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Investigating campus tree inventories in the northeastern United States

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ABSTRACT

Trees are an essential component of urban greenscapes that provide shade, habitat for wildlife, and aesthetic benefits. Given their extensive landscapes, many college campuses function as green spaces within the urban matrix. An exploratory investigation of college campus tree inventories was conducted to identify the availability and accessibility of campus tree inventories in the northeastern United States, compare species diversity and tree measurements across campuses, and identify and promote best management practices. Using directed searches and non-probabilistic sampling, campus tree inventories were obtained from twenty-eight colleges spanning Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. It was observed that trees are more often identified with common name than scientific name, that the quality of data varied considerably, and that campus tree populations lack diversity among genera (*Acer*, *Quercus*, and *Pinus* were often abundantly represented). Priority should be given to ensuring that 1) inventories are maintained, 2) tree species are identified using scientific names, and 3) key measurements are obtained. Standardising and recording campus inventory data in a systematic, consistent method would more readily promote direct comparison, robust analysis, and foster a broader understanding of the state of campus trees beyond a single institution. Tree programmes and student volunteers may incentivise more comprehensive campus tree inventory management.

KEYWORDS

Tree inventory; urban forest; college campus; genera; DBH

Introduction

With increasing global urbanisation, there is a widespread need to protect and maintain greenspace in urban areas. Trees comprise a critical component of urban greenspace and provide ecosystem services by mitigating heat island effects, decreasing water runoff, and improving human mental health (Figure 1) (Dowtin et al., 2023; Hwang et al., 2017; Powning et al., 2024). The term "urban trees" often refers to street trees or trees that have been selected for land that is publicly accessible, such as parks, cemeteries, and university campuses. Compared to trees in rural settings, urban trees require increased monitoring and care because they often grow in close proximity to both urban residents and their property. As

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Figure 1. Trees planted on a cement lot on the University of Massachusetts Amherst campus to provide ecosystem services.

a consequence, trees may present a higher risk to human safety in urban settings and may also be at risk of injury themselves. Additionally, trees may be restricted by facets of infrastructure such as sidewalks, buildings, and utilities. Thus, urban tree management is necessary and a crucial first step in managing this resource is to conduct an inventory (Wisemanet al., 2025).

Tree inventories are used to record and monitor existing populations, population change, and maintenance needs in a defined geographic area (Bond, 2013; Fazio, 2017); they are often conducted by a municipal forester (i.e. tree warden, city arborist) or a campus arborist. Although tree inventories have become more prominent in recent years, there continues to be widespread opportunity for their implementation as many communities do not yet have an urban tree inventory (Wiseman et al., 2025). Tree inventories may be intricate and nuanced, or more simplistic depending on the capacity and objectives of the municipality or institution. For example, a sample inventory may be conducted by foot on a small, random sample of trees in a region, while a survey is often conducted by car, and examines a few variables over a larger geographic space (Massachusetts Urban & Community Forestry Program, n.d.). In contrast, a partial tree inventory is conducted within a defined geographic area, and many partial inventories can be compiled over a period of time to compose a complete inventory. A complete inventory is extensive, sometimes including areas of open space where more trees could be planted. Complete inventories can help to improve a municipality's or institution's ability to respond to storm damage, to proactively detect and manage pests, and to efficiently locate specific trees by a given attribute.

The data collected as part of an urban tree inventory should catalogue and locate trees that are being measured (i.e. numbered; location), document tree identification (including the scientific name), and record tree diameter at breast height (DBH) (Wiseman et al., 2025). Other attributes that may be recorded as part of a tree inventory include tree condition, risk assessment, or height. Condition ratings endeavour to capture the state of tree health, and risk ratings are ascribed in an effort to better understand and categorise the likelihood of tree failure and the putative consequences of that failure (i.e. injury to person or damage to property) (Wiseman et al., 2025). Additionally, the date of when the inventory was last updated should be included to communicate the recency of data. Despite their utility, there is a scarcity of information based on urban tree inventory standards such as data storage, maintenance, and accessibility.

Inventories may be a critical tool for urban forest planning and management. Since they aid in establishing a baseline understanding relative to factors like tree species composition, inventories present tremendous utility as it relates to understanding tree diversity considerations. Tree diversity recommendations for urban forests vary with a range of commonly espoused goals indicating that an urban forest should consist of no more than 10% of a single species (Miller & Miller, 1991). Other guidelines range from no more than 5% of a species (Barker, 1975) to 10% – 15% of a species (Grey & Deneke, 1986). Both Moll (1989, as cited in Clapp et al., 2014) and Ryan and Bloniarz (2008, as cited in Clapp et al., 2014) recommend no more than 10% of any one genus, with Santamour (1990) recommending no more than 10% of a species, 20% of a genus, and 30% of a family. Ball and Tyo (2016) establish a more conservative guideline, that no more than 5% of a single tree genus should comprise the urban forest. An inventory that digitally records species, genus, and family readily enables an understanding of these percentages in a given area.

Studies on the prevalence of urban street tree genera in Massachusetts have found that *Acer* (maple) has been substantially overrepresented, comprising 38% – 49% of urban tree populations, thus representing approximately 20% – 40% more of the tree canopy than is recommended (Coleman et al., 2025; Cowett & Bassuk, 2020; Cumming et al., 2006). Other common genera included *Quercus* (oak), which comprised 12% – 15% of Massachusetts street tree inventories, and *Pinus* (pine), constituting 4% – 7% of these inventories (Coleman et al., 2025; Cowett & Bassuk, 2020; Cumming et al., 2006). While formal study on the presence of tree species has been performed at the state and municipal level, no formal investigation has been conducted regarding the composition of tree species present on college campuses.

In the United States (US), college campuses may occupy large tracts of terrestrial landscape. For instance, the campuses of Berry College (Mount Berry, Georgia) and SUNY College of Environmental Science and Forestry (Syracuse, NY) total over 50,000 acres (Kushner, 2024). College campuses exhibit characteristics that are similar to urban greenspaces, with prominent features of the built environment like roads and buildings; they have also been referred to as a microcosm of the urban forest and indicative of urban forestry trends (Roman et al., 2017). Furthermore, college campuses have often been associated with providing significant benefits to biodiversity through provisioning of critical habitat resources as well as movement corridors within the heavily fragmented urban matrix (Liu et al., 2021). In fact, several institutions have recognised the role that campus open spaces provide for neighbouring wildlife populations and have even developed wildlife habitat management plans (Loch et al., 2024). Similarly, the green landscapes present on college campuses have been shown to promote physical and

Figure 2. Greenspace on the University of Massachusetts Amherst campus promotes physical and psychological well-being.

psychological well-being within the student population, thereby reinforcing the importance of maintaining campus tree health (Figure 2) (Zhang et al., 2023).

The northeastern US was chosen for this research because of the prevalence of educational institutions and regional consistency in tree species and climate. This exploratory investigation of college campus tree inventories was conducted to 1) identify the availability and accessibility of campus tree inventories in the northeastern region of the US, 2) compare species and size of trees across campuses, and 3) identify and promote best practices regarding conducting a campus tree inventory.

Methods

Data collection

To obtain campus inventories from the northeastern US (Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont), directed internet searches were conducted, and college campus arborists or sustainability offices were emailed from May 2024 to February 2025. Initial correspondences contained an introduction to this research initiative and requested sharing the college's complete campus tree inventory files (e.g. .csv, .xlsx, .pdf, or other formats). Information about this initiative was also shared with the listserv of a local professional association and the New England Chapter of the International Society of Arboriculture (see Figure A1 in Appendix). Non-probabilistic sampling (i.e. network or snowball sampling) was also employed by sending follow-up emails (Sexton, Miller, & Dietsch, 2011) to active respondents, requesting contact information of other individuals who may have access to a tree inventory at another institution. The 2024 list of Tree Campuses from the Arbor Day Foundation was also reviewed to identify colleges to contact (Arbor Day Foundation, n.d.-a). In total, 102 individuals and fifty-four colleges were contacted, in addition to directed internet searches for publicly available campus tree inventories.

Data analysis

Tree-specific attributes were tallied from each inventory. Attention was paid to stem diameter measurement at 1.37 metres (diameter at breast height or DBH) and how species were identified (i.e. scientific name, common name, genus). Other tree-related characteristics included in the analysis of the inventory data were height, condition, risk, and when the inventory had been last updated. Aspects of the inventory format considered were: 1) data storage (e.g. electronic spreadsheet), 2) presence of a georeferenced website, and 3) public accessibility of the inventory. Characteristics of the colleges included if they were a registered "Tree Campus" (Arbor Day Foundation, n.d.-a) and if they were a public institution.

Inventory data were identified by state, and presence of the following were considered: scientific name, common name, DBH, condition, risk, when last updated, spreadsheet format, georeferenced format, public accessibility, tree campus, and public school. Zeros and ones were used to indicate the absence or presence of recorded information, respectively. An informal notes column was added to provide context. These inventories were evaluated based on the recorded data provided. Descriptive visualisations (e.g. barplot, boxplots, etc.) were generated for Connecticut, Massachusetts, New York, and Rhode Island to evaluate the prevalence of selected tree-specific attributes or characteristics within states. Maine, New Hampshire, and Vermont were not included in visualisations due to low sample size given the response rate (i.e. one college per state).

Descriptive patterns regarding the prevalence of each species and associated DBH measurements were explored. Since the data were too diverse to consider every genus, this analysis only considered genera studied by Cumming et al. (2006), Cowett and Bassuk (2020), and Coleman et al. (2025). To count the number of trees per genus, a "find-search" in Microsoft Excel was conducted to determine a total count for each of the genera and common names of tree species recorded for each institution. If genus data were not available, a common name search was conducted where *Acer* was searched as maple, *Quercus* as oak, *Pinus* as pine, *Fraxinus* as ash, *Pyrus* as callery, *Prunus* as cherry, *Betula* as birch, *Tilia* as linden, *Robinia* as black locust, *Gleditsia* as honey locust, *Malus* as apple, *Ulmus* as elm, *Platanus* as plane, *Picea* as spruce, and *Tsuga* as hemlock. The percentage occurrence of each genus per state and overall total of each genus was calculated as well as the mean DBH of each species per campus, state, and in total. The mean DBH and of individual genera were calculated by state and overall using individual campus means. All calculations were conducted in Microsoft Excel (Microsoft Corporation, 2024). Figures four to seven were generated using R Statistical Software (2025).

Results

Geographic scope

Overall, approximately 100 colleges within the northeastern US were identified as candidates that may have a tree inventory. A lack of response or confirmation that there was no available inventory from this original 100, resulted in a total sample size of twenty-eight colleges with inventories. Of these twenty-eight inventories, twenty-six inventories provided data in a spreadsheet format. Two of the twenty-six provided a .pdf and one only provided a georeferenced link that did not allow public extraction of a spreadsheet. Thus, twenty-three inventories provided data in a .csv or .xlsx file. Of these twenty-three inventories, fourteen measured DBH which provided an opportunity to examine tree size relative to genus. Campus trees were identified using either scientific name or common name. Massachusetts colleges provided the largest number of campus inventories ($n = 11$) (Figure 3). Of these eleven inventories, eight contained tree identification with scientific name and seven featured both scientific name and DBH data. Only four of the eleven were in a format that allowed for a comparison between species and DBH. Eight campus inventories were obtained from colleges in New York. Only four contained tree identification using the scientific name, all of which also featured DBH data. Overall, five of the eight schools were used in the comparison of species and DBH. Three campus inventories were obtained from Connecticut. Although all three provided data in spreadsheet format and measured DBH, only two documented the identification of trees using scientific names. All three were used in a comparison of species and DBH. Three campus inventories were obtained from Rhode Island; one inventory was stored as a .pdf and the remaining two were stored in a .csv or .xlsx file format. Two provided scientific name and DBH data, and only one was able to be used in a comparison of species and DBH. One college provided an inventory from

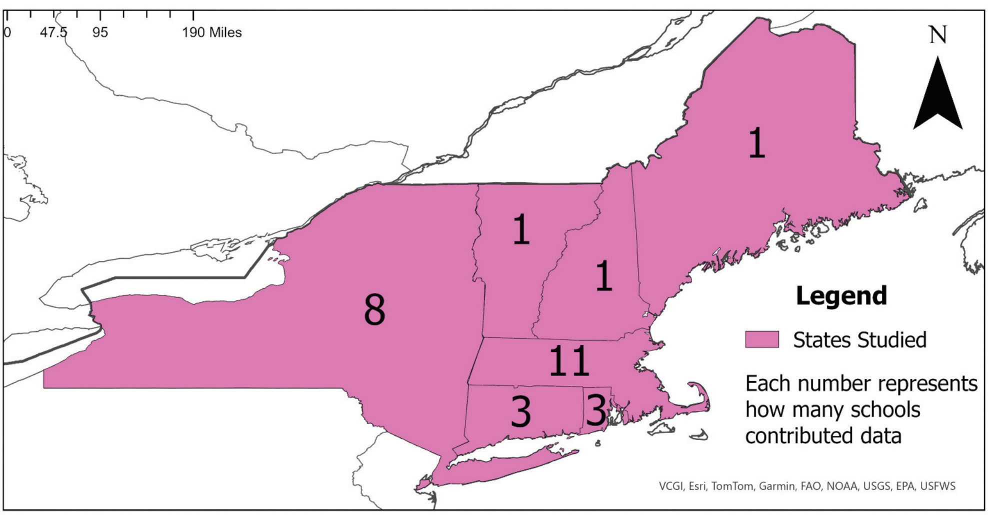

Figure 3. Number of inventories obtained per state (Environmental Systems Research Institute [ESRI], 2022).

Table 1. Number of colleges contacted from each state, colleges that provided an inventory, percentage of colleges providing inventory. Summary column displays total for the first two rows and average for the third row.

	CT	MA	ME	NH	NY	RI	VT	Summary
Colleges contacted	8	14	3	5	15	6	3	54
Colleges that provided an inventory	3	11	1	1	8	3	1	28
Rate of providing inventory	38%	79%	33%	20%	53%	50%	33%	44%

Maine, and it only included species data as common name. One campus inventory was provided from New Hampshire. The inventory contained scientific name but not DBH. One inventory was obtained from Vermont, which recorded common name and DBH but not scientific name. The inventory from Vermont was able to be used in a comparison of species and DBH. Campus inventories were conducted over a span of dates including 2001 (one inventory), 2010 (one inventory), 2018 (one inventory), 2020 (one inventory), 2021 (two inventories), 2023 (six inventories), and 2024 (four inventories). The remaining 12 inventories were not dated and seven of the fifty-four colleges that were directly contacted reported that they had not updated their inventory recently enough to share their data or that they did not have a formal campus tree inventory.

The majority of data were collected from Massachusetts and New York, which host the most colleges of the seven investigated states (Korhonen, 2025). Mean inventory rate among respondents was 44% with the highest inventory response rate from Massachusetts (79%), followed by New York (53%) (Table 1).

Inventory formatting

The format of organising data varied greatly among the campus tree inventories that were obtained from the various colleges. Georeferenced, or digitally mapped, campus tree inventories were supported by software such as TreeKeeper (Davey Resource Group, n.d.), ArborScope (Bartlett Tree Experts, n.d.), and ArcGIS (ESRI, 2022), or as a customised mobile phone application developed for use (at a single institution). Inventory spreadsheet data also varied stylistically and organisationally. Some listed tree species, followed by the total number of occurrences of each species whereas other inventories individually listed every tree in the study area as an individual row. The latter format allows for more comprehensive data collection such as DBH, tree condition, and a tree risk rating to be associated with an individual tree. There was also one inventory that placed scientific names in one row and DBH in half inch increments along the columns, with the number of trees that met the requirements of each cell being tallied accordingly.

Of the twenty-eight total institutions that participated in this study and provided campus tree inventory data, 71% (20/28) were private institutions, and the remaining 29% (8/28) were public. Approximately 68% (19/28) of colleges were registered as a Tree Campus by the Arbor Day Foundation. At the state level, all the colleges from Connecticut and Rhode Island provided data in spreadsheet format. None of the three colleges in Rhode Island provided data in a georeferenced format. It was most common for publicly available data to be georeferenced. Furthermore, being a Tree Campus is not

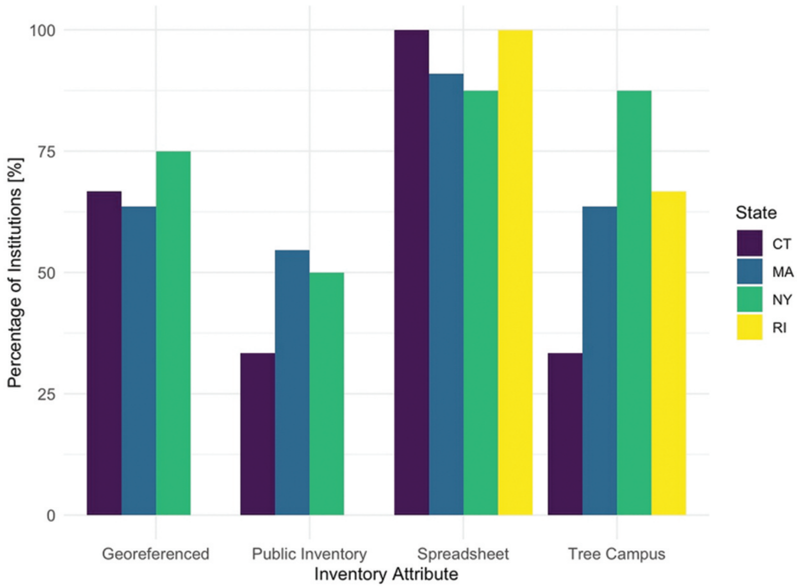

Figure 4. Format of inventories by state in percentage – each state (Connecticut: purple, Massachusetts: blue, New York: green, Rhode Island: yellow) is represented by a different colour bar above each attribute labelled on the x-axis. Percentage is labelled on the y-axis. The absence of a bar (eg. Rhode Island in the georeferenced section) is indicative of none of the investigated campus tree inventories from the given state having that attribute.

necessarily indicative of having a tree inventory (Figure 4). Interestingly, the states with the lowest percentage of Tree Campuses had the highest percentage of inventory data stored in a spreadsheet.

Inventory attributes

Of the twenty-eight total institutions that participated in this study and provided campus tree inventory data, 79% (22/28) identified trees using common names with only 64% (18/28) using scientific names. Approximately 43% (12/28) of institutions used both common and scientific names. Occasionally, an inventory would include the attributes of genus and species in addition to scientific name, but they were usually included in addition to common name. Three-quarters of college inventories (75%, 21/28) featured DBH. Approximately 54% (15/28) of colleges recorded tree condition and 46% (13/28) recorded tree height. Only 11% (3/28) of colleges included a column to monitor tree-related risk, whereas approximately 43% (12/28) included the date when the inventory was conducted or when the individual tree data had been last updated. Approximately 43% (12/28) of inventories were publicly available but varied widely in terms of formats: 82% (23/28) used a spreadsheet file and 57% (16/28) used digital mapping software. The most significant error in inventories was mislabelling columns of species name. In 36% (10/28) of the inventories, columns labelled "Scientific Name" identified trees using the common name instead.

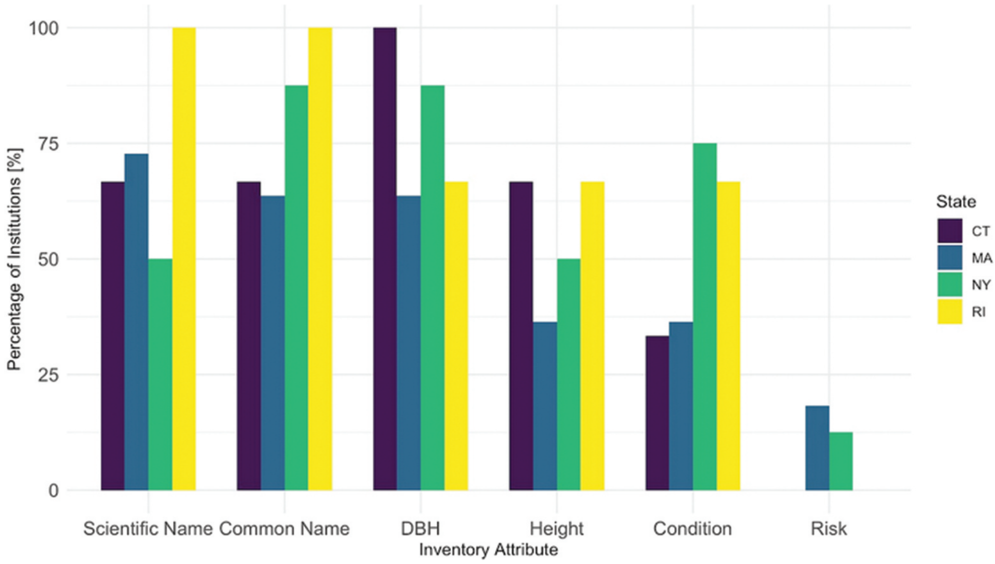

Figure 5. Tree attributes recorded by inventories by state (%) – each state (Connecticut: purple, Massachusetts: blue, New York: green, Rhode Island: yellow) is represented by a different colour bar over each attribute labelled on the x-axis. Percentage is labelled on the y-axis. The absence of a bar (eg. Connecticut in the risk section) is indicative that none of the investigated campus tree inventories from the given state had that attribute.

A closer examination of the data within each state may reflect norms. Most institutions in Massachusetts (73%, 8/11) recorded scientific name and 64% (7/11) recorded common name. Of Massachusetts colleges, 73% (8/11) recorded DBH and 36% (4/11) recorded height. In New York, it was much more common to record common name (88%, 7/8), whereas scientific name was only recorded by half (4/8) of the colleges that participated in this study. Three-quarters (6/8) of New York colleges recorded condition compared to just 36% (4/11) of the participating colleges from Massachusetts. Condition and date of the previous update to the inventory were not included by two of the three Connecticut colleges but were used by two of the three Rhode Island colleges. The responding institution from Maine recorded only common name and provided detail regarding the last update. The sole school that participated from New Hampshire recorded scientific name, common name, and condition. The participating school in Vermont reported common name in addition to DBH, height, condition, and when last updated. Overall, common name was used more frequently than scientific name and condition was recorded more frequently than risk, although both condition and risk were recorded rather minimally (Figure 5).

Tree size in DBH

Trees with the highest mean DBH across all institutions were *Quercus* (mean 43 centimetres, range 28–69 centimetres) and *Platanus* (mean 41 centimetres, range 13–71 centimetres), with the lowest mean DBH genera being *Betula* (mean 20 centimetres,

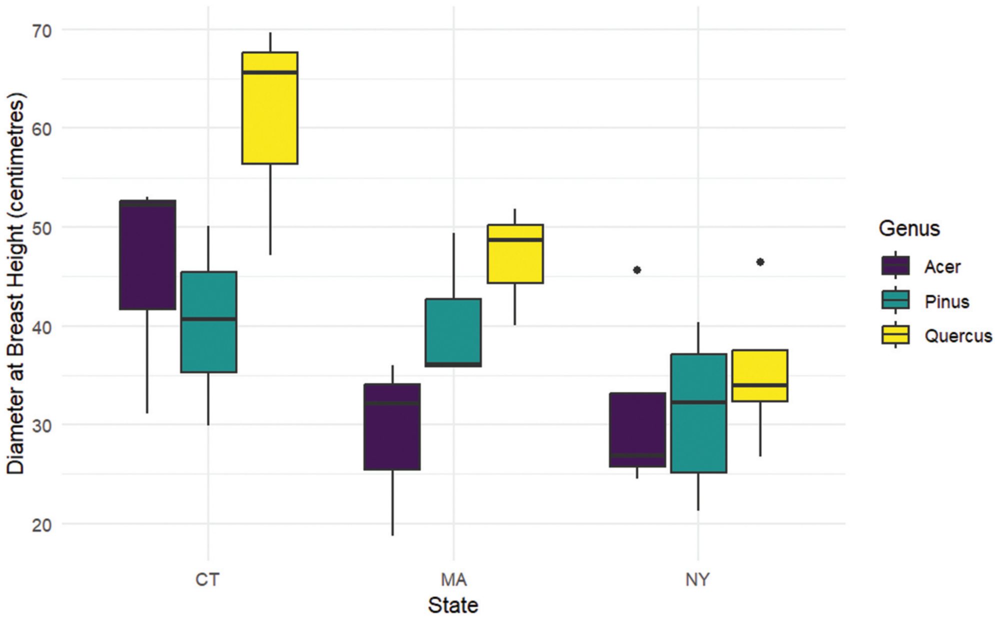

Figure 6. Range of DBH of the topmost frequent tree genera by state – each genus (*Acer*: purple, *Pinus*: teal, *Quercus*: yellow) is represented by a different colour box over each state (Connecticut: *n* = 3, Massachusetts: *n* = 4, New York: *n* = 5) labelled on the x-axis. The y-axis represents the mean tree diameter at breast-height (DBH) in centimetres across the college campus inventories of that state. Each box represents the middle 50% of data with the line within each box representing the median. The whiskers on either side of each box represent the remaining range of data in the upper 25% (above) and lower 25% (below). Any points outside of the whiskers represent outliers.

range 13–38 centimetres) and *Malus* (mean 20 centimetres, range 13–28 centimetres). The mean tree size across genera was more similar in New York when compared to Connecticut and Massachusetts (Figure 6). To compare mean tree size across genera required that a college provide a spreadsheet that included tree species and DBH. The only college campuses to provide enough data for this comparison were from New York (*n* = 5), Massachusetts (*n* = 4), and Connecticut (*n* = 3).

Tree diversity of genera

Overall, the fifteen investigated genera were present across all the inventories: *Acer*, *Quercus*, *Pinus*, *Fraxinus*, *Pyrus*, *Prunus*, *Betula*, *Tilia*, *Robinia*, *Gleditsia*, *Malus*, *Ulmus*, *Platanus*, *Picea*, and *Tsuga*. Tree genera that were present in the highest percentages were *Acer*, *Quercus*, and *Pinus*, (Figure 7). The least frequent genera were *Robinia*, *Platanus*, and *Pyrus*. *Acer* was the only genus to exceed 20% of the total tree canopy by colleges. The least common genus was *Robinia*, with twelve colleges not recording any in their inventory.

The cumulative mean of each tree genus was evaluated for this study (Figure 7). On average, 17% of a campus tree inventory consisted of *Acer*, 10% was *Quercus*, and 10%

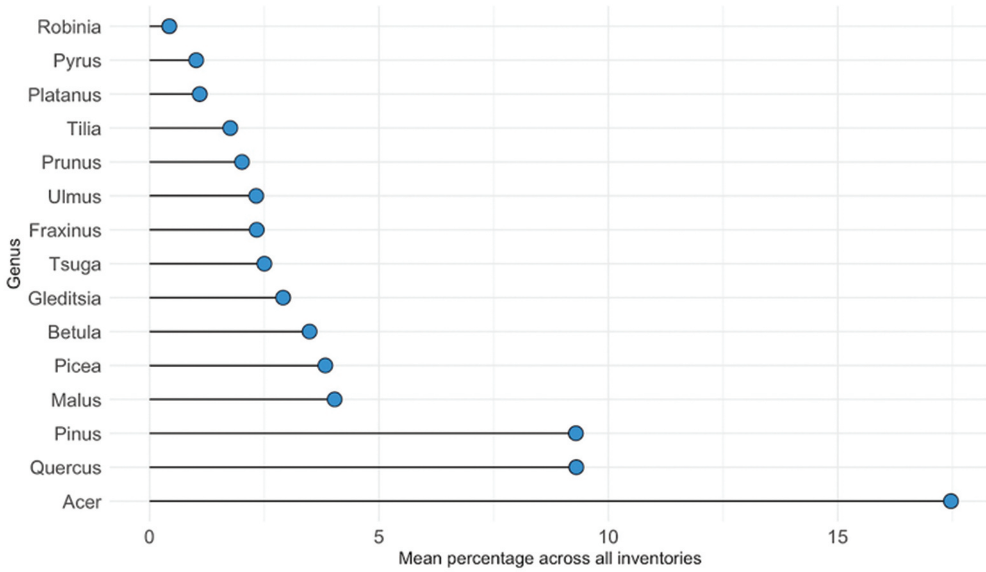

Figure 7. Mean percentage of each genus across all inventories – mean genus composition of the twenty-three investigated college campus inventories that were formatted in a spreadsheet file. This chart only includes the fifteen investigated genera. The most frequent genera were *Acer*, *Quercus*, and *Pinus*.

was *Pinus*. The remaining genera, *Pyrus, Prunus, Tilia, Robinia, Gleditsia, Ulmus*, and *Platanus*, each represented less than 5% of the tree inventory.

Discussion

To understand our current knowledge related to campus tree resources within the urban matrix, this study set out to 1) identify the availability and accessibility of campus tree inventories in the northeastern US, 2) compare species diversity and DBH of trees across campuses, and 3) identify and promote best practices regarding conducting a campus tree inventory. Findings showed a high level of variation across campus inventories regarding the types of data collected, how the data were stored, and accessibility. These findings reflect how substantial variation exists at the institutional level regarding campus tree inventory collection methodologies in favour of a systematic, coordinated approach that would include standardised data collection. The number of respondents to regularly maintain a comprehensive campus tree inventory was smaller than expected. Less than half tracked the last survey date of each tree (39%, 11/28), while more campus inventories than anticipated (32%, 9/28) only recorded common name. Nearly half (46%, 10/28) of the inventories obtained did not record scientific names and one-quarter (25%, 7/28) did not record DBH. In relation to tree identification, the use of scientific nomenclature is appropriate as it is more precise than the use of common names that vary depending on factors such as region and attributes of the tree.

For a tree inventory, condition rating provides an evaluation in relation to tree health. Additionally, a formal tree risk assessment may be conducted as part of an inventory to evaluate risk of tree failure and consequences in relation to the safety of pedestrians and infrastructure. While over half of the participating institutions included a tree condition assessment (54%, 15/28), tree risk assessments were rarely conducted (11%, 3/28). This is perhaps due to the somewhat specialised nature of these assessments and the challenge of parsing the overlapping implications of risk and condition (Figure 5). Substantial value would be added to a campus tree inventory if formal tree risk assessments were regularly conducted by qualified, experienced professionals. Colleges with exceptional inventories (i.e. Rank 1 (Table 2)) may have recorded attributes such as age class, desirability, root infringement, ecosystem services, and individually recorded when each tree was last inventoried. Standardising and recording campus inventory data in a systematic, consistent method would more readily promote direct comparison, robust analysis, and foster a broader understanding of the state of campus trees beyond a single institution.

Consistent with Cumming et al. (2006) and Coleman et al. (2025), and similar to Cowett and Bassuk (2020), the same tree genera (e.g. *Acer*, *Quercus*, and *Pinus)* were present in the highest percentages on college campuses in the Northeast region (Figure 7). The amount of *Acer* found (17%) equates to less than 50% of the composition of urban trees according to Cumming (49%), Cowett (41.4%) and Coleman (38.4%). Similarly, the amount of *Quercus* on campuses (10%) is notably less than the findings of Cumming (15%), Cowett (12.5%) and Coleman (12.6%). Conversely, the amount of campus *Pinus* (10%) is notably more than Cumming (7%) Cowett (4.4%) and Coleman's (5.9%) findings. The genera *Robinia*, *Platanus*, and *Pyrus* were least commonly represented in the inventory data. This likely reflects that most of the species within these genera are non-native to the Northeast and that they are a less recurrent planting choice. This also aligns with the finding by Cumming et al. (2006) that the Norway maple is the most common street tree in Massachusetts whereas the Callery pear is the most common street tree in Maryland, south of the Northeast. When considering species evenness, college campuses featured a higher representation of *Acer* likely due to a variety of factors such as availability in the trade, compatibility with growing conditions, and ornamental considerations such as attractive autumn foliage. Cumming et al. (2006) suggest that the outbreak of Dutch elm disease may have initiated an abundant planting of Norway maples in Massachusetts in previous decades. A finding of overall lower representation of *Acer* and *Quercus* on campuses compared to street tree inventories may imply biodiversity on college campuses being increased compared to typical urban areas. However, the relationship of campus planting selections and local

Table 2. Range of tree data recorded by colleges regardless of state was divided into three tiers. Rank 1 inventories ($n = 5$) are institutions that contain all characteristics except for risk and common name. Rank 2 inventories ($n = 7$) are institutions that recorded scientific name and DBH and may track the remaining characteristics. Rank 3 inventories represent institutions that recorded either scientific name, DBH, or neither ($n = 11$). Total sample size was twenty-three with five schools providing incomplete data (see Table A1 in Appendix).

Rank	Scientific Name	Common Name	DBH	Height	Condition	Risk	Date of update
1	100%	80%	100%	100%	100%	40%	100%
2	100%	57%	100%	43%	29%	14%	29%
3	27%	91%	45%	36%	54%	0	27%

municipal planting selections is not well understood and is worthy of further study. The increased prevalence of *Pinus* relative to *Acer* and *Quercus* was of interest and may be due to a number of considerations such as that campus tree management may align more with management considerations of urban greenspaces (i.e. parks, conservation spaces, greenways, etc.) than urban (i.e. street) tree populations. The mean DBH for *Acer*, *Quercus*, and *Pinus* were more similar to one another in New York than in Massachusetts and Connecticut. This is likely reflective of the trees being a similar age (i.e. planted at similar time periods) or of the higher sampling size for New York ($n = 5$). Additionally, New York is located the furthest west among the investigated states and tree composition may vary further. Tree age, and the affiliated DBH, is an important component that is often overlooked in relation to diversity-related considerations (Richards, 1983). Larger, more mature trees provide substantially more ecosystem services (carbon storage, rainfall interception, cavity nesting habitat), and smaller, juvenile tree populations are necessary to replace their older, larger counterparts when they begin to decline.

In the event that a college is initiating a campus tree inventory, best practices from a municipal setting would suggest the importance of collecting attributes such as scientific name to denote tree identification, DBH as a proxy for age and to better understand growth rate, ascribing a condition rating for health, and conducting a formal tree risk assessment (Wiseman et al., 2025). Additionally, recording the date of data collection provides an understanding of how accurate the inventory may be.

An important consideration is the understanding and systematisation of the timing of campus inventory work: being able to locate the initial date of an inventory and assuring periodical updating is important to assuring the quality and usefulness of inventory data (Bond, 2013). Recruiting volunteers from resident student populations through experiential and nature-based coursework or clubs may promote interest in campus trees and provide assistance with obtaining and maintaining inventory data (Coleman et al., 2025; Elton, Harper, Bullard, et al., 2023). Additionally, students in GIS or arboriculture courses could assist inventory managers with digitising inventories or maintaining trees that require pruning or other care. Monitoring properly identified trees would also help with tracking the percentage distribution of family, genus, and species to further the understanding of campus biodiversity.

Several programmes are in existence that promote campus sustainability and often include the consideration of campus trees as an important component. The Tree Campus programme has been established and administered by the Arbor Day Foundation (n.d.-a) to promote tree planting and maintenance on college campuses. The five requirements to obtain the Tree Campus designation include establishing a Campus Tree Advisory Committee, a Campus Tree Care Plan, dedicated annual expenditures for tree care, to observe Arbor Day, and to create a relevant Service Learning Project (Arbor Day Foundation, n.d.-b). The Sustainability Tracking, Assessment & Rating System™ (STARS) is a self-reporting framework for colleges to measure their sustainability performance and foster an understanding of biodiversity (the presence of wildlife, pollinators, trees, and gardens) to promote a healthy ecosystem (The Sustainability Tracking, Assessment & Rating System, n.d.). The Audubon Cooperative Sanctuary Certification Program (ACSP) uses certifications as benchmarks of success for participating organisations, such as office parks, public parks, and college campuses (Audubon Cooperative Sanctuary Certification Program, n.d.). The main areas of sustainability addressed by the ACSP are site assessment, wildlife management, resource management, and outreach. ArbNet's Arboretum Accreditation Program is designed to determine standards for arboreta and advance the planting, study, and conservation of trees (ArbNet, n.d.). This accreditation programme offers four tiered levels, in which levels 2–4 require an inventory. Among these arboreta are eligible college campuses. Participatory campus stewardship evaluation programmes like these may be modified to more prominently emphasise the importance of understanding and tallying campus resources to foster the initiation of a campus tree inventory.

Infrequent monitoring and inconsistent recording methods also prevent campuses from engaging in proactive management that could support populations of flora and fauna across their grounds and enable resilience in the face of ongoing environmental change. For example, understanding species composition helps with implementing preventative practices against potential diseases and pests such as insects and nematodes. This study has revealed that *Acer*, *Quercus*, and *Pinus* represent a significant portion of standing tree biomass on college campuses. Therefore, it would be prudent to understand their vulnerability to such stressors. Fungal diseases are one threat that is currently on the rise (Casadevall, 2018; Nnadi & Carter, 2021) as well as oak-specific fungal diseases such as anthracnose, oak leaf blister, and oak wilt which may thrive under a changing climate. For example, oak wilt is expected to expand its range northward due to warmer winters that affect the timing of sap beetle flights which spread the disease (Pedlar, McKenney, Hope, Reed, & Sweeney, 2020). Similarly, both anthracnose and oak leaf blister are predicted to flourish in future northeastern climates given their propensity for cool, wet conditions. In fact, the northeast region is expected to get wetter with an already observed 60% increase in the number of days with extreme precipitation (Jay, Crimmins, Avery, et al., 2023). While all three genera represent relatively long-lived species (>100 years), disruptions to predictable climate conditions within their native ranges may result in reductions in growth, reduced lifespans, and eventually cause extirpation. Rogers, Jantz, and Goetz (2017) conducted a climate vulnerability analysis for forty major tree species in the eastern US that took into account exposure, sensitivity, and adaptive capacity to estimate changes in future habitat suitability using the Representative Concentration Pathway 8.5 scenario (essentially, representing a "business as usual" scenario where little to no climate change mitigation occurs). Red maple (*Acer rubrum*) and sugar maple (*Acer saccharum*) ranked 5th and 6th, respectively, out of forty total tree species evaluated, each with a mean vulnerability score of 3.6. Not far behind, striped maple (A*cer pensylvanicum*), pitch pine (*Pinus rigida*), mountain maple (*Acer spicatum*), and eastern white pine (*Pinus strobus*) were ranked within the top fifteen most vulnerable species. This work suggests that range shifts and migration by these species will not be rapid enough to keep up with the pace of modern climate change and will likely require human assistance to persist. It is possible that climate change refugia will exist to buffer some of the extremes in temperature and precipitation that are expected, however the response of pests and pathogens to changing conditions may exacerbate the existing vulnerability faced by many of these species (Rogers, Jantz, & Goetz, 2017). While campus tree inventories cannot be expected to solve the scale of climate change issues referenced here, the vulnerability of many of the current tree stock across these institutions should inspire proactive approaches to improving campus tree resilience which would indirectly benefit wildlife outcomes as well as the mental and physical well-being of the nearby human communities.

Conclusions

This work is the first systematic effort conducted to identify the availability and accessibility of campus tree inventories in the Northeast US, compare species diversity and size of trees across campuses, and identify and promote best practices regarding conducting a campus tree inventory. The inherently non-random nature of a non-probabilistic (i.e. convenience) sample presents important limitations including the preclusion of both performing inferential statistics, as well as the generation of confidence interval estimates. The nature of our convenience sample, however, facilitated responses from a pool of willing survey participants that yielded meaningful data from which conclusions may be drawn (Coleman et al., 2023; Lass & Harper, 2023). These conclusions may inform future research and workforce development initiatives, as well as policy aimed at standardising workplace practice in relation to campus tree inventories. Though the limited sample size made it difficult to make determinations beyond the actual number of campuses that participated in this research, this effort was an example of a strong collaboration among active stakeholders and university researchers (Harper & Lass, 2024; Harper et al., 2016).

Advocating for a systematic approach to conducting tree inventory practices on college campuses would appear to be in order. A consistent methodology would more readily facilitate a clearer understanding of the state of campus tree populations – a consideration germane to human and environmental health. As part of a standard campus tree inventory, priority practices should include the identification of species with scientific name, the measuring of DBH to understand age and growth rate, ascribing a condition rating for tree health and a separate formal rating for tree risk. Campus tree inventories should clearly identify the date when the inventory was last updated. Recruiting student volunteers to contribute to maintaining tree data records would serve the dual purpose of strengthening student education while proactively maintaining the campus tree inventory.

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Author contributions

CRediT: **Gwendolen Van Allen:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing; **Kelly Klingler:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing; **Roxann Cormier:** Resources, Supervision, Validation, Writing – review & editing; **Richard Harper:** Conceptualization, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing.

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No potential conflict of interest was reported by the author(s).

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Appendix

Table A1. Table of all the data split into tiers. Rank 1 inventories contain all characteristics except for risk and common name. Rank 2 inventories record scientific name and DBH and may track the remaining characteristics. Rank 3 inventories have either scientific name, DBH, or neither.

Rank	State	Common Name	Scientific Name	DBH	Height	Condition	Risk	Date of update
1	MA	✓	✓	✓	✓	✓	✓	✓
1	NY	✓	✓	✓	✓	✓	✓	✓
1	NY	✓	✓	✓	✓	✓		✓
1	RI	✓	✓	✓	✓	✓		✓
1	CT		✓	✓	✓	✓		✓
2	CT	✓	✓	✓	✓			
2	MA		✓	✓		✓	✓	
2	MA	✓	✓	✓				✓
2	MA	✓	✓	✓	✓			
2	MA		✓	✓		✓		
2	NY		✓	✓				✓
2	MA	✓	✓	✓				
3	VT	✓		✓	✓	✓		✓
3	MA	✓		✓	✓	✓		
3	NY	✓		✓	✓	✓		
3	NY	✓		✓	✓			
3	NY	✓		✓		✓		
3	MA		✓					✓
3	NH	✓	✓			✓		
3	RI	✓	✓					✓
3	NY	✓				✓		
3	MA	✓						
3	MA	✓						

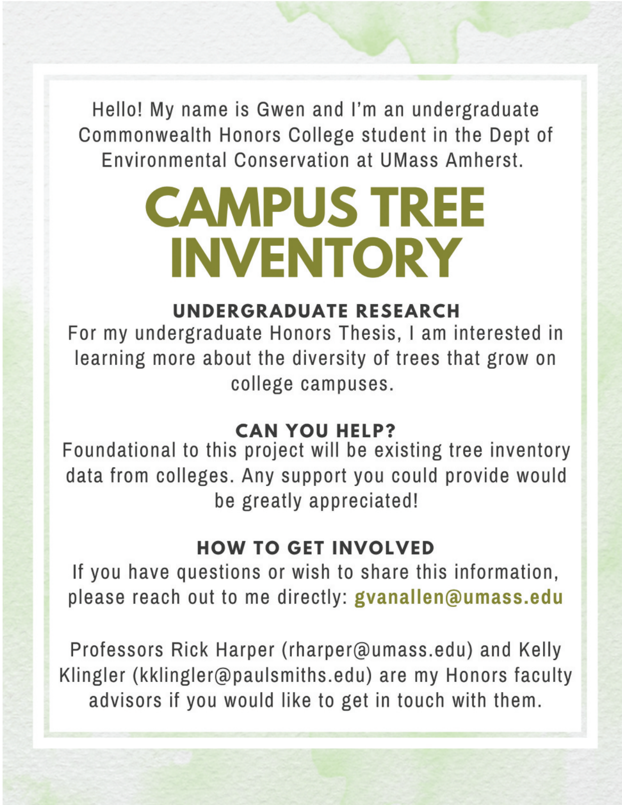

Figure A1. Informational poster shared at the New England Chapter of the International Society of Arboriculture (October 2024).