly articulate definitions of distributional green equity, while some participants defined recognitional green equity most clearly through their descriptions of strategies rather than through their direct descriptions of the concept. Distributional equity appears to be the conception of urban green equity that most commonly informs urban forest management activities, although equity may not be a management priority in some cities (Pregitzer et al., 2019), while recognitional equity is an emerging dimension of urban green equity in practice. This may reflect the reality that distributional inequity is something that can be seen in practice, through the experience of urban forests on the ground or via remotely-sensed data and maps, while recognitional inequity is harder to encounter in a tangible way, particularly if practitioners are accustomed to engaging in urban forestry practices that are recognitionally inequitable.

The observed variation in equity definitions also appears to reflect the role of the practitioner within urban forestry and the focus of urban forest management within the city. Participants who included a recognitional dimension in their description of green equity and its practice were often involved in delivering stewardship programs, managing community-based projects, engaged in public outreach, or members of the academic community. Their day-to-day work was thus

more likely to be focused on issues of recognitional equity or they were more likely to be engaged in theorizing about equity. Reflecting the potential role of habit and custom in recognitional equity, recognitional equity was more often described in New York and Portland, two cities with urban forestry equity programs and policies that are starting to consider and codify equity in urban forest management (Hendricks et al., 2017; NYC Parks, 2014).

This variation may have real consequences for strategies to achieve urban green equity on the ground. If practitioners do not understand and use both distributional and recognitional green equity, they may not allocate sufficient resources to improving both dimensions of urban green equity. As conversations and conceptions of urban green equity become more developed in the urban forestry and allied green professions, this imbalance will hopefully be corrected, promoting a balanced approach to improving urban green equity in various contexts.

5. Conclusion

Cities continue to grow around the world and urban forests are becoming more and more important to urban well-being. However, urban green equity plays a key role in determining whether urban residents can benefit from those forests. Urban forestry and associated green practitioners are central players in urban green equity; this research revealed the ways in which they use the concept and key barriers to equity that can be targeted to improve urban green equity on the ground. As cities become increasingly aware of the importance of urban forests and residents begin to grapple with the urban green equity in their daily lives and professional practice, conversations around conceptions of equity have the potential to grow and mature, refining the collective understanding of urban green equity and producing new strategies to improve it around the world.

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Declaration of competing interest

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Appendix A and B. Supplementary data

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