



Where is environmental justice? A review of US urban forest management plans

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ABSTRACT

The distribution of trees and access to nature is rarely equitable across urban neighborhoods. This injustice is present in many cities, and its origins are predominantly rooted in enduring procedural and recognitional injustices. The purpose of this research was to systematically investigate Urban Forest Management Plans (UFMPs) prepared by municipalities across the United States (107 total) for their mention and explanation of environmental justice themes relevant to urban forestry. UFMPs describe municipal urban tree-planting and stewardship goals as well as pathways for both implementation and monitoring. Using a mixed-method approach that combines qualitative content analysis and quantitative measurement, we interrogated UFMPs for reference to three specific environmental justice pillars: distribution, procedure, and recognition. Mentions and explanations of these concepts were identified and counted for all UFMPs. Summary counts were then investigated for association with a UFMP's publication year, its municipal population, and its racial composition. The frequency of reference to environmental justice themes was greater in UFMPs published more recently and whose authoring municipalities have a larger population. A positive association exists between the proportion of Black residents in a city with an UFMP and the frequency of identified distributional justice explanations. While a positive association with procedural justice mentions was found with the proportion of white residents in UFMP authoring cities, environmental justice, overall, is not a central theme across most UFMPs published to date. More generally, we discovered that where UFMPs referenced environmental justice concepts, it was often brief and lacking in substance; recognitional justice themes were absent in almost all documents. Improving environmental justice goals and implementation strategies in UFMPs that validate the perspectives and experiences of residents can strengthen accountability between urban foresters and the communities they serve.

1. Introduction

Urban trees provide many social, ecological, and economic benefits (Turner-Skoff and Cavender, 2019). Proximity to trees has been shown to reduce stress and anxiety, create a welcoming and safe environment for community activities, and contribute to intellectual and emotional fulfillment (Maas et al., 2009; Jiang et al., 2016; Nesbitt et al., 2017). Ecologically, city trees, and especially those mature in stature, play an essential role in mitigating the impacts of climate change by helping to moderate microclimate temperatures, reduce stormwater runoff, and sequester carbon (Liu and Li, 2012; Greene and Millward, 2017; Kuehler

et al., 2017). Yet urban trees and their associated socio-ecological benefits are often inequitably distributed across society and space (Greene et al., 2018).

To effectively manage the urban forest, an increasing number of cities worldwide have designed Urban Forest Management Plans (UFMPs) (Gibbons and Ryan, 2015). UFMPs are localized planning documents that provide short- and long-term urban tree-planting and stewardship goals and include a roadmap for their implementation and monitoring (Ordóñez and Duinker, 2013). Typically, public involvement is encouraged during the development of UFMPs (Miller et al., 2015). Thus, priorities and content can vary for specified goals and strategies as

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plans are context/city-specific and reflect local stakeholders' socio-cultural, economic, and ecological values toward trees (Gibbons and Ryan, 2015; Kowalski and Conway, 2019).

Typical goals of UFMPs include improving biodiversity, planting native tree species, increasing the number of large trees, and expanding overall tree canopy cover across city neighborhoods (Ordóñez and Duinker, 2013). Accordingly, most UFMPs focus on enhancing ecological urban tree benefits (e.g., stormwater mitigation, carbon sequestration, pollution abatement) through various approaches (e.g., increasing tree replacement rates, shortening maintenance cycles, species selection) (Miller et al., 2015). In most United States (US) cities, much of the urban forest grows on private land (i.e., residential, commercial, institutional) (Nguyen et al., 2017), and therefore many recently published UFMPs in the US consider social factors including strategies for facilitating more inclusive community engagement and/or public awareness about urban tree benefits (Gibbons and Ryan, 2015).

The importance of inclusive, participatory urban forest management practices is increasingly accepted among urban foresters, non-profits, and scholars (Ordóñez et al., 2020; Butt et al., 2021). Such practices are instrumental in strengthening environmental decision-making and community-led stewardship of urban environmental resources (Edge and McAllister, 2009; Andersson et al., 2014). Yet, there remains a need to understand better how power relations influence urban forest management and related community engagement practices (Watkins et al., 2017; Carmichael and McDonough, 2018, 2019; Nesbitt et al., 2019a). The concept of environmental justice helps advance such lines of inquiry by providing a framework for evaluating urban tree access among residents and the processes through which urban forest goals are pursued and implemented.

Historically, environmental justice as a theory and movement has been concerned with how racialized and low-income groups are disproportionately burdened by environmental "bads" or hazards (e.g., oil refineries, incinerators) (Ringquist, 2005; Agyeman et al., 2016). More recently, this concern has extended to address inequitable access to certain environmental "goods" or amenities such as urban parks, urban nature, and urban trees (Grove et al., 2006; Boone et al., 2009; Landry and Chakraborty, 2009; Greene et al., 2018; Rigolon and Németh, 2021). Racialized and low-income neighborhoods tend to have fewer trees, while white and more affluent communities have more (Heynen et al., 2006; Schwarz et al., 2015; Gerrish and Watkins, 2018; Watkins and Gerrish, 2018). Further, environmental justice theorists have highlighted how the lack of environmental amenities is linked to systems of structural inequalities (e.g., structural racism, redlining) (Alvarez, 2022).

UFMPs provide an opportunity for municipalities to address the lack of tree canopy within racialized and low-income neighborhoods given their influence as planning documents that govern natural spaces in cities. To date, few studies have analyzed UFMPs (Ordóñez and Duinker, 2013; Gibbons and Ryan, 2015; Kowalski and Conway, 2019), and no studies have systematically examined whether and how environmental justice goals related to urban trees are defined and operationalized within these plans.

This research examines UFMPs published and endorsed by US municipalities to understand and document the baseline of environmental justice practice and its recognition and manifestation in urban forest decision-making and management. Specifically, our objectives were to (1) assess all US UFMPs published between 2002 and 2020 to understand whether and how environmental justice goals are defined, prioritized, or neglected in plans; and (2) quantify and visualize, for all US cities with UFMPs, the frequency and depth of plan references to environmental justice. We then close with a discussion of strategies to activate environmental justice concepts within UFMPs and subsequent management practices.

2. Environmental justice theory and urban forest management

Environmental justice theory includes three intersecting pillars: distributional, procedural, and recognition justice (Fig. 1). Recognition justice, which directly influences procedural and distributional outcomes, is concerned with whether the perspectives, knowledge, and experiences of disadvantaged and/or neglected groups are recognized and prioritized within policy development and decision-making (Young, 1990; Fraser, 1997). Procedural justice is focused on addressing a lack of fairness, access, and transparency in decision-making processes that shape distributional outcomes (Corburn, 2003; Walker, 2009). Distributional injustice is the physical manifestation of recognition and procedural injustices, where certain groups lack access to an environmental good and/or live in proximity to environmental harm (Schlosberg, 2007).

Most urban greening research related to environmental justice has examined distributional injustice related to urban tree canopy (UTC) cover and urban vegetation distribution such as in urban parks (e.g., Rigolon et al., 2018; Nesbitt et al., 2019b; Riley and Gardiner, 2020). Researchers have highlighted how urban forests are inequitably distributed in several cities associated with sociodemographic variables such as race or income (see meta-analyses by Gerrish and Watkins, 2018; Watkins and Gerrish, 2018). Studies on urban parks similarly conclude that total park space, and quality of park amenities and facilities, is greater in more affluent, white neighborhoods (Rigolon et al., 2018). Urban parks often comprise trees (and sometimes forests), yet nonetheless typically make up a small proportion of total urban forest. This research focuses on the treatment of environmental justice in UFMPs specifically (not documents focused on urban park management more generally, which are often concerned with other park management matters beyond access to trees). Our application of environmental justice theory is placed squarely within the context of urban forest management and decision-making. Nonetheless it is important to acknowledge that distributional injustices have been found to be commonly referenced in sustainability policies, regulations, and urban planning documents more broadly (Pearsall and Pierce, 2010), amidst growing recognition that efforts to address distributional injustices related to urban forests (e.g., planting trees in lower canopy neighborhoods) can be associated with environmental or green gentrification because the presence of trees and/or parks usually increases neighborhood desirability (Donovan et al., 2021; Anguelovski, 2016). Still, some researchers acknowledge it would be improvident to avoid urban greening or tree planting in lower canopy neighborhoods but have encouraged urban foresters to be mindful of potential "unintended" consequences such as gentrification and displacement (Donovan et al., 2021).

Procedural and recognition pillars of environmental justice remain underexplored in environmental management studies broadly, and in urban forest management specifically, likely because they are less visible than distributional injustices and are tied to situated issues of power which are more challenging to measure and change. Addressing procedural and recognition injustices requires a nuanced understanding of the social, political, and institutional histories that influence and shape local decision-making.

The few studies in urban forestry that have adopted more of a procedural justice lens suggest the importance of organizing community meetings, stewardship opportunities, and other tree-related events in ways that allow all residents to participate, regardless of socio-economic status, cultural background, language, or schedule (Nesbitt et al., 2018). Such access requires tree-related events to be promoted accurately using jargon-free, accessible language and via various mediums (Walker et al., 2006; Nesbitt et al., 2019a).

Recognition injustices occur when urban foresters either knowingly or unknowingly under-recognize, misrecognize, and/or exclude certain groups within the political process (Schlosberg, 2007). Many US cities have a history of racist planning practices such as redlining and

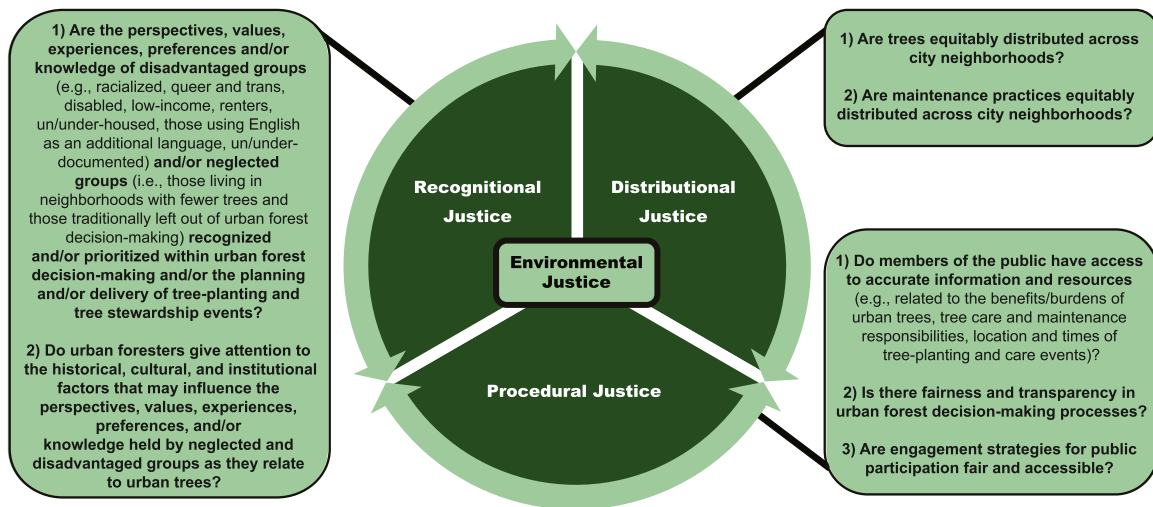


Fig. 1. Conceptual diagram of the three pillars of environmental justice theory and prompting questions to apply each pillar to urban forest management.

urban renewal policies that have influenced urban forest distribution (Locke et al., 2021; Roman et al., 2021a). If urban foresters were to disregard historical, cultural, and institutional factors that systematically exclude or disadvantage neglected and oppressed groups, individuals and communities might be disenfranchised from decision-making and lack trust in municipal service delivery (Grove et al., 2018; Shcheglovitova, 2020).

3. Methods

We completed a content analysis of UFMPs published by municipalities in the US between 2002 and 2020 ($n = 107$) to determine whether and how environmental justice goals were mentioned and explained (Table 1; Appendix A). In environmental justice research, content analysis (Krippendorff, 1989) is commonly used to uncover the intentions or goals of stakeholders involved in policy or planning (Graham et al., 2017). Through a close text analysis of the UFMPs, we illuminated how environmental justice goals are in/excluded. The inclusion criteria for each UFMP followed Ordóñez and Duinker (2013) which identified that a comprehensive UFMP must have: (1) a vision (2) a set of objectives, values, and/or targets and, (3) an implementation strategy. Only city-level ($n = 105$) and regional ($n = 2$; Chicago, IL; Memphis, TX) UFMPs were included. Most UFMPs in the US have been developed and implemented at the municipal level, making their comparison and contrast relevant (Krippendorff, 1989). Other municipal documents that referenced urban forests, but which did not focus on them (e.g., tree removal policies, sustainability plans, urban park management plans) were excluded. Neighborhood-scale, multi-city, and state-wide plans were also excluded.

Creation of a UFMP usually requires a sizable forestry budget and political interest (Miller et al., 2015). Since property taxes are the largest contributor municipal budgets (Pagano and Hoene, 2018), the existence of UFMPs is often associated with more populous cities. Population data for each US city with a population of 50,000 or more (U.S. Census Bureau, 2019a) served as a reasonable indicator of which cities were likely to have UFMPs.

Based on this population data, the Google search engine was used to identify US cities that had UFMPs by searching "urban forest management plan for [city name]". A total of 788 cities were investigated. The most populous cities in each state were explored first, followed by cities with smaller populations. This process continued until no additional UFMPs were found. While UFMPs from US cities with a population of less than 50,000 were not intentionally searched for, these plans were included in the analysis if they were identified throughout the search process (e.g., North Kansas City, MO was found when searching for

Kansas City, MO). Our goal was to understand the treatment of environmental justice in UFMPs across the US rather than to examine every UFMP in only a few states. Where they existed, UFMPs were accessed and downloaded from official municipal websites. In the rare event that an UFMP was available online but was not available for public download, the corresponding municipal departments were contacted via email to request a copy. No hard-copy documents were retrieved or analyzed.

A keyword search within each of the UFMPs was performed to identify the frequency of terms related to the three pillars of environmental justice. We used NVivo 12 (QSR International Pty Ltd., 2018), a qualitative data analysis software tool, to identify terms (codes) and organize data into specific categories. Synonymous terms for distributional, procedural, and recognitional justice were determined deductively based on existing environmental justice literature and inductively by iteratively reviewing the UFMPs to identify which terms may be most relevant based on the content presented in the plans.

The terms "access", "distribution", "equitable", "lack of maintenance", "lack of trees", and "low canopy" were used when searching for potential distributional justice-related themes. When locating possible procedural justice themes, the terms "access", "availability", "campaigns", "collaboration", "information", "jargon", "outreach", "public participation", and "social media" were used. Finally, when identifying prospective recognitional justice themes, the terms "inclusion", "identity", "low-income", "people of color", "BIPOC", "minority", "historic", "race", "socio-economic", and "targeted outreach" were used. To ensure a comprehensive search was conducted stemmed words (e.g., equity/equitable) and synonyms (e.g., lack of trees/fewer trees, people of color/BIPOC) were used.

We used NVivo to investigate the text surrounding each keyword and to examine whether the term was used in a context associated with one or more pillars of environmental justice. For instance, given the nature of urban forestry, terms such as "distribution" or "maintenance" may be used several times throughout an UFMP; however, these terms were only included in the analysis if they made explicit reference to the distribution of trees and/or maintenance practices across city neighborhoods. This process was replicated for terms related to procedural and recognitional justice.

Once terms were assigned to one or more pillars of environmental justice, they were further subdivided into separate categories based upon whether they were simply "mentioned" or received more fulsome "explanation". For example, when considering distributional justice, content counted as a "mention" would consist of a brief comment (e.g., 1–2 sentences) about the UTC cover of a city or neighborhood, or a map of UTC cover. "Mentions" did not make detailed reference to

Table 1
US Urban Forest Management Plans (UFMPs) analyzed for reference to environmental justice (EJ) broadly, and distributional justice (DJ), procedural justice (PJ), and recognition justice (RJ), more specifically. Sociodemographic data are from the 2019 US Census Bureau. Total EJ mentions and explanations are per 1000 words as determined in the UFMP primary document and appendices (NA in word count indicates no appendices present). DJ, PJ and RJ mention and explanation counts are derived from the primary UFMP documents only.

City and State	Publication Year	Population	White Alone, Not Hispanic or Latino (%)	Black or African American (%)	Word Count (Main Document)	Word Count (Appendix)	Total EJ Mentions per 1000 words	Total EJ Explanations per 1000 words	DJ Mentions per 1000 words	DJ Explanations per 1000 words	PJ Mentions per 1000 words	PJ Explanations per 1000 words	RJ Mentions per 1000 words	RJ Explanations per 1000 words
Akron, OH	2016	197,597	57.9	30.3	3482	NA	0.57	0.29	0	0	0.57	0.29	0	0
Alameda, CA (A)	2010	77,624	42.7	7.4	18,014	9360	0.56	0.06	0.17	0	0.39	0.06	0	0
Alameda, CA (B)	2010	77,624	42.7	7.4	28,296	940	0.28	0.42	0	0	0.28	0.42	0	0
Alexandria, VA	2009	159,428	52.2	22.8	17,282	11,010	2.26	0.44	0.29	0	1.16	0.35	0	0
Anchorage, AK	2009	291,247	56.7	5.3	29,354	6052	0.97	0.31	0	0	0.48	0.31	0	0
Ann Arbor, MI	2014	119,980	67.5	6.8	23,258	11,040	2.61	1.08	0.13	0.04	1.12	0.95	0	0
Ashland, WI	2018	7843	86.3	1.2	14,088	4840	0.14	0.14	0	0	0.14	0.14	0	0
Atlanta, GA	2012	506,811	38.3	51	25,230	16,190	0.04	0.04	0	0.04	0.04	0	0	0
Austin, TX	2013	978,908	48.3	7.8	18,562	8270	1.78	1.56	0.05	0.22	0.75	0.38	0	0
Boise City, ID	2015	228,959	83.2	1.9	5808	34,630	6.01	1.38	1.03	0	3.1	1.03	0	0
Boulder, CO	2018	105,673	79.6	1.2	50,159	2980	2.21	1.27	0.12	0	1.34	0.94	0.08	0
Bozeman, MT	2016	49,831	89.6	0.7	15,828	850	2.63	0.57	0.13	0	1.26	0.57	0.06	0
Buena Park, CA	2017	81,788	23.6	2.9	79,578	600	0.09	0.04	0	0	0.09	0.04	0	0
Charlotte, NC	2017	885,708	41.5	35.2	33,875	NA	0.97	1.15	0.3	0.59	0.65	0.5	0.03	0.06
Chattanooga, TN	2014	182,799	57.3	31.4	9506	20	0.53	0.11	0.11	0	0.42	0.11	0	0
Chesapeake, VA	2010	249,422	56.4	29.7	5321	2169	1.88	0.56	0	0	1.88	0.56	0	0
Chicago, IL	2018	2693,976	33.3	29.6	19,329	NA	2.28	0.72	0.41	0.26	1.66	0.47	0.21	0
Citrus Heights, CA	2015	87,796	69.2	3.9	20,008	2800	2.17	1.77	0.15	0.05	0.95	0.65	0	0
Cleveland, OH	2015	381,009	33.8	48.8	22,319	21,070	2.4	1.52	0.94	0.4	0.99	0.4	0.04	0
Colorado Springs, CO	2020	478,961	67.9	6.3	14,179	34,304	2.47	0.69	0.35	0	1.27	0.42	0	0
Colton, CA	2018	54,824	17.9	7.4	10,862	19,140	2.08	0.18	0	0	1.66	0.18	0	0
Columbia, MO	2018	123,195	74.5	10.9	29,111	19,120	1.75	0.82	0.96	0.21	0.69	0.62	0	0
Concord, CA	2016	125,410	47.4	3.6	9281	6830	0.86	0.22	0	0	0.86	0.22	0	0
Culver City, CA	2015	39,185	45.8	8.8	22,807	23,470	0.92	0.7	0.18	0.09	0.57	0.57	0	0
Davis, CA	2002	69,413	55.5	2.2	17,138	6130	1.35	0.29	0.06	0	0.64	0.29	0	0
Denton, TX	2020	139,869	57.4	10.1	23,873	7824	1.69	1.22	0.54	0.04	0.34	0.8	0.04	0
Des Moines, IA	2020	214,133	64.6	11.4	21,051	NA	1.28	1.28	0.38	0.43	0.67	0.76	0.24	0.1
Durham, NC	2018	278,993	39.5	38.7	5489	NA	4.19	0.73	2.55	0.73	1.46	0	0.18	0
Eau Claire, WI	2010	68,802	88.2	1.4	21,587	24,140	0.28	0	0	0	0.28	0	0	0
El Cerrito, CA	2007	25,508	47.5	5.0	6131	8780	0.82	0	0	0	0.82	0	0	0
El Monte, CA	2010	115,487	3.6	0.6	40,881	NA	0.51	0.27	0.07	0.1	0.44	0.17	0	0
Essex Junction, VT	2016	10,852	82.2	2.4	3785	2200	1.51	0.26	0	0	1.06	0.26	0	0
Fort Wayne, IN	2014	270,402	67.0	15.1	14,839	19,160	0.17	0	0	0	0.07	0	0	0
	2020	141,085	56.3	20.7	14,959	14,137	1.3	0.68	0.33	0	0.4	0.4	0.07	0

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Table 1 (continued)

City and State	Publication Year	Population	White Alone, Not Hispanic or Latino (%)	Black or African American (%)	Word Count (Main Document)	Word Count (Appendix)	Total EJ Mentions per 1000 words	Total EJ Explanations per 1000 words	DJ Mentions per 1000 words	DJ Explanations per 1000 words	PJ Mentions per 1000 words	PJ Explanations per 1000 words	RJ Mentions per 1000 words	RJ Explanations per 1000 words
Gainesville, FL														
Garden Grove, CA	2020	171,949	18.7	0.9	28,758	18,972	0.66	1.01	0.1	0.03	0.35	0.56	0	0
Grand Rapids, MI	2009	201,013	78.3	6.1	3395	1520	7.19	0.29	0.29	0	2.95	0.29	0	0
Gresham, OR	2011	109,381	59.0	18.6	23,427	44,380	1.11	0.55	0.17	0.09	0.85	0.47	0	0
Guttenberg, IA	2018	17,549	63.1	4.8	3744	310	0	0	0	0	0	0	0	0
Hartford, CT	2020	121,054	14.9	37.2	29,483	51,337	1.34	0.83	0.41	0.27	0.68	0.51	0.1	0.03
Honolulu, HI	2019	97,4563	95.8	0.9	6989	350	1.14	0.57	0.29	0	0.86	0.57	0	0
Iowa City, IA	2018	75,130	17.9	2.8	14,664	5050	0.61	0.33	0.07	0	0.55	0.14	0	0
Joplin, MO	2016	50,925	75.3	8.3	11,407	1690	0.18	0	0.09	0	0.09	0	0	0
Kansas City, MO	2018	508,090	55.1	27.7	16,191	10,766	1.36	1.36	0.19	0.31	0.49	0.68	0.12	0
Kirkland, WA	2013	93,010	83.4	3.2	20,275	23,310	1.47	0.69	0.1	0	0.99	0.69	0	0
Knoxville, TN	2011	187,603	71.2	1.4	11,759	20,680	1.28	0.26	0.43	0	0.85	0.26	0	0
Lacey, WA	2013	52,592	72.4	17	7406	18,660	0.92	0	0.14	0	0.68	0	0	0
Largo, FL	2016	82,485	76.1	7.0	16,536	4623	2.94	2.07	0.42	0.3	0.6	0.91	0.18	0
Leesburg, VA	2006	53,727	63.2	6.2	42,114	118,140	0.68	0.22	0.19	0	0.45	0.19	0	0
Lexington-Fayette, KY	2017	323,152	61.8	8.2	13,803	NA	1.09	0.14	0.14	0	0.94	0.14	0	0
Long Beach, CA	2012	466,742	28.1	12.6	2655	13,862	2.07	0.43	0.38	0	0.75	0	0	0
Memphis, TN	2015	651,073	65.6	23.6	7643	2780	4.58	1.01	0.92	0	1.83	0.65	0.39	0
Merced, CA	2020	86,333	24.0	5.2	17,959	5989	1.73	0.78	0.33	0	0.56	0.28	0	0
Meridian, MS	2017	36,347	25.7	64.1	14,669	1190	0.48	0	0.2	0	0.27	0	0	0
Miami Beach, FL	2020	88,885	33.3	62.9	46,790	8600	0.83	0.82	0.36	0.06	0.24	0.17	0	0
Missoula, MT	2015	75,516	35.6	4.7	20,075	4960	0.45	0.65	0.2	0.05	0.25	0.6	0	0
Montgomery, AL	2014	198,525	88.5	0.8	5881	1420	0.17	0	0.17	0	0	0	0	0
Mount Prospect, IL	2013	53,719	30.7	60.8	45,967	6980	0.28	0.34	0	0	0.28	0.2	0	0
Mountain View, CA	2014	82,739	67.0	3.2	19,813	33,850	1.63	0.88	0.35	0	0.61	0.76	0.05	0
Nashville, TN	2016	670,820	43.9	1.6	18,399	2880	5.44	0.38	0.05	0.05	0.87	0.33	0	0
National City, CA	2017	56,173	13.2	5.1	27,234	12,827	0.71	0.67	0.07	0	0.48	0.51	0	0
New York, NY	2018	8336,817	40.0	12.8	6482	1410	1.23	0.15	0.77	0	0.46	0.15	0	0
Norman, OK	2006	128,026	71.1	4.9	4293	612	0.23	0	0	0	0.23	0	0	0
North Kansas City, MO	2017	27,489	32.1	24.3	16,147	18,210	0.92	0.23	0.12	0	0.25	0.12	0	0
North Miami, FL	2015	62,822	11.0	50.1	10,419	1350	0.67	0.1	0.29	0	0.38	0.1	0	0
Norwalk, CT	2009	88,816	9.2	60.2	5173	NA	0.77	0.77	0	0	0.77	0.77	0	0
Palo Alto, CA	2019	65,364	50.8	14.7	40,492	4150	1.23	0.62	0.64	0.15	0.59	0.47	0	0
Pasadena, CA	2015	141,029	54.9	1.8	19,565	149,060	0.46	0.33	0	0	0.31	0.31	0	0
Phoenix, AZ	2010	1680,992	35.9	8.8	8733	1020	1.78	0.11	0	0	0.8	0.11	0	0
Pittsburgh, PA	2012	300,286	42.5	7.1	37,758	1000	1.56	1.35	0.42	0.45	0.93	0.87	0.21	0.03
Placentia, CA	2019	51,233	64.7	23	10,446	11,110	1.91	0.28	0.29	0	1.63	0.19	0	0

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Table 1 (continued)

City and State	Publication Year	Population	White Alone, Not Hispanic or Latino (%)	Black or African American (%)	Word Count (Main Document)	Word Count (Appendix)	Total EJ Mentions per 1000 words	Total EJ Explanations per 1000 words	DJ Mentions per 1000 words	DJ Explanations per 1000 words	PJ Mentions per 1000 words	PJ Explanations per 1000 words	RJ Mentions per 1000 words	RJ Explanations per 1000 words
Plano, TX	2017	287,677	39.2	2.0	15,045	480	1.26	2.81	0.4	0.13	0.86	0.6	0	0
Portland, OR	2004	654,741	52.4	8.6	28,137	7240	1.69	0.35	0.32	0.07	0.64	0.14	0.04	0
Reno, NV	2016	255,601	70.6	5.8	14,542	NA	0.69	0.21	0.14	0	0.55	0.21	0	0
Roanoke, VA	2003	99,143	61.0	2.8	10,865	4230	1.83	0.64	0.28	0	0.37	0.64	0	0
Rochester, NY	2012	205,695	58.5	29	12,940	1630	0.46	0.23	0.08	0	0.39	0.23	0	0
Rocklin, CA	2006	68,823	36.7	39.8	39,221	18,870	0.56	0.2	0.2	0	0.28	0.2	0.03	0
Roseville, CA	2014	141,500	70.7	1.9	36,652	11,510	1.17	1.07	0.27	0.05	0.44	0.49	0.03	0
Salem, OR	2014	174,365	67.3	2.2	4128	7070	3.92	1.86	0.73	0	0.97	0.73	0.24	0
Sammamish City, WA	2019	67,455	57.5	1.4	24,941	2271	0.84	1.08	0.2	0	0.56	0.64	0.08	0
San Diego, CA	2017	1423,851	66.9	1.4	7890	NA	1.39	0.38	0.63	0	0.76	0.38	0	0
San Francisco, CA	2014	881,549	42.8	6.4	17,917	4480	2.73	1.12	1.06	0.39	0.28	0.67	0.06	0.06
Santa Barbara, CA	2014	91,364	40.5	5.2	17,767	NA	0.84	0.79	0.39	0.11	0.45	0.68	0	0
Santa Monica, CA	2017	90,401	55.6	1.5	12,640	29,930	1.2	0.87	0.24	0.08	0.79	0.79	0	0
Schenectady, NY	2003	65,273	64.6	4.5	7099	520	0.14	0	0.14	0	0	0	0	0
Seattle, WA	2020	753,675	52.5	20.2	10,388	NA	1.64	3.37	1.06	0.96	0.29	1.54	0.29	0.87
Shoreline, WA	2014	58,608	64.4	6.4	7448	8451	1.63	1.01	0	0	0.81	0.54	0	0
South Orange, NJ	2015	282,011	63.8	7.3	4336	2470	0.46	0.46	0.23	0	0.23	0.46	0	0
South San Francisco, CA	2020	66,105	22.6	1.8	26,339	10,010	1.35	1.02	0.23	0	0.72	0.42	0	0
St. Albans, VT	2016	6801	90.9	2.2	4172	13,440	0.79	0.31	0	0	0.72	0.24	0	0
St. Charles, IL	2017	32,887	82.5	1.8	13,857	1640	0.36	0.07	0	0	0.36	0.07	0	0
St. Paul, MN	2010	308,096	51.4	16.1	11,989	4540	0.55	0.22	0	0	0.33	0	0	0
Sunnyvale, CA	2014	152,703	30.7	1.6	23,545	13,450	0.5	0.13	0.04	0	0.38	0.13	0	0
Syracuse, NY	2020	142,327	50.0	30	29,452	10,650	2.37	2.65	0.85	0.17	0.51	1.32	0.07	0.03
Tacoma, WA	2019	217,827	58.5	10.5	11,652	4490	4.37	1.1	2.23	0	1.03	0.43	0	0
Tallahassee, FL	2018	194,500	51.1	35	26,286	14,200	1.84	1.36	0.34	0.19	0.72	0.61	0	0
Tampa, FL	2013	399,700	44.6	23.6	8629	10,340	1.47	0.21	0.12	0	0.58	0.12	0	0
Tempe, AZ	2017	195,805	56.7	6.9	9775	1020	4.99	2.57	1.23	0.1	0.82	0.51	0	0
Tigard, OR	2009	55,514	72.8	1.1	7288	24,630	2.13	0.16	0.27	0	1.37	0	0	0
Troy, NY	2019	51,401	62.8	17.4	24,252	14,248	1.21	0.68	0.21	0.16	0.87	0.37	0	0
Tulsa, OK	2016	401,190	54.0	15.2	8434	1730	3.56	1.54	1.3	0.47	2.02	1.07	0.24	0
Vancouver, WA	2007	184,463	71.5	2.3	16,003	13,400	2.95	1.25	0.31	0.25	1.75	0.62	0.06	0
Virginia Beach, VA	2014	449,974	61.7	19	19,169	3160	2	2.26	0.16	0.05	0.57	0.63	0	0
Washington, DC	2013	689,545	36.7	45.4	7923	629	5.53	0.13	0.38	0.13	0.25	0	0.13	0
West Fargo, ND	2015	37,058	89.3	3.4	4022	9060	1.49	0	0	0	1.49	0	0	0
West Palm Beach, FL	2018	111,955	37.3	34.4	44,291	NA	0.2	0.25	0	0	0.18	0.25	0.02	0
Winter Park, FL	2014	30,825	76.7	6.0	6048	1120	0.66	0	0.17	0	0.5	0	0	0
Woodland, CA	2019	61,032	37.1	1.7	28,621	7435	0.69	0.66	0.14	0.03	0.31	0.45	0.1	0.03

environmental injustice implications. The content was counted as an “explanation” when a “mention” (as previously described) was discussed in greater detail, and/or further analysis or strategy (either in written format or via figures/tables) was provided. For example, if a passage in a UFMP mentioned UTC cover briefly, it would receive one “mention”, but if the UFMP elaborated on this concept (e.g., explained the implications of inequitable tree cover, provided illustrations describing distributional inequities, suggested how relevant stakeholder groups could address the inequities), then it was counted as an “explanation” instead of a “mention”. Some “mentions” and “explanations” did not exclusively reference one specific environmental justice pillar and instead referenced a combination of the pillars. In such circumstances, we added a count to each relevant pillar.

To accurately identify relevant themes, and to strengthen the replicability and dependability of the coding and analysis scheme, an iterative coding process was conducted and multiple coders were involved (Stacy et al., 2016; Church et al., 2019). Two researchers completed coding the entire dataset individually and met to compare their results after the coding was complete. Disagreements were discussed among the two researchers and a consensus was reached. Environmental justice concepts in the form of “mentions” and “explanations” were counted and tallied for each UFMP and according to their respective pillar (i.e., distributional, procedural, recognitional). Counts were normalized based upon the word count of the respective document and, where applicable, the appendices (i.e., count[s] per 1000 words of text). This last step helped ensure that the length of a document did not bias the frequency calculation of mentions or explanations.

We also investigated whether and how environmental justice concepts were presented and discussed in the appendices compared with the main UFMP document. In several instances, the appendices of UFMPs included public consultation data associated with the conception and development of the plan (e.g., public surveys, focus group responses) and other supporting information (e.g., species lists, tree policies).

Counts per 1000 words of UFMP text were compared to assess potential variability among cities’ reference to environmental justice concepts in their plans. The possible association between sociodemographic characteristics of the UFMP authoring city and the frequency of environmental justice concepts (“mentions” and “explanations”) in a respective plan were explored using census data (U.S. Census Bureau, 2019b). The publication date of a UFMP, and the population of the city authoring the UFMP, was examined for a relationship with the

frequency of justice mentions and explanations. Informed by earlier research that explored income and race (Gerrish and Watkins, 2018; Watkins and Gerrish, 2018), we tested ‘Median Household Income’, ‘Percent Black or African American’, and ‘Percent White Alone, not Hispanic or Latino’ as possible correlates with counts of reference to environmental justice in a UFMP.

4. Results

The locations of US cities with UFMPs analyzed in this study are shown in Fig. 2. Most of these cities are located on the West and East Coast or are in the Great Lakes Region; fewer cities in the US interior have UFMPs. In the state of Hawaii, Honolulu has a UFMP, and in the state of Alaska, Anchorage has a UFMP. The greatest number of UFMPs (n = 27, 25 %) originated in California, the most populous state in the US. Florida, the third most populous state, had eight UFMPs, while Washington, the thirteenth most populous state, had seven UFMPs. Of the remaining 47 states, 32 have at least one town or city with a UFMP. Washington DC also has a UFMP.

While UFMPs tend to be associated with mid- to large-sized cities, several notable exceptions exist. Six of the nation’s ten largest cities lack UFMPs (Los Angeles, CA; Houston, TX; Philadelphia, PA; San Antonio, TX; Dallas, TX; San Jose, CA). In contrast, there are several small cities (<15,000 residents) that have UFMPs which are included in this study (St. Albans, VT; Ashland, WI; Essex Junction, VT). The oldest UFMP was adopted by municipal council in Davis, CA in 2002, and the newest UFMPs were adopted in 2020 (Colorado Springs, CO; Denton, TX; Des Moines, IA; Gainesville, FL; Garden Grove, CA; Hartford, CT; Merced, CA; Miami Beach, FL; Seattle, WA; South San Francisco, CA; Syracuse, NY). Fourteen of the plans (13 %) were adopted before 2010, whereas 51 (48 %) were adopted after 2015. The length of the UFMPs’ primary documents varied greatly from Buena Park, CA (78,932 words) to Long Beach, CA (2655 words). The average length of primary UFMP documents was 18,089 words (Standard Deviation [SD] = 12,634). Of the 107 UFMPs, 94 (88 %) had appendices that varied widely in length with an average word count of 12,547 (SD = 20,718).

Total environmental justice mentions that included any reference to distributional, procedural and recognitional justice averaged 2.2 per 1000 words of text (SD = 1.7) per UFMP. The frequency of mentions varied from zero (Guttenberg, IA) to 7.2 per 1000 words (Grand Rapids, MI) per plan. Total environmental justice explanations were much less

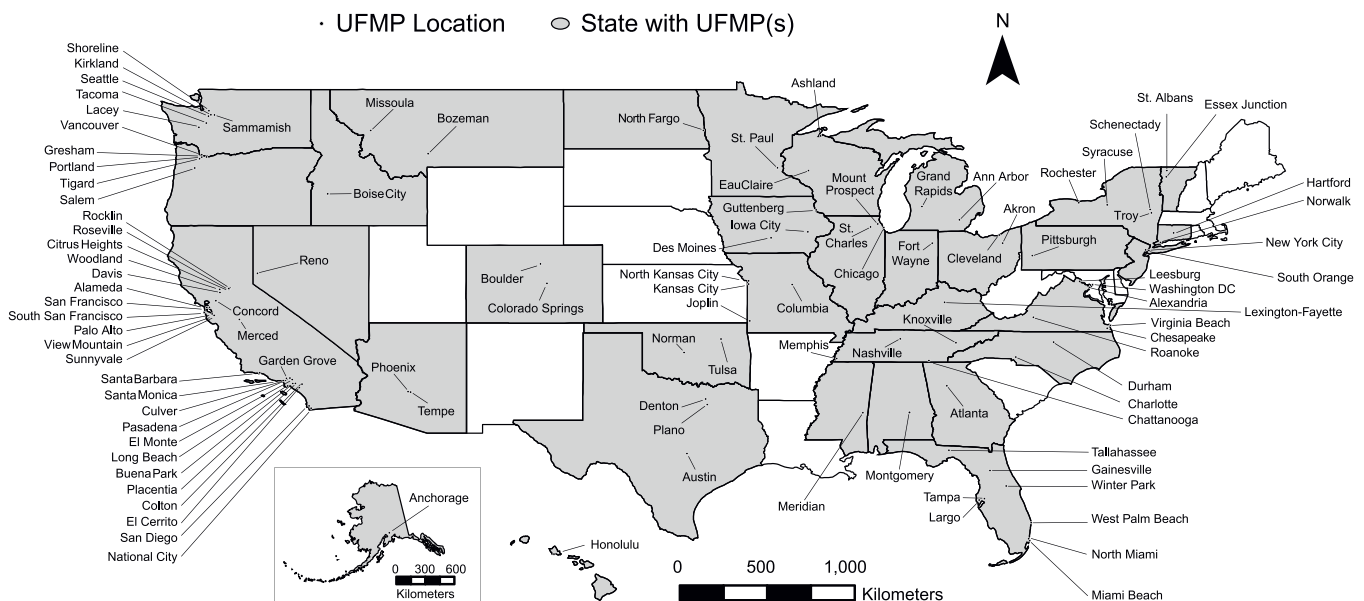


Fig. 2. Locations of US cities with UFMPs adopted between 2002 and 2020.

common and averaged 0.7 per 1000 words (SD = 0.7) per plan. Seattle, WA had the highest frequency of total explanations at 3.4 per 1000 words per plan, while 12 UFMPs (11 %) had no explanations. A full 62 UFMPs (58%) had fewer explanations than the mean number of explanations per 1000 words. Boxplots depicting the medians, quartiles, and outliers for mentions and explanations are presented in Fig. 3, with the main plan documents and appendices assessed separately.

4.1. Distributional justice

When considering both primary UFMP documents and appendices, 86 (80 %) made at least one mention of the content that was relevant to distributional justice. Notably, many representations of distributional justice themes in the UFMPs were made via figures, such as maps and graphs, rather than text. Of the 86 UFMPs (80 %) that made mention of distributional justice themes (e.g., identified low-canopy areas for planting), only 42 UFMPs (39 %) used words such as “(un)even” and/or “(in)equitable” to describe urban forest distribution across their city neighborhoods.

A Kruskal-Wallis test was conducted to determine if there were differences in the frequency of distributional justice mentions and explanations, per 1000 words, in the primary UFMP documents. We found no statistically significant difference between the frequency of mentions and explanations ($\chi^2 = 39.517$, $p = 0.09$). In contrast, the frequency of distributional justice mentions and explanations, per 1000 words, in UFMP appendices were compared and found to be statistically significantly different ($\chi^2 = 33.832$, $p = 0.002$); mentions had a mean of 0.22 and a median of 0 (IQR = 0–0.1), while explanations had a mean of 0.06 and a median of 0 (IQR = 0).

Through text supported by figures and/or maps, 17 UFMPs (16 %) highlighted that low-income and racialized communities live in neighborhoods with fewer urban trees than affluent and/or white communities. For example, Cleveland’s UFMP states: “Equitable distribution of benefits is a priority for Cleveland. Figure 15 shows how the benefits trees provide are distributed across the neighborhoods. In many cities, there are substantial disparities between neighborhoods due to gaps in

wealth or differences in social and political status” (Davey Resource Group, 2015b, p. 22). Furthermore, 24 UFMPs (22 %) also explained that those living in neighborhoods with fewer trees also live with less healthy environmental conditions (e.g., poorer air quality, hotter temperatures, increased flooding), and therefore, in some cases, suggested identifying and/or targeting these neighborhoods for tree planting. For example, Chicago’s Regional UFMP states:

“Chicago Region Trees Initiative has identified where trees are needed most... Figure 7 identifies priority communities based on levels of vulnerable populations (high poverty, low income, and low English proficiency), air pollution levels, low canopy cover, urban flooding, and high urban heat island. These communities tend to... experience a higher rate of issues such as flooding and poor air quality that additional trees could help ameliorate” (Chicago Region Trees Initiative et al., 2018, p. 18).

Occasionally, the low canopy neighborhoods proposed for targeted tree planting would be named within the respective UFMP.

Less than half of the UFMPs analyzed (n = 49, 46 %) provided examples of strategies for addressing distributional injustices related to urban tree planting. Those strategies included using Geographic Information Systems (GIS) to identify which neighborhoods have fewer urban trees, increasing funding sources to facilitate the equitable distribution of trees, and partnering with community organizations to help plant trees in low canopy neighborhoods. For instance, in Citrus Heights’ UFMP, the authors explained how: “...the GIS tree canopy layer can be used to identify neighborhoods and other locations with less trees, [and how] working with neighborhood groups, non-profits, and volunteers can increase awareness and participation in community tree-planting efforts to expand canopy in under-treed locations” (Davey Resource Group, 2015a, p. 50). While many of the UFMPs outlined strategies for addressing distributional injustices related to urban trees, only seven (7 %) provided some sort of implementation timeline related to these strategies (Charlotte, NC; Durham, NC; Hartford, CT; Largo, FL; Miami Beach, FL; Tacoma, WA; Tulsa, OK).

Of the 86 UFMPs (80 %) that made mention of distributional justice

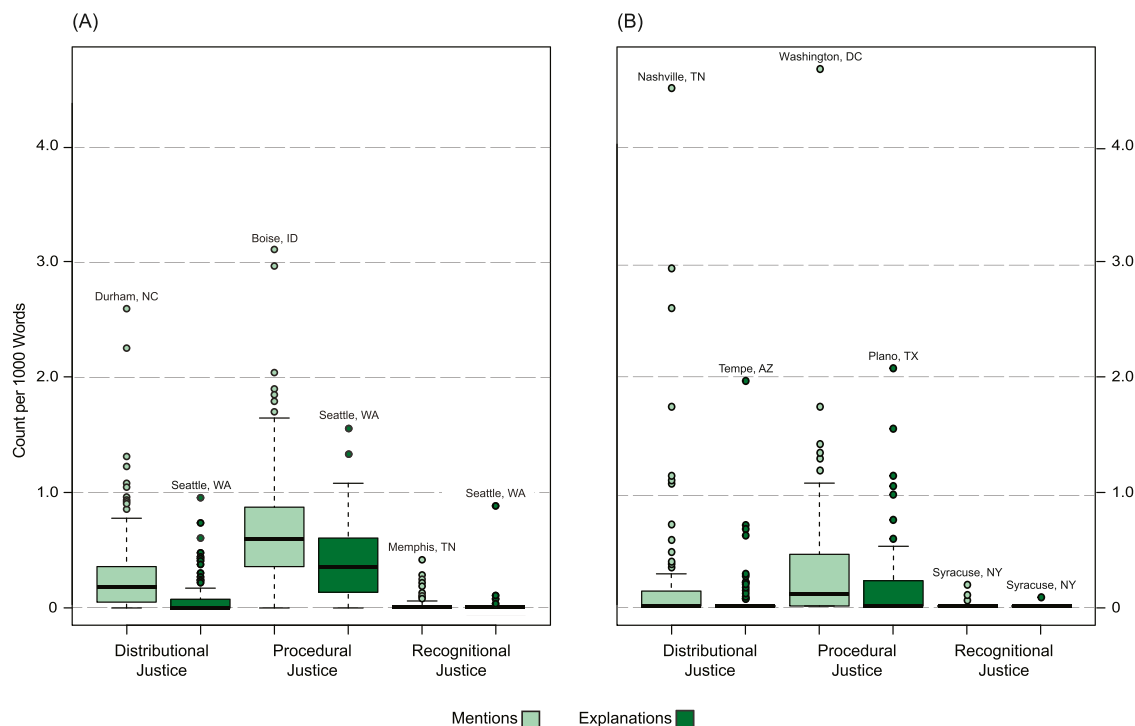


Fig. 3. Number of mentions and explanations, per 1000 words of UFMP text, for each of the three environmental justice pillars in (A) primary documents, and (B) appendices.

themes, only 12 (11 %) noted the inequitable distribution of maintenance procedures, most of which are reactive in practice. Notably, residents' perspectives on the uneven distribution of maintenance, and ultimately feelings of neglect, were captured via community surveys and public consultations in a few UFMPs ($n = 3$, 3 %). For example, in Pasadena's UFMP, a community resident shared: "In the four years that we've lived on this street, I have seen the Oak trees pruned only once. A greater effort towards regular maintenance in the less wealthy residential areas would be greatly appreciated" (Dudek, 2015, p. 272). In Vancouver's UFMP, another community resident shared:

"As a neighborhood leader one of the most difficult issues we deal with is maintaining street trees especially for lower income residents. Currently we have street trees that damaged sidewalks and bushes so overgrown they make the sidewalk unusable. Unfortunately, the residents cannot afford or otherwise don't have the resources to take care of these problems. If resources are going to be dedicated to Urban Forestry, they'd be more helpful in a maintenance program" (Conservation Technix Inc., 2007, p. 74).

Despite comments such as these from community residents, discussion of inequitable maintenance practices appeared absent from most of the UFMPs analyzed.

Seattle's UFMP was the only plan to mention gentrification and/or displacement in relation to tree planting, and only one mention was made concerning this topic. Included within a list of research areas of interest for the City of Seattle, the specific mention stated there was a desire to "[understand] how planting trees and improving the urban forest may lead to gentrification and displacement" (City of Seattle, 2020, p. 36). No UFMPs identified strategies for investigating or addressing the possible impacts associated with tree planting and gentrification.

4.2. Procedural justice

Of the 107 UFMPs analyzed, only three (3 %) made no mention whatsoever of content related to the concept of procedural justice (Guttenberg, IA; Montgomery, AL; Schenectady, NY). Using a Kruskal-Wallis test, we did not find a statistically significant difference between the frequency of procedural justice mentions and explanations, per 1000 words, in the primary UFMP documents ($\chi^2 = 59.996$, $p = 0.48$). Similarly, there was no difference in the frequency of distributional justice mentions and explanations in UFMP appendices, per 1000 words ($\chi^2 = 42.379.394$, $p = 0.1$).

We included the concepts 'community engagement/involvement' and 'public education regarding urban trees' as sub-themes of procedural justice as they are known components of fair and equitable decision-making. Both concepts were recurring themes across most of the UFMPs analyzed ($n = 101$, 94 %). Most UFMPs ($n = 93$, 87 %) stressed the importance of ensuring that the public receives educational information regarding the benefits and value of urban trees. Further, 94 UFMPs (88 %) provided strategies or tools for strengthening community engagement and/or public education. Some common examples of strategies or tools used to increase community engagement and public knowledge of tree benefits included using informational door hangers, social media, public websites, online story-mapping, and public events. However, only five (5 %) UFMPs mentioned organizing and delivering tree-related events and public meetings at varying times and/or locations. Additionally, public education was frequently described as one of the most effective strategies for encouraging future community-led tree plantings and maintenance. For example, in Phoenix's UFMP, the authors state that "by raising community awareness of and educating residents about the urban forest, stewards and champions can be created that will help to preserve, protect and increase the urban forest" (City of Phoenix, 2010, p. 32).

Apart from some instances where UFMPs ($n = 25$, 23 %) made mention of informing city residents about diseases and pests that infest

and kill certain tree species (e.g., Emerald Ash Borer, *Agrilus planipennis*), very few UFMPs ($n = 9$, 8 %) discussed informing the public about the potential risks or harms associated with urban trees (e.g., infrastructure conflicts, health and safety impacts, management costs). Further, while 37 UFMPs (35 %) highlighted the importance of informing city residents about various ordinances that affect urban trees on private residential property (e.g., tree removal policies), most UFMPs ($n = 94$, 88 %) did not outline larger policy issues, such as who is responsible and/or liable for the maintenance of a tree depending on its location and/or property regime (e.g., street trees). Thirteen (12 %) UFMPs acknowledged that urban tree-related educational and promotional materials should be published in multiple languages and free of technical jargon. Two UFMPs (Chicago, IL; Syracuse, NY) mentioned that non-native English speakers should be engaged in their native languages when discussing urban forest matters. For example, Chicago's Regional UFMP outlined that "there is a need to expand education and outreach opportunities to individuals who do not speak English and to partner with professionals in the field who speak other languages who can assist in engaging and educating broader, more diverse audiences" (Chicago Region Trees Initiative et al., 2018, p. 18).

Importantly, to support community engagement and public education efforts, most UFMPs ($n = 80$, 75 %) suggested that non-municipal actors (e.g., volunteers, city residents, non-profits, schools) play a role in educating the public about the benefits and value of urban trees, inventorying trees, and tree planting and maintenance. Regarding education, Tallahassee's UFMP states that "the city does not have to lead or take on the full financial and staff support for this educational effort, but should assist and motivate non-profits, schools, and county and state partners to spread the word" (Davey Resource Group, 2018, p. 70). Most of these UFMPs stress the importance of partnering with and relying on community residents or volunteers to grow and maintain the urban forest ($n = 70$, 65 %). For example, Alexandria's UFMP provides a recommendation to "engage citizens by creating opportunities to become program volunteers to assist in completing vital maintenance tasks... that are currently not funded or inadequately funded for completion by City staff" (City of Alexandria, 2009, p. 5).

Twenty-two plans (21 %) included raw and/or summative public consultation data or public meeting minutes in their appendices; ten other plans (9 %) included this data in the main document. These UFMPs tended to have higher procedural justice counts than UFMPs that did not include public consultation data. Several UFMPs ($n = 46$, 43 %) also discussed how public feedback was collected, which neighborhoods were included, and/or how public consultations and community meetings were advertised. For example, Pittsburgh's UFMP states the community "responses were collected from online computer surveys, person-to-person surveys, and survey form collection boxes. The online survey was promoted from e-mail list servers, partner organization websites, and news media. On-site surveys were conducted at public events [and] community meetings" (Davey Resource Group, 2012, p. 16). While some plans discussed how they collected public feedback, they did not always describe how the input contributed to the goals of the UFMP, what power dynamics existed between stakeholders, how conflict (if any) was dealt with, or how consensus was created.

4.3. Recognition justice

Recognition justice themes were not discussed in the majority of UFMPs analyzed. Only 28 UFMPs (26 %) mentioned topics relevant to recognition justice, and only eleven UFMPs (10%) had more than two mentions. Of the few that mentioned themes related to recognition justice, Seattle's (2020) UFMP was the only plan with a relatively high explanation count. Still, a Kruskal-Wallis test showed that a statistically significant difference in frequency of mentions and explanations, per 1000 words, was found between the primary UFMPs and between appendices. For the primary UFMP documents, mentions were found to have a mean of 0.03 and median of 0 (IQR = 0–0.025), whereas

explanations had a mean of 0.01 and median of 0 (IQR = 0), $\chi^2 = 26.705$, $p < 0.001$. Mentions in the appendices had a mean of 0.004 and a median of 0 (IQR = 0), explanations had a mean of 0.001 and a median of 0 (IQR = 0), $\chi^2 = 24.012$, $p < 0.001$.

Of the 28 UFMPs (26 % of total analyzed) that included recognitional justice themes, 21 mentioned targeting or prioritizing tree planting and outreach efforts in “disadvantaged”, “underserved”, “under-resourced”, and/or “unfunded/under-funded” communities, as well as those living in neighborhoods with the least access to urban forest benefits. Seven UFMPs (7 %) mentioned, and in some cases explained, how historical policies, practices, and planning decisions, many of which were discriminatory, influenced the distribution of urban trees in their city. Some examples include the past funding of tree planting in white neighborhoods by federal and municipal governments, redlining, and the underfunding or defunding of municipal parks and recreation departments. Seattle’s UFMP described its historical timeline as:

“...ranging from the time before the European settlement, where the forest was central to the culture and lifestyle of the Indigenous people[s] that inhabited the area, to redlining that led to a pattern of Black, Indigenous, and People of Color residents disproportionately living in less desirable areas with lower canopy cover, to today” (City of Seattle, 2020, p. 4).

Five UFMPs (5 %) mentioned that communities have varying needs, goals, perspectives, values, and priorities when it comes to the urban forest and suggest that local engagement is essential to center the needs and interests of each community. Seven UFMPs (7 %) mentioned partnering with local non-profits or neighborhood groups that have deep connections and relationships with these communities to better engage with disadvantaged and neglected groups. For example, Syracuse’s UFMP noted that:

“...great lengths were taken to engage community members that traditionally have not been at the table regarding trees and other community planning initiatives. Meetings were planned with neighborhood organizations that have deeply reached into the diverse groups and neighborhoods of Syracuse, and a broad geographic representation was received through our survey responses” (Davey Resource Group, 2020, p.95).

Despite the few UFMPs ($n = 21$, 20 %) that described interest in engaging disadvantaged and/or neglected groups within the planning process, many plans discussed community engagement generally as either a city-wide or universal effort (i.e., without targeting specific neighborhoods or communities) ($n = 67$, 63 %) or did not talk about community engagement or outreach at all ($n = 17$, 16 %).

Seattle’s UFMP was the only plan to emphasize recognitional justice. Early into Seattle’s UFMP, the authors explicitly define “environmental justice priority communities” as “communities of color, immigrants, refugees, youth, individuals with limited English proficiency, people with low incomes, and Indigenous peoples” and noted their commitment to intentional and ongoing engagement with these historically under-represented communities (City of Seattle, 2020, p. 21). Based on Seattle’s engagement with and feedback from these communities, their “plan goals and strategies were modified to focus on racial and social equity” (City of Seattle, 2020, p. 6). Seattle was the only city to list racial and social equity as an outcome of their UFMP and list it as the very first outcome of the plan. This specific outcome was written in Seattle’s UFMP as: “1. Racial and Social Equity: Urban forestry benefits and responsibilities are shared fairly across communities, community trust is built, and decisions are guided by diverse perspectives, including those of environmental justice communities” (City of Seattle, 2020, p. 28).

4.4. Environmental justice, plan age and UFMP city demographics

The Spearman’s rank correlation test was used to determine whether environmental justice mentions and explanations, per 1000 words, were

associated with UFMP publication year. We tested counts for the three justice pillars independently and in sum for both the primary UFMP documents and appendices. A statistically significant positive correlation was found between total environmental justice explanations (sum of three pillars) in the combined UFMP document (primary and appendix) and UFMP publication year, $r_s = 0.3$, $p < 0.001$ (Fig. 4). Cities with UFMPs were divided into two groups based on population ($\leq 100,000$ and $> 100,000$ inhabitants) and differences in total environmental justice counts (sum of three pillars) for mentions and explanations were compared using a Kruskal-Wallis test. We found that UFMPs authored by cities with $> 100,000$ residents had more mentions per 1000 words (Fig. 5), with a mean of 1.9 and median of 1.5 (IQR = 0.9–2.4) compared with mean of 1.0 and median of 0.8 (IQR = 0.6–1.5), $\chi^2 = 8.693$, $p = 0.003$. Likewise, explanations had a mean of 0.8 and a median of 0.6 (IQR = 0.3–1.3) compared with a mean of 0.5 and a median of 0.3 (IQR = 0.1–0.7), $\chi^2 = 7.689$, $p = 0.006$. Using a Spearman’s rank correlation test, we identified a statistically significant positive correlation between percent “Black or African American” in cities with UFMPs and distributional justice explanations, $r_s = 0.25$, $p = 0.01$ (Fig. 6a). In contrast, distributional justice explanations were statistically significantly negatively correlated with percent “White, Not Hispanic or Latino”, in cities with UFMPs, $r_s = -0.22$, $p = 0.02$ (Fig. 6b). One additional statistically significant correlation was identified between procedural justice mentions and percent “White, Not Hispanic or Latino” in cities with UFMPs, $r_s = 0.23$, $p = 0.02$ (Fig. 6c).

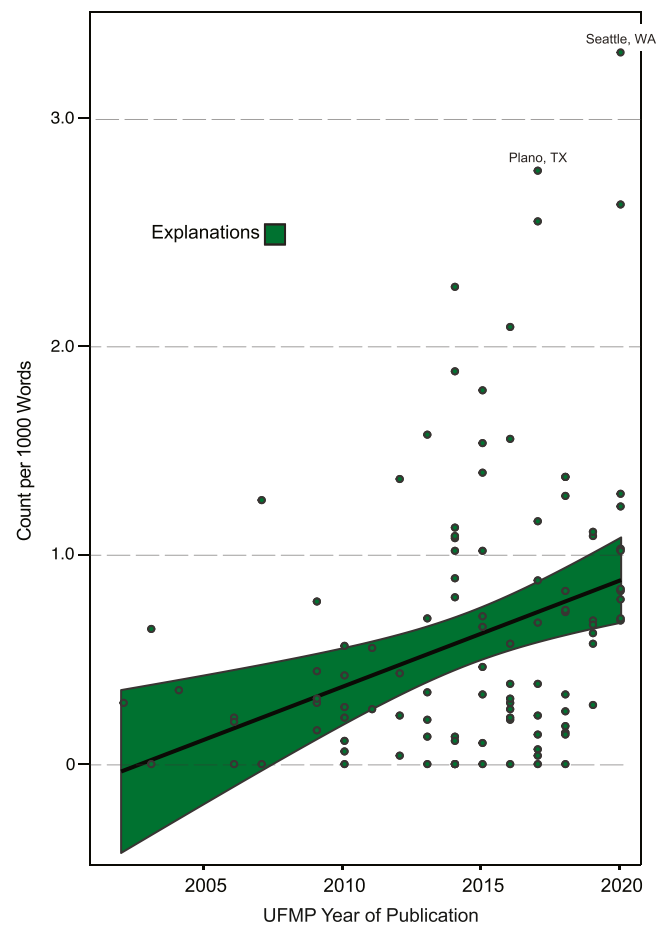


Fig. 4. Correlation between UFMP publication year and number of environmental justice explanations (sum of mentions for distributional, procedural, and recognitional justice) per 1000 words of UFMP primary document text.

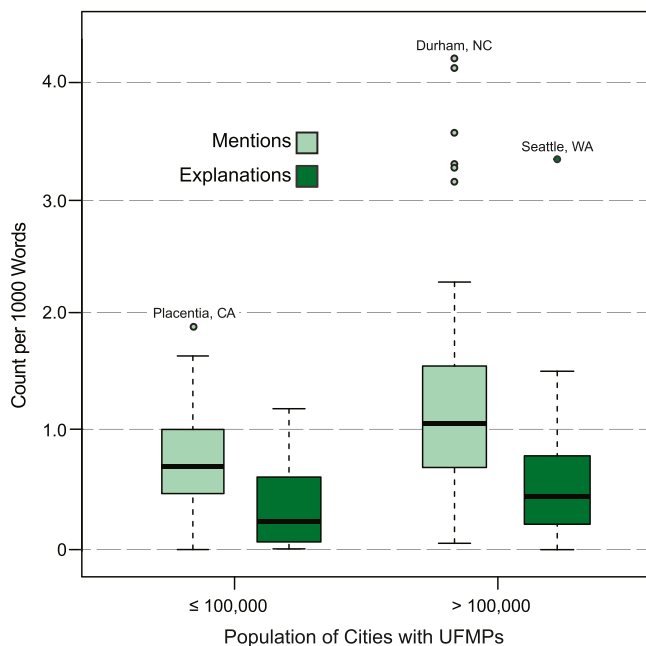


Fig. 5. Number of environmental justice mentions and explanations (sum of distributional, procedural, and recognitional justice for each), per 1000 words of UFMP primary document text, grouped into authoring cities of $\leq 100,000$ residents and $> 100,000$ residents.

5. Discussion

While most urban forestry literature has focused on distributional injustices related to UTC cover (Nesbitt et al., 2019b; Riley and Gardiner, 2020), our results suggest municipalities with UFMPs place greater attention on procedural justice. This finding may partly be due to the generous nature through which procedural justice codes were counted since "community engagement/outreach" and "public education" were included as components of procedural justice. While these concepts do not equate to procedural justice on their own, they are important themes associated with procedural justice (Edge et al., 2020), and therefore were included under this pillar. Urban forests mainly exist on private residential property (Nguyen et al. 2017), and even street tree plantings along the public right-of-way in US cities involve some level of resident buy-in (Carmichael and McDonough, 2018, 2019). Consequently, it may be unsurprising that most UFMPs discussed community engagement/outreach and public education since residents or property owner engagement is required (Nguyen et al., 2017). UFMPs that explained public consultation steps and included raw/summative data from community members had a higher procedural justice count.

Additional considerations among proponents of procedural justice include issues related to relationship-building, trust, and fairness during conflict resolution and/or when making resource allocation decisions (Hammond Wagner and Niles, 2020). These considerations were infrequently mentioned or elaborated upon across UFMPs. Therefore, plans may benefit from additional consideration to these factors to complement existing public engagement, outreach, and inclusion efforts. Procedural issues of trust, relationship-building and fairness overlap with recognitional environmental justice dynamics (e.g., whether the perspectives of disadvantaged groups are recognized and prioritized). Some scholars use the terms "procedural justice/equity" and "recognitional justice/equity" interchangeably (Schwarz et al., 2015; Nesbitt et al., 2019a). Observing the nuances between these terms yields more targeted solutions for advancing and realizing environmental justice in urban forest management.

UFMPs authored by cities with a larger proportion of Black residents had greater distributional justice explanation counts. The inverse was

true for cities with a larger proportion of white residents. Considering that most US cities have fewer urban trees in Black neighborhoods and more trees in white communities (Watkins and Gerrish, 2018), it may be expected that urban foresters in cities with higher populations of Black residents have a greater sense of awareness concerning these inequities, and therefore placed more emphasis on them in their UFMPs. Given growing awareness of known race-related distributional inequities, it is important to highlight that procedural justice mention counts were in contrast higher in UFMPs authored by cities with a larger proportion of white residents (despite low-level acknowledgment of race-related distributional and recognitional inequities). Further research is needed to understand these relationships, including the potential underlying role of education, grassroots/advocacy organizations, political leadership and values, and media discourse in influencing the in/exclusion of distributional and procedural justice concepts in UFMPs. Nonetheless, these findings suggest that current states of practice of public engagement, participation, and educational outreach within urban forestry and planning continued to be centered within white (and usually affluent) communities. This is likely a result of urban forestry and planning operating within the context of systemic racism and white supremacy (see: Schell et al., 2020; Heynen and Ybarra, 2021; Hoover and Lim, 2021). For example, urban greening and environmental conservation initiatives have produced racist and classist forms of land dispossession; management decisions have historically privileged white, urban, bourgeois interests; priority concerns of racialized populations have been overlooked; and environmental organizations have continued to lack diversity (Curnow & Helferty, 2018; Mullenbach et al., 2022). Further, some scholars have argued that community engagement (which accounted for most of the procedural justice mentions found in the UFMPs analyzed) is often operationalized to support pre-existing goals of decision-makers rather than centering the needs of oppressed and neglected groups (Gibson-Wood and Wakefield, 2013). Moreover, the majority of UFMPs ($n = 86$; 80 %) excluded recognitional justice themes (e.g., prioritizing the perspectives of neglected and oppressed groups, acknowledging historical discriminatory planning policies). Therefore, authors of future UFMPs should consider expanding on procedural justice goals and integrate recognitional justice concepts within their work and broader efforts toward environmental justice.

Of the 86 UFMPs (80 %) that mentioned or explained themes related to distributional justice, 42 (39 %) referred to the (in)equitable or (un) even distribution of urban trees across city neighborhoods. However, only 12 UFMPs (11%) referred to the (in)equitable distribution of maintenance procedures. This finding is likely a result of the underfunding of municipal parks and recreation departments that often have limited resources for supporting tree care (Roman et al., 2021a) and therefore adopt a reactive, complaint-driven approach to maintenance (Vogt et al., 2015). It is common for municipalities to respond to emergencies regarding extreme events (e.g., storms) rather than create a proactive plan for pruning, watering, and mulching (Hauer and Peterson, 2016). If trees are not properly maintained, it can create the impression that the municipality cannot care for existing trees. Therefore, community members may not trust municipalities to care for new tree plantings (Carmichael and McDonough, 2018; Shcheglovitova, 2020). This cycle can contribute to increased resistance to tree planting in neglected or under-resourced neighborhoods, because even when a tree is offered for free, residents may worry about financial costs associated with tree maintenance (e.g., pruning, increased water demand) and potential liability (Carmichael and McDonough, 2019; Roman et al., 2021b). Prioritizing maintenance in communities that have been historically neglected could help rebuild trust and increase tree planting in neighborhoods with fewer trees.

Gentrification and/or displacement was only mentioned once in one UFMP (Seattle, WA). This may be because urban foresters do not have jurisdiction over housing or land use decisions (Sheppard et al., 2017). Nonetheless, it is common for municipal urban foresters to work closely with land use planners and real estate developers to advance

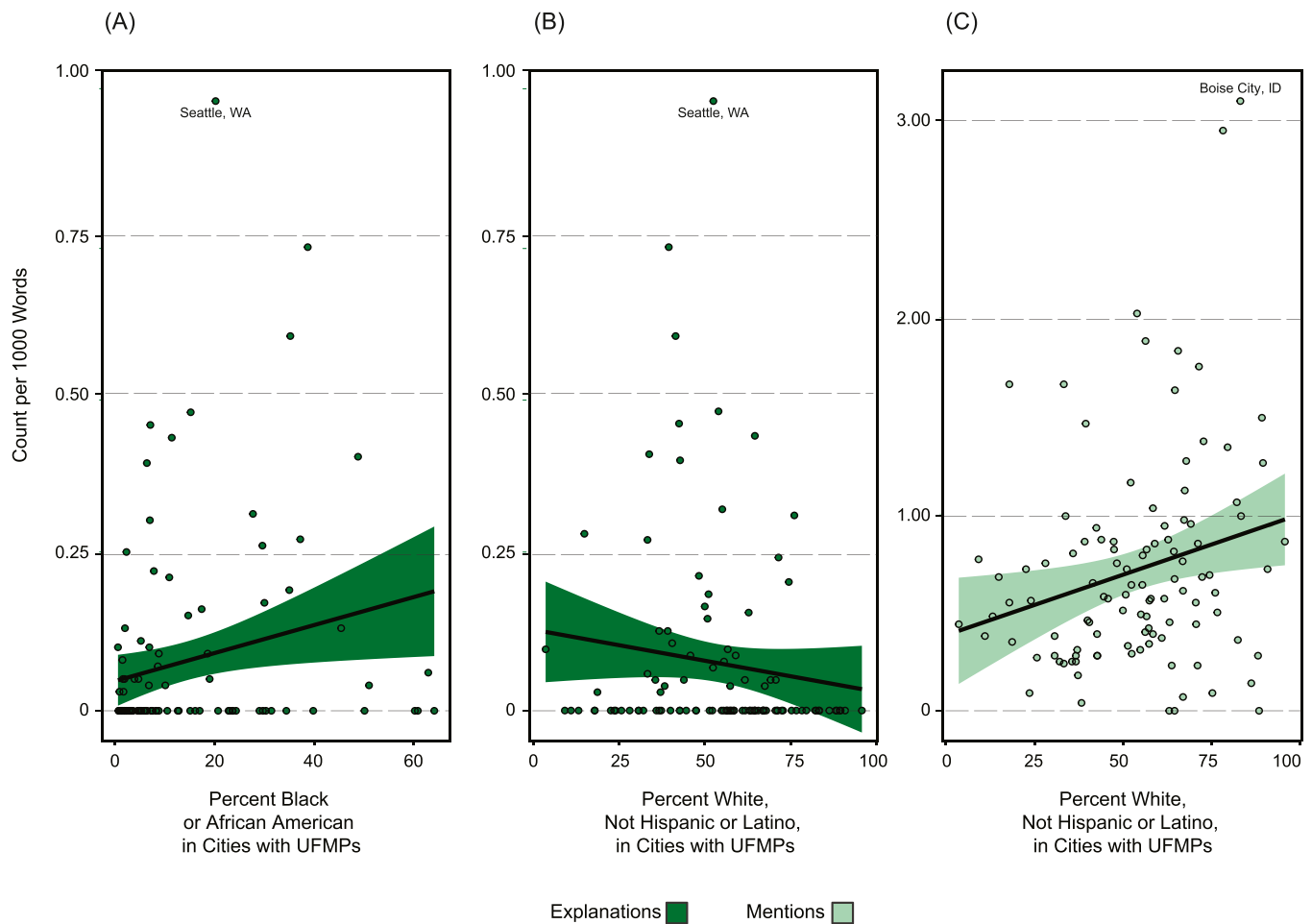


Fig. 6. Correlation between distributional justice explanations, per 1000 words, in UFMP primary documents and (A) Proportion of Black or African American residents in UFMP authoring cities, and (B) Proportion of white, not Hispanic or Latino, residents in UFMP authoring cities. (C) Correlation between procedural justice mentions, per 1000 words, in UFMP primary documents and proportion of white, not Hispanic or Latino, residents in UFMP authoring cities.

tree-planting goals (Sheppard et al., 2017). Moreover, gentrification is an important environmental justice issue associated with urban tree planting (Donovan et al., 2021). City governments have started to create action plans dedicated to avoiding gentrification and displacement (e.g., City of Portland's Anti-Displacement Action Plan, 2021; City of Tacoma's Anti-Displacement Best Practices, 2021); however, these plans are not focused solely on green gentrification. Therefore, outlining specific strategies for preventing green gentrification in UFMPs could help strengthen environmental justice outcomes in cities. In addition, greater coordination between urban foresters, housing organizations, and municipal planning departments is needed (Rigolon and Németh, 2018). Addressing procedural and recognitional injustices, such as inequitable access to decision-making among neglected and oppressed groups, may reduce possible "unintended" consequences related to urban tree planting, namely environmental gentrification. Still, more research is needed to investigate whether and how municipal urban foresters are working with planning departments, developers, and non-profit housing organizations to address green gentrification in cities (e.g., through policies and regulations that prevent gentrification). We encourage cities to include strategies for avoiding green gentrification and/or displacement within their future UFMPs.

Most UFMPs ($n = 80$; 75 %) suggested that non-municipal actors, such as local non-profits, schools, volunteers, and community groups, should help provide public education on the benefits of urban trees, support with tree inventories and/or assist with delivering tree-planting and care programs. This direction aligns with neoliberal governance strategies (e.g., minimal government intervention, emphasis on private

sector partnerships, private property rights). Such approaches can result from municipal resource constraints (Campbell, 2014). Unsurprisingly, most municipalities stress the value of volunteers and other non-municipal actors in their UFMPs, considering historic disinvestment from parks and recreation departments across many US cities (Vogt et al., 2015; Roman et al., 2021a). Some scholars argue that the neoliberalization of responsibility in urban forestry, while dependent on context, can increase collaboration across various stakeholder groups, strengthen community engagement, and create a sense of ownership while reducing operating costs (Fisher et al., 2011; Watkins et al., 2018). However, increased pressure and reliance on local non-profits, community groups, and volunteers to support tree planting and maintenance can result in uneven power dynamics between state and non-municipal actors and place an additional burden on populations already experiencing cumulative socio-economic and environmental inequities (Perkins, 2013; Campbell, 2014). Municipalities therefore may wish to consider providing opportunities to community residents to participate in urban greening work beyond volunteerism. Research suggests that community residents, especially those from neglected and oppressed groups, should have an opportunity to meaningfully participate in decision-making processes (Teelucksingh and Poland, 2011) surrounding municipal urban forest planning goals (e.g., tree species selection, planting locations, maintenance procedures) (Carmichael and McDonough, 2019). Yet, urban residents must also have the desire and ability to participate; it is not sufficient to just invite certain community groups to contribute (Nesbitt et al., 2018). Increasing workplace diversity among urban foresters in municipal departments and non-profits may

help residents see their identities, perspectives, and interests reflected within decision-making and, therefore, this may increase resident desire and interest to participate in the political process (Nesbitt et al., 2018).

Across the 107 UFMPs analyzed, public education concerning the value and benefits of urban trees was described as one of the most vital strategies for ensuring future community-driven tree plantings and maintenance. This narrative suggests that if a person or community knew more about the value and benefits of urban trees, then they would be more willing to plant them, care for them, and invest in them financially. Moreover, it implies that distributional inequities related to UTC cover may be due to some residents not realizing the value of urban trees. However, this narrative oversimplifies the spatio-temporal and socio-ecological complexity of urban forest systems, as there are other legitimate structural, historical, and institutional factors that impact the distribution of urban trees (Locke et al. 2021; Roman et al. 2021a).

Mainstream approaches to knowledge translation and education rests upon two assumptions that limit the ability to strengthen environmental justice (Masuda et al. 2014). First, there is the assumption that inequities result from a knowledge deficit rather than competing priorities, vested interests, and fiscal austerity. Second, there is the assumption that all stakeholders share a common aim. Masuda and colleagues outline that an equity-focused approach to knowledge transfer recognizes the relationship between knowledge and power and the institutional and/or regulatory conditions in which knowledge is produced, translated, and communicated. Their prescribed framework for an equity-focused approach to knowledge transfer involves a reflexive practice that embraces inclusivity, transparency, and humility (Masuda et al., 2014). In the context of translating knowledge from urban foresters to community members about the value and benefits of urban trees, inclusivity involves recognizing and acknowledging power dynamics across stakeholder groups. Transparency means effectively communicating the benefits of urban trees and the potential risks and "disservices" associated with them. Humility involves active listening and deep reflexivity. For those responsible for public outreach, it means sharing space, knowledge, and welcoming insights from "non-experts" or those with lived experience (e.g., long-term residents from a low canopy or neglected neighborhood). Integrating an equity-focused approach to knowledge translation in UFMPs and subsequent management practices may help municipalities realize environmental justice goals related to urban trees.

Recognitional justice was the least mentioned or explained environmental justice pillar across the UFMPs analyzed. Seattle was the only city with a relatively high mention and explanation count, and only 27 other UFMPs (25 %) made mention of the content that was relevant to recognitional justice. Recognitional injustices occur when certain groups are unrecognized or willfully excluded from the political process (Young, 1990; Fraser, 1997). When certain groups are unrecognized or underrecognized, their collective and unique views are not expressed in decision-making. Therefore, they are not reflected in policy creation, which directly influences the distribution of environmental goods/harms (Schlosberg, 2007).

Notably, the historical, cultural, or institutional factors influencing community perspectives concerning city trees may not always be related to trees. For example, past discriminatory planning practices (e.g., urban renewal policies, redlining), localized examples of environmental racism (e.g., siting of toxic waste sites), and/or municipal disinvestment in specific communities has resulted in cumulative injustices (Edge et al., 2020), and distrust among community members toward municipalities and the state more broadly (Bullard, 1993; Collin et al., 1995). Further, these unjust practices often become systemic and normalized such that the same neighborhoods that experience disinvestment or redlining often have less UTC cover (Schell et al., 2020; Locke et al., 2021). Therefore, urban foresters may wish to consider acknowledging past discriminatory planning practices, even if they are not directly linked to urban trees, within their UFMPs and subsequent management practices to build solidarity and trust with communities that have been

historically neglected and oppressed. Seattle's UFMP provides a strong example.

Despite the many omissions of environmental justice themes in the UFMPs investigated, it is notable that newer plans show a trend toward a greater number of explanations. This may reflect a greater awareness and commitment to environmental justice principles among urban foresters. Urban foresters in Holyoke, Massachusetts are a contemporary illustrative example of this commitment as they have published what we believe is the first Urban Forest Equity Plan in the US – a plan that prioritizes equity explicitly, distinguishing itself from most other US UFMPs that are broader in scope (City of Holyoke, 2021). Our findings also show a positive association between city population and a higher frequency of environmental justice mentions and explanations. There are likely many reasons for this result, including more resources devoted to the planning process, a greater diversity of voices contributing to the plan, as well as more and varied community input. Our findings also highlight a spatial trend in the presence and absence of UFMPs in cities across the US. Future research should explore why these spatial trends exist, as well as what motivates cities to develop UFMPs and in/exclude environmental justice goals within them. Future research should also investigate whether and how different types of authoring stakeholders (e.g., municipal planners, urban foresters, non-profits, consulting firms) influence the treatment of environmental justice goals within UFMPs.

Self-education among urban foresters can play a key role in the transition toward more just and inclusive urban forest systems, and more broadly, socio-ecologically sustainable futures, especially concerning the impacts of racism, class inequality, and other related inequities regarding access to infrastructure and amenities (including trees) (Schell et al., 2020; Dean et al., 2021). This learning includes examining how or whether environmental injustices are considered, addressed and/or perpetuated through planning documents, management, and decision-making practices (Dorries et al., 2019). Indeed, we note that this self-learning process has already begun in the urban forestry profession through environmental justice trainings offered through the Alliance for Community Trees and a private consultant (Arbor Day Foundation, 2021).

6. Conclusion

Environmental justice has not been a central theme in UFMPs published in the US. In general, environmental justice visions, goals, and/or implementation strategies have lacked both attention and detail. Specifically, recognitional justice content was missing from most UFMPs. This omission indicates that urban foresters may not be prioritizing the perspectives of neglected and oppressed groups within decision-making. While many UFMPs highlighted the importance of community engagement and public education regarding urban tree benefits, other aspects of procedural justice (e.g., engaging residents in different languages, building trust, communicating risks and liability) were absent from most plans.

UFMPs are a key representation of the current state of urban forest management practice. Future research should examine urban foresters' perspectives and the factors that enable or constrain their ability to realize environmental justice goals. Further research attention should also be given to efforts driven by community-based actors outside of government, as well as the actualization of environmental justice goals through plan implementation and program process. Moving forward, urban foresters may consider building upon growing strengths in community engagement and public education through adopting an equity-focused approach to knowledge translation. The practice of urban forestry may benefit from understanding, acknowledging, and taking accountability for historical, cultural, and institutional factors that may influence urban forest management along with centering the perspectives, experiences, knowledge, and aspirations of oppressed and neglected groups. Embedding such awareness in UFMPs can help achieve more equitable urban futures.

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CRedit authorship contribution statement

Amber Grant: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, **Andrew A. Millward:** Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing, Visualization, **Sara Edge:** Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing, **Lara A. Roman:** Writing – original draft, Writing – review & editing, **Cheryl Teelucksingh:** Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

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

Data availability

Data will be made available on request.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ufug.2022.127737](https://doi.org/10.1016/j.ufug.2022.127737).

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