

URBAN FOREST RESOURCE INVENTORIES: A COMMUNITY BASED APPROACH

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ABSTRACT. The use of trained community volunteers in conducting urban forest resource inventories is outlined in two case studies conducted in Brookline and Springfield, Massachusetts, by the Northeast Center for Urban & Community Forestry at the University of Massachusetts/Amherst. The accuracy and validity of urban forest resource data that was collected by trained volunteers was established and a summary of the findings are presented. Results indicate that the data collected by trained volunteers is valid, and its accuracy compares favorably to levels found among a control group of Certified Arborists. Indirect benefits associated with this type of volunteer effort include the development of a more informed urban forest constituency, increased environmental awareness, an increased political voice, and an improved quality of life for urban residents.

BACKGROUND

The successful use of community volunteers in providing assistance to various urban forestry initiatives has been documented in the literature, and the benefits of these type of efforts have been outlined. The development of volunteer initiatives in establishing effective urban forestry programs and the assisting of municipal tree care programs have also been discussed. These cooperative efforts, which involve citizen “stakeholders” are successful because they create ways for citizens to play an important role in shaping and managing their environment. Volunteer based urban forestry initiatives, often times, enable communities to identify and fulfill their environmental goals, including urban forest resource planning and management.

The Northeast Center for Urban & Community Forestry at the University of Massachusetts/Amherst is providing technical assistance and technology transfer to the seven states of New England and New York in an effort to improve urban and community forestry programs in the region. Recently, the Northeast Center for Urban & Community Forestry has successfully organized and carried out urban forest resource inventories, utilizing community volunteers, in over a dozen communities throughout the northeast. Included in these efforts have been the development of training curriculum and volunteer training manual, which are used to provide community volunteers with a competency to complete the forest resource inventories. Street tree populations, as well as trees found in parks and other open space, have been inventoried and mapped by trained volunteers. In most instances, the collected data and spatial location of the trees has been input into a Geographic Information System (GIS) and utilized as a component of a municipality’s urban forest management plan.

Empowerment of citizens to partake in the betterment of their own community is one of the primary benefits of utilizing volunteers to assist in an urban forest resource inventory, while at the same time providing a fiscally appropriate methodology for gathering data necessary to develop a successful strategic plan for a community’s urban forest. While the use of volunteers to assist in gathering data on urban forest resources has been described, the benefits are more difficult to quantify since the costs of recruitment, training, mobilization, and supervision must be factored into a cost/benefit analysis. These costs will vary for each community that utilizes volunteers, making cost/benefit analyses more difficult. Additionally, the benefits of empowerment and community involvement are difficult to accurately assess, but must be considered. The evolution of a group of involved citizens as urban forest advocates

and a focused political voice must also be considered when discussing the benefits of volunteer efforts.

While the literature suggests that volunteers can be used to complete urban forest resource inventories, the initiatives completed by the Northeast Center for Urban & Community Forestry have been used to test the validity and accuracy of data collected by volunteers. The following case studies are presented to outline the results of two volunteer based street tree inventories in Massachusetts, and to provide a measure of the reliability of urban forest resource data collected by trained volunteers.

CASE STUDY ONE: BROOKLINE MASSACHUSETTS

Volunteer Data Acquisition

A street tree inventory was conducted in Brookline, Massachusetts by 97 community volunteers during the Spring of 1994. The project team included professional urban forestry personnel as well as educators, municipal officials, conservation personnel, citizen advocates and representatives of local utilities.

Approximately 11,250 trees found along 104 miles of roads were inventoried. Inventory teams documented the species, condition, diameter at breast height (DBH), management needs, root zone cover, percentage of impervious material over the root zone, and presence of cavities, dead wood and overhead utilities. Each tree's location was plotted on a base map for inclusion into the Town's GIS. The data acquisition took place on three weekends during June 1994.

Volunteers were recruited from the community using a variety of methods including the media, mailings to target environmental organizations, and presentation in public forums. Over 95% of the volunteers were Brookline residents and ranged from 13 to over 70 years in age. Each volunteer completed a training program consisting of 12 contact hours with instructors from the University of Massachusetts Department of Forestry and Wildlife Management, and the Arnold Arboretum of Harvard University. Training included classroom and practical field instruction, and the volunteers were trained on a series of items ranging from tree identification and condition assessment to map reading skills and data entry procedures. All of the volunteers were required to attend the two training sessions in order to ensure that all survey personnel had received a standard level of training.

The goal of the training curriculum was to introduce all aspects of the survey process to the volunteers and to develop skills in tree identification, maintenance requirements, hazard assessment, and assessing the overall condition of the tree. It was critical that the training program develop a uniform technique for gathering information on the trees in order to ensure consistency in data acquisition by the volunteers. The training curriculum was developed specifically for the Brookline inventory and contained information on situations that were likely to occur along the Town's streets.

Accuracy Assessment

The accuracy of the data that was collected by the volunteer teams was examined by the development of a testing methodology presented here. A random sample of 473 trees was generated and these were re-examined by a two person team of Massachusetts Certified Arborists (MCA/2), experienced in urban forest resource inventories. The same criteria variables that were used by the volunteers to assess the trees were used by the professionals. Once the data on the trees was collected it was compared with the data collected by the volunteers through the use of frequency tables or agreement matrixes, showing the number of times the two Certified Arborists (MCA/2) agreed with the volunteers. This allowed for a determination as to the relative accuracy of data collected by volunteers as compared to practicing professionals.

It was also important to examine how well the two Certified Arborists compared to other professionals by establishing a level of agreement for collected data. This was done by setting up a separate study in which a series of trees were examined by the two Certified Arborists and also by ten other Certified Arborists (MCA/10). In this manner, the observations made by the two Certified Arborists (MCA/2) could be tested against observations made by other professionals in this Control Group (MCA/10). By determining how often they all agreed on specific variables it would be possible to ensure that the sample data they collected in Brookline was representative of typical Certified Arborists, so that it could be compared with the data collected by the volunteers. It would also validate their use as experts to complete the random sample survey and enable a determination to be made as to the accuracy and validity of using community volunteers to complete urban forest resource inventories.

Data Reliability

The data that was collected by the Volunteers was examined to determine how closely it agreed to data obtained by the two Certified Arborists (MCA/2), in order to test the accuracy of the volunteer effort.

The first item reviewed was the level of agreement in tree identification. In this portion of the study, the most commonly occurring trees found along Brookline’s streets were considered. Frequency tables were calculated for each of the trees found in the sample in order to determine the levels of agreement between the two Certified Arborists (MCA/2) and the Volunteers. The frequency table enables a determination to be made as to the number of times two observations agree, therefore an accuracy level for the volunteers can be established.

Shown below, Table 1 provides a summary of the agreement percentages for the most frequent tree types found in Brookline, arranged by genus. The agreement levels decrease when identification of both genus and species were calculated, with the lowest levels occurring among *Platanus*, *Fraxinus* and *Quercus* trees.

Table 1. Percentage of agreement between Certified Arborists (MCA/2) and Volunteers’ tree identification . Levels of agreement as to the genus of sample trees were high between Volunteers and Certified Arborists (MCA/2). Agreement levels decreased when genus and species were examined.

<u>Tree Type</u>	<u>Genus</u>	<u>Genus & Species</u>
<i>Acer</i>	95.00%	90.00%
<i>Fraxinus</i>	96.00%	68.00%
<i>Quercus</i>	93.00%	70.00%
<i>Platanus</i>	92.00%	46.00%
<i>Gleditsia</i>	96.00%	96.00%
<i>Tilia</i>	91.00%	73.00%

Other variables were examined to determine the levels of agreement between Certified Arborists (MCA/2) and the Volunteers. These variables included condition assessment, management requirements, and occurrence of cavities or weak crotches in the sample trees.

Table 2 summarizes the agreement levels between the two Certified Arborists (MCA/2) and Volunteers, and between the two Certified Arborists and the Certified Arborist Control Group (MCA/10), for several different variables that were observed in the sample.

Table 2. Agreement levels showing percentage of agreement between Certified Arborists(MCA/2) and Volunteers and between the Certified Arborists (MCA/2 and MCA/10) when examining individual variables of sample trees.

<u>Variable</u>	Volunteers/ Cert. Arborists (MCA/2) <u>Agreement Level</u>	Cert. Arborists (MCA/2) / Cert. Arborists (MCA/10) <u>Agreement Level</u>
Genus	94%	100%
Genus & Species	80%	98%
Condition	83%	89%
Management Need	75%	86%
Weak Crotch	90%	80%
Cavity	92%	93%
Root Zone Cover Material	82%	98%

Table 2 shows that there is a range of agreement levels between Volunteers and Certified Arborists (MCA/2), with agreement percentages between 80% and 94%. Table 2 also shows that the Certified Arborists (MCA/2 and MCA/10) were not entirely consistent in their levels of agreement, with assessment of management needs and the occurrence of weak crotches representing areas in which there was noticeably disagreement. Agreement of the assessment of the tree's condition by the Volunteers and Certified Arborists (MCA/2) (83%) was nearly the same as that found between the Certified Arborists (MCA/2 and MCA/10) (89%). Assessment of weak crotches also showed a 20% disagreement amongst the Certified Arborists (MCA/2 and MCA/10), while only a 10% disagreement between the Volunteers and Certified Arborists (MCA/2). The remaining variables were assessed fairly consistently amongst the Certified Arborists (MCA/2 and MCA/10), with less than 10% disagreement among the variables.

Another noticeable area in which the Certified Arborists (MCA/2) and Volunteers disagree, is in the area of assessing the management needs of the trees. In 25% of the cases, the Certified Arborists (MCA/2) and Volunteers do not agree as to the need to prune or remove the tree. The Volunteers were consistently more conservative in their assessment of the pruning and removal needs of the tree, reporting that trees were in need of pruning more often than did the Certified Arborists (MCA/2). This is probably a result of the fiscal reality that the Certified Arborist faces, realizing that not every street tree can receive the same level of maintenance and pruning as a tree growing at a private residence.

A complete Frequency Table comparing responses between Certified Arborists (MCA/2) and Volunteers when assessing the management needs of the sampled trees is shown in Table 3.

Table 3. Frequency Tables comparing the management needs as identified by the Certified Arborists (MCA/2) and Volunteers. The two groups agreed in 75% of the cases, with the Volunteers determining that pruning was needed more often than concluded by the Certified Arborists (MCA/2).

Mgt. Need Cert. Arborist (MCA/2)	Mgt. Need -- Volunteers				Total
	None	Prune	Remove	Consult	
None	345	94	4	13	456
Prune	7	5	0	0	12
Remove	0	0	4	0	4
Consult	1	0	0	0	1
	353	99	8	13	473

Summary

	Management Need				Total
	None	Prune	Remove	Consult	
Cert. Arborists (MCA/2)	456	12	4	1	473
Volunteers	353	99	8	13	473

As shown in Table 3, the Volunteers recommended pruning in 99 cases while the Certified Arborists (MCA/2) only observed 12 trees that needed trimming. This reinforces the concept of the volunteers being more conservative in their assessment of the tree's management needs. Additionally, the volunteers listed 13 trees that needed Consultation by the Town Arborist, while the Certified Arborists (MCA/2) recommended only 1 tree that was in need of a second professional opinion. This represents agreement in 75% of the sampled cases. Subsequent review of the trees determined to be in need of pruning by the Volunteers were observed to have some dead wood in the crown, indicating that the Volunteers were very cautious in their determination of management needs.

Condition assessment is a critical component of a tree inventory, providing some of the most useful information to be used in the development of an effective urban forest management system. When examining how often the volunteers and Certified Arborists (MCA/2) agreed on the trees condition, one finds that in 83% of the cases the two groups agreed.

Table 4 shows a Frequency Table for condition assessment of the trees. It can be noted that in most cases there is agreement as to condition, with the most noticeable exceptions being that the volunteers are more conservative in their assessment of the condition.

Table 4. Frequency Table showing condition assessment as identified by the Certified Arborists and volunteers. Agreement between the Certified Arborists and Volunteers occurred in 83% of the cases.

Condition Assessment		Volunteers					
Cert. Arborists (MCA/2)	Good	Fair	Poor	Dead	Hazard	Total	
Good	381	51	8	0	1	441	
Fair	12	6	4	0	2	24	
Poor	0	2	1	1	0	4	
Dead	0	0	0	2	0	2	
Hazard	1	0	0	0	1	2	
	394	59	13	3	4	473	

Summary

	Condition					
	Good	Fair	oor	Dead	Hazard	Total
Cert. Arborists (MCA/2)	441	24	4	2	2	473
Volunteers	394	59	13	3	4	473

If the ranges of assessment were collapsed into two coarser sets based on observations of Good/Fair and Poor/Dead/Hazard then the level of agreement between the Volunteers and Certified Arborists increases to 96%. Comparison of agreement levels between Arborist/Arborist and Arborist/Volunteers shows that for most of the variables assessed the agreement levels are nearly consistent. Identification of cavities, assessment of management needs, and identification of weak crotches had agreement levels that were nearly the same. This indicates that the data collection for these variables, by the volunteers, was nearly as accurate as the professional data acquisition. The validity of the data, as collected by the volunteers, compares favorably to quality of the professional's assessment of these variables.

CASE STUDY TWO: SPRINGFIELD, MASSACHUSETTS

Volunteer Data Acquisition and Training

A street tree inventory was also conducted in Springfield, Massachusetts by 55 community volunteers during the Fall of 1994. 1,025 trees were inventoried and mapped by the trained volunteers, with a random sample of 30 trees utilized to assess the accuracy and validity of the volunteer data acquisition. The training curriculum, inventory program, and statistical analysis was nearly identical to the Brookline inventory procedures outlined above.

Accuracy Assessment

The use of agreement levels and frequency tables to determine the validity and accuracy of the volunteer data was also used in the Springfield study. Summary tables outlining the results obtained in Springfield are provided here.

Table 5, below, provides a summary of the agreement percentages for the tree types sampled in Springfield, arranged by genus. The agreement levels are nearly 100% for all species, with the exception of *Pyrus*.

Table 5 - Tree identification agreement percentages between Certified Arborist (MCA/2) and Volunteers in Springfield.

<u>Tree Type</u>	<u>Genus</u>	<u>Genus & Species</u>
Acer	100%	100%
Celtis	100%	100%
Gleditsia	100%	100%
Malus	100%	100%
Platanus	100%	100%
Pyrus	75%	75%
Quercus	100%	100%
Tilia	100%	100%
Ulmus	100%	100%

Table 6, shown below, provides a Frequency Table for condition assessment of the trees sampled in Springfield. As was also found in Brookline, in most cases there is agreement as to condition, with the most noticeable exceptions being that the volunteers are somewhat more conservative in their assessment of the condition.

Table 6. Frequency Table showing condition assessment as identified by the Certified Arborists (MCA/2) and volunteers in Springfield.

Condition Class by Certified Arborist (MCA/2)	Condition Class by Volunteers			
	Good	Fair	Poor	Total
Good (25)	22	2	1	25
Fair (5)	0	5	0	5
Poor (0)	0	0	0	0
Total	22	7	1	30

	Condition Class			
	Good	Fair	Poor	Total
Cert. Arborists (MCA/2)	25	5	0	30
Volunteers	22	7	1	30

Table 7 Frequency Tables comparing the management needs as identified by the Certified Arborists (MCA/2) and Volunteers in Springfield.

Mgt. Need Cert. Arborists (MCA/2)	Mgt. Need -- Volunteers			Total
	None	Prune	Consult	
None (25)	<i>14</i>	8	3	25
Prune (5)	0	5	0	5
Consult (0)	0	0	<i>0</i>	0
	14	13	3	30

Summary	None	Prune	Consult	Total
Cert. Arborists (MCA/2)	25	5	0	30
Volunteers	14	13	3	30

CONCLUSIONS

The results of these studies conclude that the use of community volunteers for acquisition of data on trees found in an urban forest can be assessed and validated. Agreement amongst Certified Arborists often varies considerably when specific inventory criteria are examined, and this variability can be used for establishment of baseline measures from which to determine the accuracy of volunteer data collection. The results of this study indicate that the urban forest resource data collected by community volunteers compares favorably with data collected by Certified Arborists, when agreement levels are used as the accuracy criteria.

The political strength that a group of community volunteers can provide is difficult to quantify, but it is clear that they provide a voice that represents a strong advocacy for urban forestry issues. In addition, the use of community volunteers allows for the establishment of a network of proactive constituents who provide a strong political voice that can be used to strengthen urban forest management programs in a community, while empowering the volunteers to play a critical role in the development of a better community. The involvement of a community's citizens in helping to shape the quality of their neighborhood becomes a primary benefit of volunteer staffing efforts, and should be included in any strategic urban forest resource management plan being developed by a community.

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