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Volunteer engagement in urban forestry in the United States: reviewing the literature

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ABSTRACT

This article presents the results of a literature review related to volunteerism in urban forestry in the United States. **Themes explored were inductively emergent from the research reviewed and included ‘volunteer demographics’, ‘motivations of volunteers’, ‘benefits of volunteering’, ‘volunteer engagement and barriers’, ‘value of volunteering’, and ‘volunteer recruitment and retention’.** Urban forestry volunteers are often motivated by personal, social, and environmental considerations. Volunteers in urban forestry may not be representative of a cross-section of the communities that they are serving, rather they are often middle-aged, well-educated white women. Further research is required both to ascertain barriers to volunteerism and to enhance future volunteer recruitment and retention efforts. Volunteers in the United States account for 5% of municipal tree care in urban forests – accounting for an estimated \$35 million USD in value. Volunteers perform critical urban forestry-related tasks that aim to increase urban tree canopy cover through tree selection and planting efforts. Volunteers encourage urban tree survival by advocating for, as well as performing, important maintenance-related duties including the administration of supplemental watering and urban tree pruning. With proper training and support, volunteers may accurately perform important data collection efforts that may inform management decisions and urban tree care maintenance programmes.

KEYWORDS

Urban forest; volunteer;
urban forestry; citizen
science

Introduction

The urban forest may be defined as all woody plants and vegetation in and around dense human settlements, such as street trees, residential trees, park trees, and green-belt vegetation (Miller, Hauer, & Werner, 2015). Urban forestry was first defined by Professor Eric Jorgensen, University of Toronto (1970):

“Urban Forestry is a specialized branch of forestry and has as its objective the cultivation and management of trees for their present and potential contributions to the physiological, sociological, and economic well-being of urban society. These contributions include the over-all ameliorating effect of trees on their environment, as well as their recreational and general amenity value” (pp.43a-51a).

More recently, a content analysis of 58 urban forestry definitions found that urban forestry can be summarised into six categories: People, geography, benefit, resource, activity, and science (Brown, 2007; Miller et al., 2015). With 80% of the United States (U.S.) population living in urbanised areas, urban forests are the contemporary forest-types with which most Americans are familiar. Urban forests provide important services by reducing structural cooling costs, stormwater runoff, and noise pollution; by enhancing property values, wildlife habitat, and biodiversity; and by providing positive emotional and spiritual experiences for citizens and residents (Bosci et al., 2018; Nowak & Greenfield, 2018; Peckham, Duinker, & Ordóñez, 2013; Roy, Byrne, & Pickering, 2012).

Worryingly, urban tree canopy cover (UTCC) has been decreasing in the conterminous U.S. (~1.0% total from 2009–2014), while impervious cover has been increasing (~1.0%) (Nowak & Greenfield, 2018). Although a 1.0% decrease may seem minimal, it equates to the annual loss of approximately 36 million trees (the equivalent of 175,000 acres), and an annual economic loss of urban forest benefits conservatively estimated at \$96 million USD (Nowak & Greenfield, 2018). Furthermore, funding for urban and community forestry at the state level has also decreased, and although federal support for urban and community forestry activities has increased, a majority (58.9%) of state urban and community forestry coordinators believe that the total funding has not kept pace with mounting costs and should be increased further (Hauer & Johnson, 2008).

Though legislation and regulations designed to advance urban and community forestry practices and promote urban forest sustainability have increased in recent years (Hauer & Johnson, 2008), policies and ordinances have actually been in effect for several centuries in the U.S. Hastings (1921) described a law originating in 1633 that prohibited the wanton felling of trees that lined the path from Cambridge to Charlestown, Massachusetts. According to this ordinance, violators would be fined five shillings for every tree removed (Hastings, 1921). In 1807, Michigan Territory law specified the installation of trees as it was thought that they would be an important component of providing a healthier environment for citizens – one of the same reasons why cities plant trees today (Hauer, 2018). In 1896, Massachusetts state law enabled municipalities to appoint the first urban forestry officials responsible for the management of trees in the public right-of-way, known as municipal tree wardens. In 1899 their appointment was mandated at the community level (Harper, Bloniarz, DeStefano, & Nicolson, 2017; Miller et al., 2015; Ricard & Bloniarz, 2006). Research interviews conducted over a multi-year period with tree wardens demonstrated that these professionals routinely interact with citizen volunteers engaging in urban forestry-related activities (Harper et al., 2017).

Volunteers account for a small (5%), yet significant amount of municipal tree care performed in the United States (Hauer et al., 2018). According to Roman, Smith, Dentice, Maslin, and Abrams (2018), members of the public play a valuable and multi-faceted role in stewarding and studying urban trees and green spaces. Volunteers often engage in a variety of tasks that include the installation of urban trees (Figure 1, Figure 2) and maintenance practices that may include the watering (Figure 3) or pruning (Figure 4) of urban trees (Fazio, 2015). They may also find themselves participating in a suite of duties related to urban forest inventory initiatives that include critical assistance with data collection (Figure 5, Figure 6) (Bloniarz & Ryan, 1996). Volunteers may also educate

fellow community members and advocate before local government officials on behalf of the urban forest (Harper, Huff, Bloniarz, DeStefano, & Nicolson, 2018).

A committee that volunteers may find themselves routinely participating in – and even initiating the formation of – is a local tree board. Tree board volunteers may act in an official capacity on issues pertaining to the management of their urban forest (Harper et al., 2018). Though tree board volunteers are routinely tasked with the care of trees located in urban streets and parks, they may also find themselves concerned with the management of urban trees found growing on private properties. This is an important consideration since trees growing on private landscapes may comprise up to 90% of the urban tree canopy cover of a community (Fazio, 2015). Whatever the setting, volunteers that comprise tree boards endeavour to “reflect the will of the community” (Fazio, 2015) and balance the needs of urban trees with the resources of the municipality.

Regardless of the task, volunteer contributions to the urban forestry sector are increasingly important in this era of austerity. With this in mind, the following literature review synthesises the current state of knowledge regarding urban forest volunteers. It also calls attention to areas requiring further investigation and research, including the need to better understand urban forest nongovernmental organisations (NGOs) that develop programmes utilising volunteers, the potential success rate of urban trees stewarded by volunteers, and further details related to better understanding the subtleties and nuances of volunteer motivations. Information related to the detriments or perceived detriments of utilising volunteers in the urban forest was also included in this review.



Figure 1. Community volunteers gather to celebrate an urban tree planting initiative.

Photograph: D. Bloniarz



Figure 2. Community volunteers planting trees. Photograph: D. Bloniarz.

Methods

A total of 185 research articles regarding urban forest volunteers were reviewed and compared, predominantly from four major urban forestry journals: *Arboriculture & Urban Forestry* (AUF) (formerly known as the *Journal of Arboriculture*), *Urban Forestry & Urban Greening* (UFUG), *Cities and the Environment* (CATE), and the *Arboricultural Journal*. Articles were identified in the University of Massachusetts library research database, the United States Forest Service TreeSearch database, and the International Society of Arboriculture research database. Emphasis was placed on articles within the discipline of urban forestry that featured a qualitative discussion of volunteerism. Textbooks, web-based industry resources, professional white papers and government reports were also reviewed. These resources were searched using the key word phrase “urban forest” “urban forestry” and variations of the keyword “volunteer” including “volunteering” and “volunteerism”. The following themes were emergent from the literature reviewed and formed the outline for this review: volunteer demographics, motivations of volunteers, benefits of volunteering, volunteer engagement and barriers, value of volunteering, accuracy and reach of volunteer work, and volunteer recruitment and retention.



Figure 3. Gator bags may be placed and refilled by volunteers to facilitate urban tree watering.
Photograph: R. Harper

Volunteer demographics

Community-wide citizen engagement initiatives that incorporate participation from volunteers should involve individuals that reflect and represent the community (Locke & Grove, 2016).

In contrast, volunteer efforts involving urban tree planting and citizen science tree inventories have historically incorporated limited, non-representative subsets of the urban population (Martinez & McMullin, 2004). Urban forestry volunteers tend to be well-educated, middle-class White women with full-time employment (Asah, Lenentine, & Blahna, 2014; Guiney & Oberhauser, 2009; Still & Gerhold, 1997). They are also more likely to own their home and have lived in their city for at least a decade (Locke, Roman, & Murphy-Dunning, 2015; Summit & McPherson, 1998), but perhaps substantially longer (Still & Gerhold, 1997). These findings align with conclusions from Johnson, Campbell, Svendsen, and Silva (2018), who formally examined participant demographics of volunteers who partook in New York City's TreesCount! street tree census. Most of these participants were also found to likely be higher income-earning, well-educated, White females (Johnson et al., 2018). Still and Gerhold (1997) found that 35% of volunteers featured a household income of \$50,000-\$99,999, and 28% had a household income of \$30,000-\$49,000. These findings were consistent with conclusions from a study by



Figure 4. Student volunteers performing urban tree pruning. Photograph: R. Harper.



Figure 5. Volunteers gather to collect data about urban trees. Photograph: R. Harper.



Figure 6. Student volunteers measuring urban tree diameter. Photograph: R. Harper.

Guiney and Oberhauser (2009) who examined the relationship between volunteers and household income. Zhang, Hussain, Deng, and Letson (2007) determined that individuals who were more likely to donate time or money to community forestry programmes were employed full-time and earned more than \$75,000 in annual income. Other groups, however, are also represented; Guiney and Oberhauser (2009) found that individuals making less than \$30,000 did actively volunteer – but at a much lower rate (13%) than individuals from other income brackets. Both Guiney and Oberhauser (2009) and Still and Gerhold (1997) found a positive relationship between education and volunteerism in urban forestry volunteer initiatives, concluding that approximately 75% of their study participants had completed college. It is important to note that one study (Moskell, Allred, & Ferenz, 2010) identified that only half of urban forestry volunteers surveyed were White, suggesting that racial and ethnic composition of volunteers may feature a degree of diversity that is worthy of further formal exploration. Though opportunities to expand volunteer involvement from more varied groups abound, further research is needed to identify barriers to participation among marginalised communities (Johnson et al., 2018; Roman, Campbell, & Jordan, 2018), in an effort to create a cohort of volunteers that more accurately represent the communities they serve.

Certain age-groups are also disproportionately represented among urban forestry volunteers, especially those who are in their mid-30s or older. Still and Gerhold (1997) reported that approximately half of urban tree organisation volunteers that they surveyed in New York City and Philadelphia were ages 35 to 50, and only 13% of volunteers were younger than 35. Asah and Blahna (2013) also reported that more than half of their study participants were over the age of 40. In contrast, Moskell et al. (2010) found that half of the volunteers that participated in their study were ages 18 to 24, but this difference was reflected due to the presence of school groups. Still and Gerhold (1997) found that few students (2%) participated in urban forestry volunteer initiatives and events. Families, however, tended to volunteer in urban forestry activities when they

included their children, especially youth under the age of five, often as part of a family outing (Greene, Millward, & Ceh, 2011; Schwarz et al., 2015).

Motivations of volunteers

The motivations of volunteers have been studied somewhat extensively, relative to other topics (see Table 1). With the objective of discovering what motivates people to volunteer for urban forestry initiatives, a study of the Chicago-based Openlands Project's TreeKeepers programme was conducted using surveys, interviews, and participant observations. The TreeKeepers programme was initiated in 1991 to develop and train tree care volunteers in Chicago. The study concluded that volunteers associated with this organisation were highly motivated by the emotional, aesthetic, and spiritual values associated with community trees (Westphal, 1993). To better understand who the volunteers of urban forestry NGOs in New York City and Philadelphia were and what motivated them, Stihl & Gerhold (1997) employed mail-based surveys and concluded that respondents' desire to improve their neighbourhoods was most important, followed by the desire for acquiring more education and social interaction, respectively, as part of their volunteer experience. Volunteers found that doing "tree care" and tree planting provided the greatest personal satisfaction, compared to other tasks (Stihl & Gerhold, 1997). These findings were corroborated by Johnson et al. (2018) who employed surveys and interviews from volunteers involved in New York City's TreeCount! initiative. Moskell et al. (2010) conducted on-site surveys of volunteers and focus groups of urban forestry practitioners who participated in the MillionTreesNYC programme. They determined that

Table 1. Summary of motivations of volunteers in urban forestry and urban greening.

Motivation	Description
Personal/Psychological	Feel less guilty, making a demonstrable difference, contribute, gain satisfaction, have fun, feel good, see fruits of labour, feel needed, advocating for their values, fulfil duty, make world a better place, emotional or spiritual considerations, volunteering is necessary, boost self-esteem, be part of a cause, have volunteered in the past, grow as a person, beautify neighbourhood, values ^{1, 2, 3, 4, 5, 9, 13, 14}
Aesthetic/Functional	Replace lost trees, needed trees, want shade, get fruit, add privacy, beautify neighbourhood ^{7, 1, 13, 14}
Educational	Learn new knowledge or skills, sharpen mental acuity, teach others, model a stewardship ethic, share knowledge, apply skills, fulfil class requirements ^{1, 2, 3, 4, 5, 11, 13}
Social	Demonstrate care, connect with community, make a difference, give back to community/others, socialise with new people, socialise with neighbours, enjoy experience, ensure environment for future generations, see friends, work with a team, help others do something important, support organisation, participate in community service ^{1, 2, 3, 4, 5, 7, 9, 10, 11, 12}
Recreational	Get out of house, get away, exercise, get fresh air, enjoy outdoor work, prevent or protect against bad habits, enjoy as hobby ^{1, 2, 3, 4, 5}
Environmental	Protect, make sustainable, restore, give back to it, enhance, feel connected, help wildlife, love nature, being close to nature, create ecosystem services, fulfil need for more trees ^{1, 2, 3, 4, 5, 7, 9, 12, 14}
Economic	Give time rather than money, accept free tree, save on energy costs, add value to property, incentivized ^{3, 7, 13, 14, 15}
Skills/Professional Development	Gain job possibility, learn job skills, learn about organisation, learn about work, network, build resume ^{1, 2, 3, 5}

Literature cited: ¹(Asah & Blahna, 2012); ²(Asah & Blahna, 2013); ³(Asah et al., 2014); ⁴(Bramston et al., 2011); ⁵(Guiney & Oberhauser, 2009); ⁶(Johnson et al., 2018); ⁷(Locke et al., 2014); ⁸(Mincey & Vogt, 2014); ⁹(Moskell et al., 2010); ¹⁰(Pike, Brokaw, & Vogt, 2020); ¹¹(Shwartz et al., 2012); ¹²(Still & Gerhold, 1997); ¹³(Summit & McPherson, 1998); ¹⁴(Summit & Sommer, 1998); ¹⁵(Westphal, 1993).

volunteers were driven by a number of motivations that ranged from helping their neighbours to helping the environment. Some volunteers participated, however, simply out of a personal passion for planting trees (Moskell et al., 2010).

Asah & Blahna (2012, 2013) surveyed volunteers in the Seattle-Tacoma metropolitan area, to ascertain motivations and commitment to urban conservation volunteerism. Their research availed six motivational factors including: environmental concerns, well-being of the community, opportunities associated with learning and career advancement, to escape the day-to-day routine and get exercise, to socialise, and to defend and enhance their egos (Asah & Blahna, 2012, 2013). Wall, Straka, and Miller (2006), determined that volunteer motivations can be examined – and even explained – through an econometric lens. They posited that a state’s working population (%), the income level, forested land (%), dominant political affiliation, state government expenditures on education, and the number of communities participating in urban and community forestry programmes help explain volunteer participation rates among the general public. They concluded that urban and community forestry programme directors should strive to engage more communities to encourage more participation in urban forestry related programmes, and that recruitment efforts should focus on middle-aged individuals (Wall et al., 2006). According to Johnson et al. (2018) NYC TreesCount! volunteers indicated that they were volunteering as an exercise of their personal values, out of a desire to contribute and give back, and to learn new skills and gain further education. Overall, volunteer motives are varied and include a number of different aims, both personal and public. Notably, across many of the studies there is a reflection on the greater good of the community – specifically concerns related to the environment and about keeping local spaces liveable (Asah & Blahna, 2013; Asah et al., 2014; Locke et al., 2014). Generally, future efforts can leverage these two broad trends, while also identifying the specific interests of the local community that will motivate volunteers to stay active.

Benefits of volunteering

Volunteers often indicate that the social benefit(s) derived from community-based volunteering are highly meaningful. Westphal’s Chicago-based study (2003) concluded that education, crime, safety, and the local economy can all be impacted positively by the activities of volunteers, and that they are most effective when they are directly associated with community beautification:

“ ... no one will say ‘we need to plant more trees to reduce stress and raise our cognitive functioning,’ but they might say ‘this place brings you down. We need more life here, more colour!’ ... ” (p.144).

Another Chicago-based study produced at the same time examined the social benefits of urban forests at the individual level. Kuo (2003) concluded that “informal social contact among neighbours” is critical in the development of person-to-person “social ties”, and that trees themselves may be an important cohesive factor pertaining to social contact among neighbourhood residents (Kuo, 2003). Elmendorf (2008) echoed this sentiment, concluding that

“tree plantings and other civic environmental projects can be used to promote both healthy environments and healthy social structure even in the most deteriorated neighbourhoods” (p.152).

According to Hansmann et al. (2016) urban forestry and community-based natural resource initiatives have the potential to “nurture” relationships between different stakeholder groups, conceivably developing social capital and building capacity. Watkins, Mincey, and Sweeney (2017) also found a statistically significant relationship between urban tree planting and the strengthening of neighbourhood ties. Tree planting, after all, is viewed as an actionable way that community volunteers and professionals can make a discernible impact on the community. Lipkis and Lipkis (1990) summarise these sentiments:

“Tree planting ... can build the bridges and promote the understanding that brings the neighbourhood together. The initial efforts of the tree planters compound themselves as others find in the trees a deeper appreciation of the community as well as natural beauty. It is the beginning of the formation of new values that is the foundation for city-wide transformation” (p. viii).

To explore in-depth the attraction between people and trees, Dwyer, Schroeder, and Gobster (1991) employed intercept interviews of visitors at the Morton Arboretum, in Lisle, IL. They summarised that urban trees are living, breathing organisms with which people form a “strong relationship”.

Volunteer engagement and barriers

Volunteer opportunities may provide citizens and residents with an enhanced awareness of, and engagement with, community greening initiatives. In Detroit, Michigan, resident volunteers’ involvement in tree planting and maintenance were investigated with interviews and a survey (Austin, 2002). Researchers concluded that interactions between forestry professionals and the public can be more positive through increased efforts to understand the urban audience (Austin, 2002). According to Moskell et al. (2010) urban forestry practitioners, from municipalities to NGOs, may organise and be a catalyst for opportunities for stakeholders to become involved. In an article reporting the results of a 2003 state-wide survey of South Carolina, U.S., residents investigated the characteristics affecting participation in urban and community forestry programmes. To attract potential volunteers not directly related to the forestry industry or community government, a more efficient method of raising awareness was deemed essential for the continued success of urban and community forestry programmes. The primary concern was that many survey participants had no knowledge of the urban and community forestry programmes – likely the result of poor publicity (Straka, Marsinko, & Childers, 2005).

Though perhaps surprising to some, not all municipal tree planting programmes are well-received. In an investigation performed between 2011–2014, it was determined that 24% of residents offered a street tree in Detroit, Michigan, U.S. submitted a “no-tree request” (Carmichael & McDonough, 2019). The study used transcribed dialogue of community meetings and interviews with city residents, and those within the local urban forestry NGO, The Greening of Detroit, to understand this aversion to tree

planting. Reasons indicated were consistent with other bodies of work (Schwarz et al., 2015) where residents identified concerns regarding the maintenance and perceived disservices (i.e. root damage to infrastructure, pruning, and raking leaves) associated with trees. It was concluded that urban forestry-related programmes – such as community tree planting – should commence with a dialogue between citizens, decision-makers and other stakeholders aimed at first understanding the character of a place according to its inhabitants (Carmichael & McDonough, 2019).

Other barriers to participation in urban forestry-related activities by residents of the community may include availability and knowledge. Individuals have expressed that they do not have enough time to become involved with an urban forestry volunteer-led effort (Schwarz et al., 2015), or that they already have competing commitments that occupy their free time (Martinez & McMullin, 2004). Residents may also simply not be aware of or fully appreciate the benefits provided by trees, or the support provided by the municipality or a local NGO regarding the ongoing maintenance of a tree (Zhang & Zheng, 2011). Thus, decision-makers should keep in mind that residents are more likely to participate in a volunteer activity if it is a short-term endeavour (Schwarz et al., 2015), and efforts should be made to inform citizens about the urban forestry resources available to them (Treiman & Gartner, 2005) at the local level.

Value of volunteering

At the national level, volunteerism is both an important mechanism through which individuals may give their time, knowledge, and resources to the community around them (Harrison, Franklin, & Mills, 2017), as well as a generator of an estimated \$187.7 billion USD in annual value to the U.S. economy (Independent Sector, 2021). Regarding the urban forestry sector specifically, Hauer and Peterson (2016) estimate that Americans annually volunteered almost 1.5 million hours on activities relating to municipal trees. This equates to an estimated value of \$35 million USD and amounts to almost 5% of the total time required for tree care in a community. According to Daniels, Robbins, Brinkley, Wolf, and Chase (2014) volunteers themselves bear about a third of the costs associated with an environmental programme or initiative, including time, travel, equipment, and salary-related expenses.

As trees mature, increasing in size and stature, their capacity to provide a variety of social and environmental benefits augments substantially (Barro, Gobster, Schroeder, & Bartram, 1997; Berland et al., 2017; Lohr, Peterson-Mims et al., 2004; Scharenbroch, Morgenroth, & Maule, 2016). According to a meta-analysis of street tree survival rates conducted by Roman and Scatena (2011), the population half-life for trees installed in a city street tree pit was found to only be 13–20 years. Overall street tree life expectancy was determined to be 19–28 years (Roman & Scatena, 2011). Though longer than previous survival estimates of 7 or 13-year average life spans, (Moll, 1989; Skiera & Moll, 1992), current understanding of urban tree life expectancy remains well below life expectancy projections of trees growing in undisturbed, forested settings, and well below tree size potential. An economic study of urban forest survival and growth revealed that the energy-saving benefits conferred by long-term planting programmes in the city of Sacramento, California fell substantially short of the projected savings values in association with higher than

expected tree mortality rates (Ko, Lee, McPherson, & Roman, 2015). Volunteers, however, may contribute to the economic and environmental capacity of the urban forest by increasing tree survival and fostering tree growth and maturation. For example, they may help mitigate these losses by minimising the variability of post-planting tree care (Allen, Harper, Bayer, & Brazee, 2017; Jack-Scott, Piana, Troxel, Murphy-Dunning, & Ashton, 2013). According to a 2013 study conducted in New Haven, CT, tree survival, growth and longevity were positively associated with installation and maintenance by volunteer-based groups (Jack-Scott et al., 2013). Similarly, two case studies described by researchers from the US Forest Service and Fairmount Park Conservancy identified a clear uptick in tree establishment, survival, and growth of juvenile urban trees that were planted as part of initiatives in East Palo Alto, CA and Philadelphia, PA. Stewardship was deemed to be critical both in terms of activities pertaining to tree care, and programme processes in place to support those activities (Roman et al., 2015). Mincey and Vogt (2014) concluded that group-related tree maintenance activities (i.e. collective watering), formally documented maintenance activities (i.e. signing watering agreements), and follow-up monitoring contributed positively to behaviour and enhanced tree survival. They concluded that their findings may help to

“improve the guidance offered by municipalities and non-profits to neighbourhoods for the management of successful tree-planting projects, and can ultimately improve the survival, growth, and thereby benefits provided by neighbourhood-planted trees” (p. 84).

Breger et al. (2019) examined the stewardship network and survival rates of trees planted in Holyoke, MA, as part of the state-led initiative, Greening the Gateway Cities Programme (GGCP). By employing stakeholder interviews and surveying newly planted trees for survival, vigour, and planting site type, they concluded that stewardship is essential for ensuring urban tree survival:

“In the GGCP pilot in Holyoke, trees that were stewarded by local programme recipients died at a higher rate than trees stewarded by the state DCR. Trees maintained by local recipients during drought fared particularly poorly. This survival and stewardship differential may be explained by a lack of institutional capacity and misalignment of tree management goals among key actors. Urban tree planting programmes may see higher survival if they plan for and fund maintenance of newly planted trees in coordination with municipal government, NGOs, and other local actors” (Breger et al., 2019, p. 8).

A study of New York City’s Triangle Below Canal neighbourhood found that street trees without stewards were three times more likely to die than trees that received post-planting care and stewardship from volunteers (Boyce, 2010). To increase chances of tree survival, it is important to select trees that have a high tolerance to difficult urban conditions, requiring minimal supplemental care required beyond the time of installation (Allen et al., 2017). Volunteers may aid in this critical planning stage by researching and collecting appropriate urban tree selection resources (McElhinney & Harper, 2019), as well as by working directly with nursery professionals on behalf of the municipality (J. Kinchla, Amherst Nurseries, pers. comm.).

Accuracy and reach of tasks performed by volunteers

Successful urban forestry-related research and operations require sound data. Volunteers may find themselves assisting with aspects of data collection or coordinating these activities in their entirety. Bloniarz and Ryan (1996) investigated the use of volunteer initiatives in relation to conducting urban forest resource inventories. A street tree inventory was conducted in Brookline, MA, using community volunteers. Each volunteer completed a 12-hour training programme that included classroom and practical field instruction, and featured expert instructors from the University of Massachusetts and the Arnold Arboretum of Harvard University. They concluded that data collected by trained volunteers was valid, and the accuracy compared “favourably” to results from a control group of certified arborists (Bloniarz & Ryan, 1996).

A more recent Minnesota-based study aimed to determine the accuracy of volunteer-based data collection and examine the impact of training protocols on data quality and the degree of agreement between volunteer-collected data and data collected by university specialists. Through press releases in community newspapers, volunteers were recruited to participate in data collection as part of performing an urban tree inventory. Volunteers were provided formal training in identifying trees, measuring diameter (DBH) and crown width, as well as assigning a qualitative condition rating. Researchers concluded that agreement among the groups exceeded 90% in relation to tree identification to the level of genera and achieved nearly 70% agreement in relation to tree condition rating (Bancks, North, & Johnson, 2018). According to Bancks et al. (2018):

“The results of this research indicate that trained volunteers can collect urban forest survey data at a higher frequency of agreement with university researchers when provided with appropriate tools and technical assistance” (p. 83).

In 1995, 2005, and 2015 citizen scientists participating in the annual volunteer tree inventory NYC TreesCount! were asked to record the location, size, species, and condition of all public curb side trees. According to Crown, Greer, Gift, and Watt (2018), findings indicated that 2015 participants were able to build on the experiences of the 1995 and 2005 inventories, collecting data in an increasingly accurate manner. TreesCount! activities also served to connect like-minded citizen scientists and promote awareness of the importance of the urban forest (Crown et al., 2018). Roman et al. (2017) investigated data quality by comparing street tree data collected from four cities by experts, to data collected by less experienced field crews. Findings indicated that citizen science is a viable option for some urban tree inventory and monitoring projects, particularly if DBH accuracy is required only at coarse precision, and genus-level identification of street trees is acceptable (Roman et al., 2017).

A “virtual survey” involves the recording of urban tree data by manually interpreting photos. This approach is similar to vehicular windshield surveys, which involve rapid data collection by a crew driving a vehicle along a street. In one study, urban tree inventory field data was collected by trained students and then compared with data that was collected by trained volunteers using Google Street View (Berland, Roman, & Vogt, 2019). Researchers concluded that virtual surveys using street-level imagery offer an alternative or complimentary approach to field data collection for street tree inventories.

In practical terms, these findings point to the use of virtual surveys to efficiently collect high-quality tree location data using volunteers (Berland et al., 2019).

The Forest Health Ambassador Programme is a joint public-private initiative of Oakville, Ontario, Canada that recruits volunteers from the community to assess municipal street tree health. In a case study of this programme, a volunteer citizen-scientist programme was implemented to increase public awareness of urban forest health issues and to gather data on tree health and invasive insects (Barker, Craig, Winmill, Meating, & Karandiuk, 2018). Training volunteers to inspect trees was contracted to a private consultant. The programme was designed to achieve three primary goals: increase the capacity for early detection of invasive species, track forest health trends over time, and foster public awareness of urban forest health. The study found that the programme demonstrates how a nominal investment by a municipality can effectively extend early detection capability beyond monitoring programmes staffed with professionals only (Barker et al., 2018).

Volunteer recruitment and retention

Nationally, U.S. volunteer participation rates fluctuate annually and volunteers themselves express concern regarding future citizen volunteer recruitment and retention efforts (Harper et al., 2018). The most effective recruitment efforts may occur by word of mouth and through the media (Locke et al., 2015; Still & Gerhold, 1997; Summit & Sommer, 1998). Still and Gerhold (1997) noted that half of those asked to join an organisation did so because of a direct request and would otherwise not have joined. Thus, recruitment efforts should focus on advertising urban forestry-related events and volunteer opportunities through these channels. Urban forestry practitioners have identified long-term volunteer communication as one of the more successful stakeholder engagement strategies (Moskell et al., 2010). Contact with volunteers in general is important, as communication and participation in decision-making typically increases voluntary commitment (Knoke, 1981). Environmental concern remains a key motivator to many urban forestry-urban greening volunteers, but generally, research has indicated that social and personal motivators are more prevalent in repeat volunteers (Asah & Blahna, 2012). Ryan, Kaplan, and Grese (2001) also demonstrated that volunteers' motivations change over time, during different stages of participation. The authors found that helping the environment and learning about the urban forest were important initial motivators, while social factors and project organisation were significant predictors of volunteer commitment. Thus, ensuring that social and personal benefits are readily understood by participants may encourage volunteers to return and contribute on an ongoing basis (Asah & Blahna, 2012; Summit & Sommer, 1998). Organization leaders should incorporate personal and social incentives, as well as environmental motivators into their advertising efforts and include refreshments and time for socialisation (Asah & Blahna, 2012; D. Bloniarz, USDA Forest Service, pers. comm.). Constructing games or friendly competition from conservation efforts may also prove to be a successful way of appealing to volunteers and may increase the number of millennial participants involved in environmental volunteer work (Asah & Blahna, 2012; Bowser et al., 2013; Summit & Sommer, 1998).

Volunteer involvement and experience may also be improved by emphasising participant satisfaction. Martinez and McMullin (2004) concluded that perceived efficacy was the most important determinant in volunteers' decision to participate in a nongovernmental organisation. The authors suggest that, in order to recruit and retain participants, programmes should produce results of which members are proud (Martinez & McMullin, 2004). Ryan et al. (2001) provided similar recommendations regarding the tangible results of volunteer efforts. Likewise, research by Sommer, Learey, Summit, and Tirrell (1994a, 1994b) showed that resident involvement in tree planting leads to improved satisfaction, which bodes well for participant attitudes regarding their volunteer experience.

In their survey of Minnesota Master Naturalist programme participants, Guiney and Oberhauser (2009) noted that 98% of participants indicated that they felt moderately to extremely connected to nature, demonstrating the significance of this connection and its relevance in finding future urban greening volunteers. Of their participants, 77% became interested in nature by age 10, and 88% by age 15 (Guiney & Oberhauser, 2009). These figures iterate the importance of involving youth in volunteer recruitment efforts. Volunteers surveyed expressed that their interest developed from the influence of family more so than friends, which points to the importance of family-friendly initiatives and programmes. Additionally, experiences that were unstructured and located in wilder settings (e.g. camping and observation) than those that were structured and located in domestic nature (e.g. classes), inspired greater interest (Guiney & Oberhauser, 2009). Peckham et al. (2013) observed a similar response, where volunteers described their wonder for nature when they were surrounded by wilder places. These findings are further supported by the noted environmentalist Rachel Carson, who also posited that unstructured exploration of the wild by youth is what ultimately sparks interest in nature (Carson & Pratt, 1965). Those who did not report being interested in nature until ages 11–19, however, were found to more likely name a specific class that piqued their interest; this illustrates the critical role of schools and nature programmes in fostering a love for the natural world among adolescents (Guiney & Oberhauser, 2009).

A 1996 case study of Chicago fifth graders demonstrated that offering urban greening opportunities to school-age children not only provides benefits to students, such as empowerment and learning, but that it may also motivate parents and the community to participate out of their desire to support the students' academic experience (Bouillion & Gomez, 2001). Moreover, research has shown that students are more likely to participate in an urban greening initiative if it is directly affiliated with an educational programme (Barnett et al., 2006). It is promising that, according to McDougle, Greenspan, and Handy (2011), young adults who volunteer for other types of non-profit organisations and those who engage in pro-environmental behaviours are likely candidates for future involvement with environmental organisations. They determined that social motivators are the strongest predictors of young adult volunteerism in environmental groups (McDougle et al., 2011). Since research has identified that high school graduates, as well as individuals with some post-secondary education are more likely to want a tree in their yard, (Donovan & Mills, 2014; Greene et al., 2011; Zhang & Zheng, 2011), this speaks to the overall notion about the importance of, and connection between, education and environmental awareness.

Under-represented minority populations and low-income individuals, who are notoriously under-represented in volunteer initiatives (Guiney & Oberhauser, 2009), may also represent an important demographic for future volunteer recruitment. A study by Locke and Grove (2016) found that tree planting programmes are typically most successful where they are least needed, such as in affluent neighbourhoods. Thus, further research is needed to understand how to expand urban reforestation activities to low-middle income communities, which may help address environmental justice concerns and provide the opportunity to elevate volunteer rates among these residents (Donovan & Mills, 2014; Li, Zhang, Li, Kuzovkina, & Weiner, 2015).

Throughout the literature, there was a lack of specificity relative to occupations of volunteers, other than that most volunteers tended to be gainfully employed (Guiney & Oberhauser, 2009; Still & Gerhold, 1997). Future research may be able to determine if there is a link between certain occupations, and interest and frequency in environmental volunteering. Additionally, since researchers also identified private properties as potential sites to expand urban forestry activities and enhance urban tree canopy cover, the relationship between property ownership and citizen engagement in urban forestry volunteer efforts should be further explored (Greene et al., 2011).

Discussion and conclusion

It is estimated that more than 77 million individuals, or approximately one in four American adults, is currently engaged in some form of volunteerism (Independent Sector, 2021). Within the context of urban forestry, volunteers may vary widely relative to work habits, interest-levels, skills-set, and determination (Harrison et al., 2017), yet they are often spurred to action by select key motivational factors: concern for the environment, regard for the well-being of the community, to escape the day-to-day routine and get exercise, to socialise, and out of a passion for trees.

Community volunteers in the urban forestry sector find themselves working at the intersection of interrelated socio-ecological systems (SES) where social elements and human interests like property owners, municipal managers and employees, and policy decision-makers, interact with biophysical factors like trees and urban infrastructure (Harper et al., 2018; Mincey et al., 2013). It is in these venues that volunteers may provide essential experience, critical insights and thoughtful perspectives, and in turn benefit by deriving new skills, personal satisfaction and broadening social networks. As the U.S. population continues to age and individuals continue to relocate to more densely populated areas, the social benefits of volunteering in urban forestry-related activities should continue to be investigated. As populations continue to diversify, the sense of community often derived from volunteering may help to build new networks and create a sense of belonging. The simple act of planting a tree – often touted for its environmental benefits – may become increasingly important as a means of fostering neighbourly interactions and building social cohesion. Thus, municipal tree planting efforts may help to build unity among groups of individuals as they rally around a community-wide initiative.

As operational costs continue to increase and municipal budgets continue to be stretched, a heightened emphasis may be placed on the use of community volunteers for urban forestry-related activities. Though short-term labour savings may be realised

with the use of volunteers, many important questions remain relative to other expenses. For example, what sorts of costs may be incurred from a liability standpoint? Also, as equipment and technology continue to evolve and demand an increased knowledge base, volunteers will require increasingly sophisticated training. Volunteer support and education requires time and expense from municipal employees, agency specialists and other participants; studies aimed at investigating how these efforts can be conducted most efficiently and effectively should ensue. As industry standards change, the accuracy and validity of volunteer work – and the efforts associated with their training – will continue to need to be examined.

Volunteers in urban forestry are often organised via a committee or NGO; limited understanding exists, however, around many of these entities. Sometimes an urban forestry-related emergency or disaster is part of the genesis of an urban forest committee or NGO, but insights into their history, organisational structure, funding, partnerships, and programming would be helpful for communities that aspire to establish their own organisation as a means of leveraging volunteer services.

Relative to other aspects of volunteerism in urban forestry, substantial research has been conducted regarding the motivations of volunteers. These factors, however, are complex and deeply inter-related. For example, the ability to distinguish between the personal desire to acquire a novel skill, rather than the economic desire to build new skills that may advance one's career requires considerable context that may not be readily derived from a survey. Thus methodologies that provide substantial depth of story, such as research interviews or perhaps focus groups, should be further employed to parse out important details and build further understanding relative to volunteer motivations in urban forestry.

The complexity and dynamism behind urban forestry-related activities and operations – including the involvement of volunteers – necessitates regular and ongoing research (Svendsen & Campbell, 2008) into the constellation of organisations and networks of relationships that comprise the urban landscape of the 21st century.

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