

January 2007

A Survey of Tree Wardens to Assess Urban and Community Forestry Performance in Massachusetts (u.S.A.)

David M. Rines

University of Massachusetts Amherst, drines@comcast.net

Follow this and additional works at: <http://scholarworks.umass.edu/theses>

Rines, David M., "A Survey of Tree Wardens to Assess Urban and Community Forestry Performance in Massachusetts (u.S.A.)" (2007). *Masters Theses 1911 - February 2014*. 56.
<http://scholarworks.umass.edu/theses/56>

This thesis is brought to you for free and open access by the Dissertations and Theses at ScholarWorks@UMass Amherst. It has been accepted for inclusion in Masters Theses 1911 - February 2014 by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.

**A SURVEY OF TREE WARDENS TO ASSESS URBAN AND COMMUNITY
FORESTRY PERFORMANCE IN MASSACHUSETTS (U.S.A.)**

A Thesis Presented

by

DAVID M. RINES

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial
Fulfillment of the requirements for the degree of

MASTER OF SCIENCE

September 2007

Forest Resources

**A SURVEY OF TREE WARDENS TO ASSESS URBAN AND COMMUNITY
FORESTRY PERFORMANCE IN MASSACHUSETTS (U.S.A.)**

A Thesis Presented

by

DAVID M. RINES

Approved as to style and content by:

Brian C. P. Kane, Co-Chair

H. Dennis P. Ryan, Co-Chair

David B. Kittredge, Member

Matthew J. Kelty, Department Head
Department of Natural Resources Conservation

ACKNOWLEDGMENTS

I sincerely extend my gratitude to the members of my committee: Dr. Brian Kane, who encouraged me to undertake this project, to stick with it, and helped me stay on track through thick and thin; Dr. H. Dennis Ryan who provided me invaluable advice, helped me keep things in perspective, and assisted me in navigating the program requirements; and Dr. David B. Kittredge who encouraged me to relate my research to the broader issues of conservation and offered me friendship and guidance throughout the process of conducting the research and writing the manuscript.

I also thank Dr. Irene Goodman of Goodman Research Group for lending her expertise during questionnaire development. Her constructive suggestions about question wording and structure contributed meaningfully to developing a consistent and smoothly worded instrument. Furthermore, I thank Dr. Yorghos Tripodis of the University of Massachusetts for assisting me during the statistical data analysis phase of the project.

I thank Eric Seaborn and Paul Jahnige of the Department of Recreation and Conservation for their interest in conducting this study and their tireless input and assistance in formulating the questionnaire and scope of survey. This study was made possible by a grant from the Massachusetts Department of Recreation & Conservation.

Finally, I extend a heart-felt thank you to Wendy Slattebo for her help with manuscript editing work and especially to my loving wife Alisa who, not only endured my two years away from home and helped with organization of the manuscript, but also helped me stay focused and encouraged me to continue when the going got tough.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	iii
LIST OF TABLES	vii
LIST OF FIGURES	x
CHAPTER	
1. BACKGROUND AND LITERATURE REVIEW	1
Introduction	1
Literature Review.....	7
The Role and Opinions of Tree Wardens in New England	9
Urban & Community Forestry Performance and Community Demographics.	11
Tree City USA	12
2. METHODOLOGY	14
Study Design.....	14
Demographics	20
Statistical Methods.....	21
3. RESULTS	23
Survey Responses	23
Demographics of Responses	24
Respondent Role	25
Tree Warden Position and Department.....	26
FS U&CF Performance Parameters	28
Professional Staff	30
State and Local Ordinances	30
Advocacy and Advisory Groups and Management Plans.....	32
Inter-Agency Communication	32

Interrelationship among FS U&CF Parameters	34
Tree Warden Opinion	36
Tree Warden Opinion by Community FS U&CF Performance	37
Tree Warden Opinion by Tree City USA Accreditation	40
Tree Warden Position	42
Tree Warden Position by Community FS U&CF Performance.....	42
Tree Warden Position by Tree Warden Opinion	44
Community Work Priorities.....	44
Priorities by Community FS U&CF Performance	47
Priorities by Professional Qualification	50
Priorities by Tree Warden Position.....	51
Tree City USA	51
TCUSA Accreditation and Community FS U&CF Performance	52
TCUSA Accreditation and Inter-Agency Communication.....	54
TCUSA Accreditation and Tree Warden Work Priorities	55
Comparison of TCUSA Accreditation and FS U&CF Performance	56
Community Population	57
Tree Warden Position and Department by Community Population	57
Community FS U&CF Performance by Population	58
Inter-Agency Communication by Population	60
Tree Warden Opinion by Population	61
Community Work Priorities by Population	63
Community Median Household Income.....	64
Community FS U&CF Performance by Income.....	64
Inter-Agency Communication by Income	66
Tree Warden Opinion by Income	66
Community Work Priorities by Income.....	68
Community Education	69
Community FS U&CF Performance by Education	69
Inter-Agency Communication by Education	71
Tree Warden Opinion by Education	72
Community Work Priorities by Education	74

4. MANAGEMENT DISCUSSION	75
Response Rate and Demographic Characteristics.....	75
Community FS U&CF Performance.....	76
Community Work Priorities.....	81
Professional Staff	85
Tree Warden Position and Department.....	86
Other Qualified Individuals	88
Professional Qualifications and Work Priorities.....	89
State and Local Ordinances	91
Management Plans and Inventories	91
Tree Inventories	94
Advocacy and Advisory Groups.....	96
Inter-agency Communication.....	97
Tree Warden Opinion	100
Tree City USA	101
5. MANAGEMENT IMPLICATIONS AND CONCLUSIONS.....	102
APPENDIX: SURVEY MAILINGS	110
REFERENCES	120

LIST OF TABLES

Tables

1. USDA Forest Service Urban & Community Forestry Program 2006 Performance Parameters	3
2. Massachusetts Urban & Community Forestry Program Performance Parameters Developed by DCR	5
3. Survey Fielding Timeline for 2006 DCR U&CF Mail Survey	16
4. Means, Test of Significance, and Ranges for Demographic Measures between Respondents and all Communities	25
5. Respondent Role	26
6. Tree Warden Position and Department.....	27
7. Number and Percentage of Communities by Overall FS U&CF Parameter Score	28
8. Community Participation in Each of the 4 FS U&CF Performance Parameters and Associated Components.....	29
9. Enforcement Level of Massachusetts General Law Chapter 87	31
10. Type of Local Ordinances Held by Communities	31
11. Frequency of Inter-Agency Communication	33
12. Frequency of Routine/Periodic Inter-Agency Communication by Community FS U&CF Performance Score.....	34
13. Key Associations among the FS U&CF Performance Parameters and Their Components	35
14. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs.....	36
15. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Overall FS U&CF Performance Score.....	37

16. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Individual FS U&CF Parameters and Components.....	39
17. Tree Warden Opinions about Importance of MGL Chapter 87 by Level of MGL Chapter 87 Enforcement.....	40
18. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Tree City USA Accreditation Status.....	41
19. Community FS U&CF Performance and Tree City USA Accreditation Status by Tree Warden Position	43
20. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Tree Warden Position	45
21. Community Tree-Related Work Priorities.....	46
22. Community Tree-Related Work Priorities by Overall FS U&CF Performance Score	47
23. Community Tree-Related Work Priorities by FS U&CF Parameters and Components.....	49
24. Community Tree-Related Work Priorities by Tree Warden Qualification and by Presence of Other Qualified Individuals.....	50
25. Community Tree-Related Work Priorities by Tree Warden Position.....	52
26. Community FS U&CF Performance by Community Tree City USA Accreditation Status.....	53
27. Frequency of Routine/Periodic Inter-Agency Communication by Community Tree City USA Accreditation Status.....	54
28. Community Tree-Related Work Priorities by Community Tree City USA Accreditation Status.....	55
29. Tree Warden Position and Department by Community Population	58
30. Community FS U&CF Performance and Tree City USA Accreditation Status by Community Population	59

31. Frequency of Routine/Periodic Inter-Agency Communication by Community Population	61
32. Tree Warden Opinions about the Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs By Community Population	62
33. Community Tree-Related Work Priorities by Community Population	63
34. Community FS U&CF Performance and Tree City USA Accreditation Status by Community Median Household Income	65
35. Frequency of Routine/Periodic Inter-Agency Communication by Community Median Household Income	66
36. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Community Median Household Income	67
37. Community Tree-Related Work Priorities by Community Median Household Income	68
38. Community FS U&CF Performance and Tree City USA Accreditation Status by Percentage of College-Educated Residents	70
39. Frequency of Routine/ Periodic Inter-Agency Communication by Percentage of College-Educated Residents	71
40. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Percentage of College-Educated Residents	72
41. Community Tree-Related Work Priorities by Percentage of College-Educated Residents	73

LIST OF FIGURES

Figure

1. FS U&CF Score among Communities that Responded to the Survey.....24
2. Comparison of Sustaining Communities (FS U&CF Score of 4) and Tree City USA-Accredited Communities by Tree-Related Work Priorities.....56

CHAPTER 1

BACKGROUND AND LITERATURE REVIEW

Introduction

Massachusetts is the third most densely populated state in the US with over 91% of inhabitants living in areas designated by the United States Census Bureau as urban (U.S. Census Bureau 2007). Massachusetts has experienced one of the highest rates of urban development with a 5% growth in urbanized land between 1990 and 2000, most of which occurred in open forested land (Nowak et al. 2005). In spite of this growth, Massachusetts remains the eighth most forested state with approximately 62% of its land area considered to be forested (USDA Forest Service (FS) 1998). This combination of population density, urbanization, and forest cover suggests that the pressure between urban vegetation and people in Massachusetts is particularly intense. Unlike trees in forested lands, trees in urban environments are under greater stress from adverse growing conditions (such as restricted growing space both above- and below-ground, air pollution and poor soil conditions) and thus require proactive human intervention to remain healthy (Miller 1997; Clark & Matheny 1998; Lohr et al. 2004). Adequate funding for management of urban trees remains one of the biggest challenges facing communities (Kielbaso 1990; Schoeneman & Ries 1994). State agencies, which play an important role in the administration, coordination and promulgation of urban and community forestry programs are under increasing pressure to devise cost-effective programs that will encourage active community participation in developing self-sustaining programs for the care, protection and planting of urban trees and forests in a climate of dwindling economic resources.

As in all states in the U. S., Massachusetts receives a baseline amount of funding from the National Urban and Community Forestry Program administered by United States Department of Agriculture, Forest Service (FS U&CF) for the development of urban and community forestry programs at the municipal level. To be eligible for FS U&CF base funding, states must document achievement of national standards that include having: a full-time urban and community forestry program coordinator; a full-time volunteer/partnership coordinator; a current 5-year urban and community forestry management plan; and an active urban and community forestry advisory council (USDA Forest Service 2007). The Massachusetts Department of Conservation and Recreation (DCR) acts as the coordinating agency for Massachusetts and is chartered with the role of assisting Massachusetts communities with the development of self-sustaining urban and community forestry programs.

FS U&CF funding allocations beyond the baseline amount are granted to states based on financial need and on community performance with respect to developing and maintaining urban and community forestry programs. The number of communities and population in a state determine financial need. Community performance is measured by how well communities manage their urban and community forests and trees using the four FS U&CF performance parameters as benchmarks (Table 1). Performance funding is allocated annually by the FS based on the relative standing of states, as calculated by the number of communities that sought state assistance and the number of FS parameters attained (J. Parry pers. comm. 2/28/07). The FS U&CF performance parameters were unveiled as part of the USDA Forest Service Community Accomplishment Reporting

System (CARS) initiative in 2006. Measurement of community performance using these performance measures is the subject of this study.

Table 1. USDA Forest Service Urban & Community Forestry Program 2006 Performance Parameters

Management Plans: A detailed document or set of documents, developed from professionally-based inventories/resource assessments, which outline(s) the future management of the community's trees and forests. The plan must be active (i.e., in use by the community and updated as needed to incorporate new information).

Professional Staff: Individuals who have one or more of the following credentials, and who the community directly employs or retains through written agreement to advise and/or assist in the development or management of their urban and community forestry program: 1) a degree in urban forestry or a closely related field (e.g., forestry, horticulture, arboriculture, etc.), and/or; 2) International Society of Arboriculture Certified Arborist (ISA) or equivalent professional certification.

Ordinances/Policies: Statutes or regulations that direct citizens and local governments in the planting, protection and maintenance of urban and community trees and forests.

Advocacy/Advisory Organization: Organizations that are formalized or chartered to advise (organizations established by the local government) or advocate or act (non-governmental organizations active in the community) for the planting, protection and maintenance of urban and community trees and forests.

Under the FS U&CF CARS initiative, communities in Massachusetts received a score from 0 to 4 based on how many of the four FS U&CF parameters they met. In other words, communities that met all four performance parameters achieved a score of "4" and were identified by the FS as "Sustaining Communities" because they met all four parameters for developing a program for sustaining their urban forest resources. Communities that met fewer than four of the parameters but received state technical, educational, or financial assistance provided by DCR for developing urban and community forestry programs in the current year were identified by the FS as

“Developing Communities” because they demonstrated a commitment to developing higher performing programs. Communities that did not meet any of the parameters received a score of “0” but may be identified as “Developing Communities” if they sought state assistance for urban and community forestry programs within a 12-month period. In addition to managing the FS funding allocation to Massachusetts, DCR works in cooperation with the FS to provide technical assistance, education, and guidance to encourage communities to proactively develop programs intended to improve the health and extent of the urban forest.

The urban forest includes street trees and trees in parks, public grounds, and town forests. Coordinating agencies like DCR have leeway in administering FS U&CF funding and can tailor urban and community forestry programs to specific needs of communities in the state as long as the original intent of the FS parameters is maintained (J. Parry, pers. comm. 2/28/07). DCR strives to meet community needs and improve urban and community forestry by developing challenge grants and providing technical assistance, education, and outreach programs tailored to the needs of Massachusetts communities (MA DCR 2006).

DCR launched a community recognition program in 2007 named the Massachusetts Sustainable Community Forestry program (MA U&CF), which was based on the four FS parameters (with modifications), degree of inter-agency communication, and National Arbor Day’s Tree City USA (TCUSA) accreditation status. These six parameters (Table 2) were used as benchmarks of performance for Massachusetts communities with the goal of “assisting communities and non-profit groups in protecting, growing and managing community trees and forest ecosystems, with the ultimate aim of

improving the environment and enhancing livability of all of Massachusetts communities” (MA DCR 2006, <http://www.mass.gov/dcr/stewardship/forestry/urban>).

The MA DCR program was designed to increase community performance by meeting the specific needs of Massachusetts communities.

Table 2. Massachusetts Urban & Community Forestry Program Performance Parameters Developed by DCR

Management Plans: A document or set of documents that guide(s) the strategic management of urban & community trees and forest resources that is currently in active use, e.g., community or urban forestry management plan, open space plan, natural resources management plan, etc.

Professional Staff: Either the tree warden or another individual retained by the town who [is] regularly involved with the planting, protection and maintenance of urban and community trees and forests must have achieved one or more of the following:

- Massachusetts Certified Arborist (MCA) or equivalent;
- International Society of Arboriculture Certified Arborist (ISA);
- Associates, Bachelor’s or Master’s degree from an accredited college or university in a natural resources field;
- Completion of Professional Course in a natural resources field (for communities with populations of 10,000 or fewer people).

Ordinances/Policies: Demonstrates recent enforcement of Massachusetts General Law Chapter 87 or maintains one of the following in their local by-laws:

- Local tree ordinance
- Regulations requiring the planting of new trees during development
- Regulations that protect existing trees during development
- Written policies pertaining to tree planting, protection and maintenance

Advocacy/Advisory Organization: Groups or organizations that advise or advocate for the planting, protection and maintenance of community trees, e.g. tree board, tree commission, friends of trees, or other non-profit organization directly involved with the care of trees.

Inter-Agency Communication: Communications between the tree warden’s department and other agencies and departments regarding the planting, protection and maintenance of urban and community trees and forests.

Tree City USA Status: Achieves and maintains accreditation in the National Arbor Day Foundation’s Tree City USA program.

Developing a better understanding of the current status of urban and community forest management performance has been identified as an important first step to developing states' programs that effectively targeted municipal assistance needs (Trieman & Gartner 2004). To develop a better understanding of urban and community forest management in Massachusetts, DCR, in partnership with the University of Massachusetts-Amherst, sponsored a self-administered survey of Massachusetts tree wardens in 2006. The goals of this survey were:

1. collect data to help DCR assess current community performance and to meet FS U&CF performance reporting requirements for 2006
2. obtain baseline information about tree warden perspectives and community priorities for managing the urban forest resource.

The objectives of the study were to:

- measure community performance with respect to the FS U&CF and MA U&CF program performance parameters;
- investigate community performance with respect to components of the FS U&CF parameters, specifically local ordinances and tree inventories;
- determine the degree of association between community performance with respect to the FS U&CF and MA U&CF parameters and the key demographic measures of community population, wealth and education;
- ascertain tree warden attitudes about the relevance of the FS U&CF parameters and inter-agency communications to the success of their urban and community forestry programs; and,

- assess tree-related work priorities and their association with the FS U&CF and MA U&CF performance parameters.

The survey was designed with input from DCR, the University of Massachusetts, the Massachusetts Tree Warden's and Forester's Association (MFTWA) and other interested stakeholders. This survey is the first of a series of surveys that DCR intends to undertake to obtain tree warden feedback and to assess community performance with respect to the FS U&CF and MA U&CF program performance parameters over time. Similar surveys have been undertaken in California and Oregon to measure urban and community forestry management attributes over time (Thompson 2006; Reis et al. 2007). Findings from this study will be used by DCR to help modify the Massachusetts Sustainable Community Forestry program.

Literature Review

America has become a nation of urban dwellers. According to the U.S. Census Bureau (2007), 79% of the U.S. population resides in urbanized areas and forests continue to be converted to urban forests as land continues to be developed principally for human use. Based on findings from the FS's *Forest on the Edge* project, 44 million acres (17.8 million hectares) of open land, or 11% of private forests (an area larger than New England), will be converted to urban or suburban use over the next 25 to 30 years (Stein et al. 2006). In most cases, however, trees are not completely removed from developed areas. Instead, they remain in a new relationship with humans and the urban ecosystem. As defined by Nowak (1994 p.42), "urban forests are complex ecosystems created by the interaction of anthropogenic and natural processes."

With urbanization has come a growing awareness that urban forests are important to the quality of human life in cities (Dwyer et al. 1992, Nowak et al. 2001, Trieman & Gartner 2005). Building public awareness about the value of protecting and maintaining urban forests has led to studies that describe and quantify the economic, social and environmental benefits of trees in urban and suburban environments. For example, a cost-benefit analysis of urban trees in Modesto, California concluded that the economic benefits of trees, such as moderation of urban temperatures, management of water runoff, control of greenhouse gases, improved aesthetics, better recreation opportunities, and increased property values significantly outweighed the costs of their management (McPherson et al. 1999). A national study by Kiebaso (1988) also reported that the presence of trees increased real estate values. It has also been demonstrated that increases in urban canopy size directly reduces cooling and heating costs and indirectly reduces air pollution by reducing power consumption and increasing CO₂ consumption (Akbari 2002). Furthermore, an increase in the urban canopy can result in improved storm water management (Maco and McPherson 2002). Equally important are the sociological benefits of urban trees as described by Dwyer et al. (1992), such as reduced stress, increased enjoyment of everyday life and improved physical health.

The importance of urban forests to people began to be recognized at the national level with the advent of the environmental movement in the early 1970s. The FS U&CF program officially commenced with enactment of the Sikes Bill in 1972 (Miller 1997). This bill subsequently led to an amendment of the Cooperative Forest Assistance Act of 1978, which authorized financial, technical and related assistance to state forestry agencies in support of cooperative efforts in managing urban and community forests

(Cubbege et al. 1993). The program was expanded in the early 1990s as part of the 1990 Farm Bill, which increased funding and the authority of the FS to work with states to administer grants and provide technical assistance for the management of urban vegetation. As a result, funding to the states was increased from \$2.7 million in 1990 to \$25 million in 1993, and a 15-member National Urban and Community Forestry Advisory Council (NUCFAC) was established under the auspices of the Secretary of Agriculture. The importance of urban and community forestry is implicit in the 2006 FS \$27 million budget for urban and community forestry programs and in the development of computerized tools (e.g., iTree) to quantify the environmental benefits that urban trees provide (Maco and McPherson 2003).

The Role and Opinions of Tree Wardens in New England

Although urban forest management was first recognized at the national level in the late 1970's, the legacy of managing urban trees in New England dates back over 100 years. In 1898, Massachusetts was the first state in the U.S. to mandate that towns must elect or appoint municipal officials, known as tree wardens, to be responsible for the care and protection of public trees (Ricard & Bloniarz 2006). The other five New England States followed suit a few years later, and the position of municipal tree warden in the U.S. continues to be unique to New England (Ricard & Bloniarz 2006).

Massachusetts tree warden legislation at one time served as a model for the rest of the country with tree wardens who were highly trained and whose sole responsibilities were to care for public shade trees (Shade Tree Advisory Report 1987). But, according to findings of the Shade Tree Advisory Committee, which was created in 1986 by request of the Commissioner of the Department of Environmental Management (DEM, now

DCR), “a combination of shrinking municipal budgets and a series of enabling acts, which combined the position with several others, has seriously decreased the number of qualified individuals holding the tree warden position” (Shade Tree Advisory Report, 1987 pp. 16-17). In most cases, tree warden positions have become part-time roles held by individuals who, for the most part, work in other municipal departments. Ricard and Bloniarz (2006) found that 71% of respondents in Massachusetts performed tree warden duties on a part-time basis and that 59% worked for the Highway Department of the Department of Public Works (DPW). In New England as a whole, 83% of tree wardens considered their role to be part time and many did not hold a professional degree or certification in a natural resources field (Ricard and Bloniarz 2006). However, it was found that tree wardens in New England were, in general, receptive to learning new skills, liked to interact and share knowledge with other tree wardens, and depended on several sources for information and assistance in decision making, including their colleagues, private companies, cooperative extension systems and local nurseries (Ricard & Bloniarz 2006). In addition, tree wardens throughout New England mostly viewed themselves as professionals who were generally satisfied with their position and took pride in their jobs. Ricard & Bloniarz (2006) also found that tree wardens believed that improving tree health and maintaining public safety were the two most important justifications for having urban and community forestry programs and that tree wardens regard public safety as their most important duty and commit most of their time to assessing and removing hazardous trees. Ricard (2005) found that the perceived importance of such duties had increased during the 1990s among tree wardens in Connecticut.

Tree wardens in general value their working relationships with utility companies, which often perform right-of-way clearing that involves trimming street trees away from electrical conductors. Doherty et al. (2000) found that Massachusetts tree wardens regarded cooperation and cost sharing with utility companies as very important to the successful management of their urban trees. Similarly, Ricard and Bloniarz (2006) found that tree wardens across New England valued their working relationships with public utility companies highly. These studies suggest that utility line clearing work is an integral part of managing urban trees. Many communities in Massachusetts perform utility operations in house.

Urban & Community Forestry Performance and Community Demographics

Community population size appeared to be one of the main indicators of urban and community forestry management performance. Communities with larger populations in Wisconsin (Miller and Bate 1978), Illinois (Schroeder et al. 2003), Missouri (Trieman & Gartner 2005) and Utah (Kuhns et al. 2005) were more likely to have higher-performing urban and community forestry programs. Schroeder et al. (2003) noted that smaller communities in Illinois lacked key components of an effective urban and community forestry program, such as tree boards or commissions, shade or street tree ordinances, street tree inventories or trained staff. Residents of larger communities were also more likely to support initiatives for tree maintenance and planting. Trieman and Gartner (2005) found that Missouri residents in larger communities were more likely to support urban and community forestry programs and residents from communities with populations over 50,000 were willing to consider tax increases to support better management of public trees.

Community wealth was also correlated with urban and community forestry management performance. Miller and Bate (1978) noted that a higher than average per-capital income (as well as a larger number of community-owned trees) made communities more likely to have urban forestry programs. Lohr et al. (2004) found that wealthier and more educated community residents were more likely to agree that trees were important to their quality of life, which suggests that education, as well as wealth, were factors of urban and community forest management performance.

Tree City USA

The TCUSA program is sponsored by the National Arbor Day Foundation, the FS, and the National Association of State Foresters and provides participating communities with “direction, technical assistance, public attention, and national recognition” for urban and community forestry programs (National Arbor Day Foundation, <http://www.arborday.org/programs/treeCityUSA.cfm>). To become TCUSA accredited, communities must satisfy the following four criteria:

- have a tree board or department;
- possess a community tree ordinance;
- maintain an annual urban forestry budget of at least \$2 per capita; and,
- host an Arbor Day observance and proclamation.

Like the FS U&CF program, TCUSA-accreditation was designed to encourage cities and towns to develop their urban and community forestry programs through community recognition and citizen participation. Similar to the FS U&CF program, communities with larger populations were more likely to hold TCUSA accreditation. Galvin & Bleil (2004) found a positive correlation between population and per-capita

tree-related expenditures with more populated communities in Maryland being more likely to meet the TCUSA \$2 per-capita minimum expenditure requirement. More populated communities in Missouri were also more likely to have TCUSA accreditation (Treiman & Gartner 2004). Similarly, Reis et al. (2007) found that TCUSA-accredited communities were more likely to have tree inventories and ordinances and were more likely to have received state assistance.

CHAPTER 2

METHODOLOGY

Study Design

A self-administered mail-in survey was sent to tree wardens of all 351 incorporated communities in Massachusetts to ask them to assess their community's involvement in urban and community forestry management programs (Appendix 1). Tree wardens were selected as the primary recipient because every community is required by law to have one (M.G.L. Ch 41, Sections 1 and 106 & M.G.L. Chapter 87, Section. 2) and tree wardens were the individuals or entities (some communities have tree committees that handle the duties of tree warden) with the "greatest responsibility for the care and maintenance of municipally-owned public trees" (Ricard 2005). Tree wardens typically have the most detailed knowledge of urban forestry activity in their community.

Tree warden names and mailing addresses were supplied by DCR. All survey correspondence was mailed through the U.S. Postal Service during June - July, 2006 and addressed to the designated tree warden using the following format:

```
<sal> <first name> <last name>  
<title>  
<address 1>  
<address 2>  
<city>, MA <zip>
```

A structured, self-administered mail survey format as described by Dillman (2000) was selected as the survey methodology with the best means to achieve a high response rate given constraints on time, budget and computer programming experience. A mail survey could be developed and administered in-house and costs were limited mostly to printing and mailing. Telephone and face-to-face interviews were ruled out because of the high expense of employing a professional organization or individual with

the skills necessary to conduct them effectively (Dillman 2000). Although the structured format can be administered electronically, employing the Internet would have required programming knowledge, and a web-based study would have still involved direct mailings since e-mail addresses were not available for many tree wardens. This was especially true for tree wardens of less densely populated towns. In addition, Ricard & Bloniarz (2006) found that many tree wardens prefer not to correspond by electronic means. One expected advantage of conducting the survey electronically was faster response times (Dillman 2000); but the probability of not reaching a large number of respondents, particularly those from smaller communities, was a greater deterrent than a slower response time. Dillman (2000) indicated that a well-timed, four-contact sequence of sending a pre-notice letter, questionnaire, reminder postcard, and replacement questionnaire would yield a response rate superior to that of just sending out a single questionnaire. The survey for this study was administered using three mailings and follow up telephone calls and e-mails as follows:

- First, a pre-announcement letter was sent to all tree wardens alerting them that they would soon receive a survey in the mail (Appendix A). The letter introduced the study and explained the importance of completing the survey right away. Feedback from communities or mailings that bounced back as ‘return to sender’ were used where possible to update the contact database.
- Five days later, the questionnaire was sent with a cover letter to all tree wardens. The cover letter was integrated into the first page of the questionnaire and contained language that reinforced the importance of participating in the study by promptly completing the survey (Appendix A).

- Four weeks later, a replacement questionnaire was sent to tree wardens who had not responded to any of the previous mailings (Appendix A). The replacement questionnaire was created in the same format as the first questionnaire except it contained a shorter, more direct cover letter reminding recipients of the importance of their participation to the outcome of the study.

The original survey fielding plan included sending a thank-you and reminder card to all tree wardens 15 days after the first questionnaire was sent. The card was designed with a note of appreciation for tree wardens who had already returned their questionnaire and a gentle reminder to those who had not (Appendix A). Because of printing delays and the need to keep the project on schedule, the decision was made to send thank you/reminder e-mails where possible and to make reminder telephone calls to tree wardens in lieu of sending out the cards. Table 3 provides the intended and actual survey fielding times.

Table 3. Survey Fielding Timeline for the 2006 DCR U&CF Mail Survey

Mailing Timeline	Intended	Actual
Pre survey letter mailed to all Tree Wardens using DCR-supplied names and addresses	<i>Day 1</i> 9 June	9 June
First questionnaire and cover letter mailed to all Tree Wardens	<i>Day 5</i> 16 June	16–30 June
Follow-up thank you/reminder cards sent to all respondents	<i>Day 20</i> 30 June	21 July*
Second questionnaire and cover letter sent to Tree Wardens who had not responded to previous mailings	<i>Day 34</i> 14 July	28 July–11 Aug
Follow-up phone call/e-mail contact to non-respondents	<i>Day 45</i> 25 July	25 Aug

* A thank you/reminder email was sent in lieu of cards.

To increase the likelihood of a response, all correspondence explained the importance of the study to helping Massachusetts receive greater FS funding in the future, how the results would be utilized, and the value of respondent participation. The correspondence also addressed confidentiality by including a statement that individual survey responses would not be made public. An effort was also made to strike a tone that emphasized that the study's success was dependent on respondents' candid feedback. DCR and the University of Massachusetts logos were included on all correspondence to lend a degree of official importance.

A lottery incentive was employed in the belief that it would also help increase the response rate. Recipients were informed in the pre-survey letter and questionnaire cover letters that their community would be entered into a raffle for \$3,000 of planting materials if they completed and returned the questionnaire. However, such an incentive may have introduced a response bias because some communities may have placed more value on the award than others. For example, a community may not have resources to plant trees, in which case, \$3,000 of plant materials would offer little incentive. Also, a community that maintained planting stock in its own nursery might not want additional plant material. Token payments in the form of cash enclosed with the questionnaire were more likely to result in higher response rates compared to lottery incentives (Warriner et al. 1996). However, it was not possible to administer cash payments and it was felt a lottery incentive was better than offering no incentive at all.

Topics covered in the questionnaire included: 1) characteristics of the tree warden's position, role and compensation; 2) degree of community attainment of the four national FS U&CF performance parameters and associated components; 3) tree warden

opinion regarding the importance of the FS U&CF parameters and inter-agency/inter-departmental communication to the success of their community's urban and community forestry program; 4) frequency and scope of inter-agency/inter-departmental communication; and, 5) tree warden assessment of their community's work priorities.

The questionnaire was formatted into an 8.5" X 11" booklet with four double-sided pages that contained 21 closed and open-ended questions in black ink. Questions were designed and ordered using guidelines in Dillman (2000) and from input from the Goodman Research Group (Irene Goodman, pers. comm. 5/25/06). The questionnaire was pilot tested by 30 students in the Department of Natural Resources Conservation at the University of Massachusetts to help determine appropriate question order, to improve wording clarity, and to assess time required to complete. In addition, ten Massachusetts tree wardens were also asked to comment on a near-final version of the instrument (Answers to these questionnaires were not included in the final results). Because questionnaire length can result in lower response rates, every effort was made to limit the average time required by respondents to complete the questionnaire to less than 15 minutes. Response rates were likely to decline significantly with questionnaire completion times in excess of 15 minutes (Irene Goodman pers. comm. 5/25/06). Keeping the questionnaire short enough to encourage a higher response rate was the principal limitation to the number and types of questions asked. Additional questions asking tree wardens to give reasons behind why they answered that one parameter was more important to their program than another might have yielded further valuable insights into tree warden concerns and motivations. In addition, more questions asking respondents to describe or further categorize their communication with other community

departments may have added value in terms of greater insight into types of communication that takes place between departments and how it impacts the management of urban trees.

The chief disadvantage of open-ended questions in self-administered surveys is that respondents often do not provide complete or adequate answers (Dillman 2000). Therefore, questions in this survey were designed as closed-ended questions wherever possible. The structure of the closed-ended questions used the following types of answer choices: 'Check One', 'Check All That Apply,' and 4 and 5-point Likert Scales. The use of closed-ended questions was also believed to improve the consistency of responses, reduce the time needed for respondents to complete the questionnaire instrument, and to make the process of coding the responses easier (Dillman 2000). Assumptions about the respondent's knowledge of the subject material and the ability to arrange answer choices into logical categories facilitated the process of structuring closed-ended questions. Closed-ended responses were coded numerically (e.g. 'Yes' = 1, 'No' = 2, and 'Routinely' = 1, 'Periodically' = 2, 'Seldom' = 3 and, 'Never' = 4). Questions left blank or which contained a response of "NA" or were coded as '98,' and questions which contained "Don't Know" or "DK" as a response were coded as '99.' The comparatively small number of 98 and 99 codes justified combining them under a single code in the database (code of '9').

Ten of the closed-ended questions contained an answer choice of 'Other' where respondents were permitted to write in their own responses. Written answers were included in the coding of responses. Five of the closed-ended questions used a 5-point Likert scale (1='Strongly Agree' to 5='Strongly Disagree') to measure respondent

opinion and three questions used a 4-point Likert scale. An open-ended question format was, however, most appropriate for four of the questions for which respondents were asked to write out their answers. The open-ended questions included asking respondents to name the department or agency in which their position resides, to list the name and principal activity of advocacy or advisory groups operating in their community and to list the title, date, and current usage of documented management plans. A question at the end of the survey requested that respondents provide general comments regarding any of the topics covered in the study. Data from the questionnaires, including written responses, were entered into Microsoft Excel™ (Microsoft Corporation 2003) as questionnaires were received. The spreadsheet was checked against the questionnaires two times after data entry for accuracy.

Demographics

For purposes of this analysis, communities were divided between those with populations greater than 10,000 people and those with populations of 10,000 and fewer people. Community populations were based on 2000 Census data (U.S. Census Bureau 2007). This division was selected based on a distinction made in Massachusetts General Law Chapter 41, Section 106, which states that “in a town that exceeds 10,000 inhabitants...the tree warden shall be qualified by training and experience in the field of arboriculture” (MGL Chapter 41, <http://www.mass.gov/legis/laws/mgl/gl-41-toc.htm>). This division also seemed appropriate because the median population of communities in Massachusetts was 9,707 based on 2000 Census data. Population density could have been used as an alternative; population density was highly correlated with population size. Thus, population was used in this analysis as a proxy for population density.

Population growth (i.e., the percent change in population) between 1980 and 2000 as well as 1990 and 2000 was also considered.

In addition to population, communities were also divided into three median household income categories as a means to analyze community performance by community wealth. The three categories were \$50,000 or less, between \$50,001 and \$62,500, and over \$62,500. These categories were selected based on the average median household income among Massachusetts communities, which was \$58,315, and because most communities fell within the range of \$45,000 and \$75,000. Communities were also divided into three education categories based on the percentage of residents with a college degree. The three categories were less than 25%, those between 26% and 35%, and those with over 35%. These divisions were selected because a high percentage of Massachusetts communities had between 20% and 40% of residents with college degrees.

Statistical Methods

The non-parametric Spearman Rank-Order correlation matrix (Sheskind 2004) was used to investigate the degree and direction of associations between questions. For question pairs with significant association, pivot tables were created in Excel to investigate the relationship further. A random sampling technique was not employed in this study because it was possible to send questionnaires to all 351 incorporated cities and towns in Massachusetts and because of the desire to achieve responses from as many communities as possible. Thus, it was not possible to determine whether responses accurately represented all communities in Massachusetts. As a surrogate, the demographic measures (population, average household income, land area, and percent of population with a college degree) provided by the Massachusetts State Data

Center/Donahue Institute (2005) were compared among respondents and non-respondents. Since demographic data were not normally distributed, the Kruskal-Wallis test was used and a 95% confidence interval was used to determine significance. Data were analyzed using SAS version 9.1 (SAS Institute, Cary, 2002-03), Minitab version 14 (Mintab, Inc. 2003), and ArcGIS 9.1 (ESRI 2006).

CHAPTER 3

RESULTS

Survey Responses

Tree wardens and other public officials from 143 communities responded to the survey during July – October, 2006 for a response rate of 41%. Responding communities represented 50% (3,179,337) of the total Massachusetts population. Every questionnaire received was usable with the number of unusable responses such as “N/A,” “D/K,” “Don’t Know,” or questions simply left unanswered being very low, constituting less than 8% of responses for the majority of questions. The exceptions were questions about education and training of additional individuals involved with tree care (Questions 6 and 7), which had unusable responses ranging from 69% to 81% and were thus not included in the analysis. This was due in large part to 45% of respondents answering “no” to the survey question that asked whether communities retained individuals other than the tree warden who were involved with the planting, protection, and maintenance of urban and community trees. In addition, unusable responses for components of the questions about inter-agency communication (Question 10) ranged from 3% (town leaders) to 34% (tree department), which permitted only limited analysis of this topic. This was due to many answer choices being left blank.

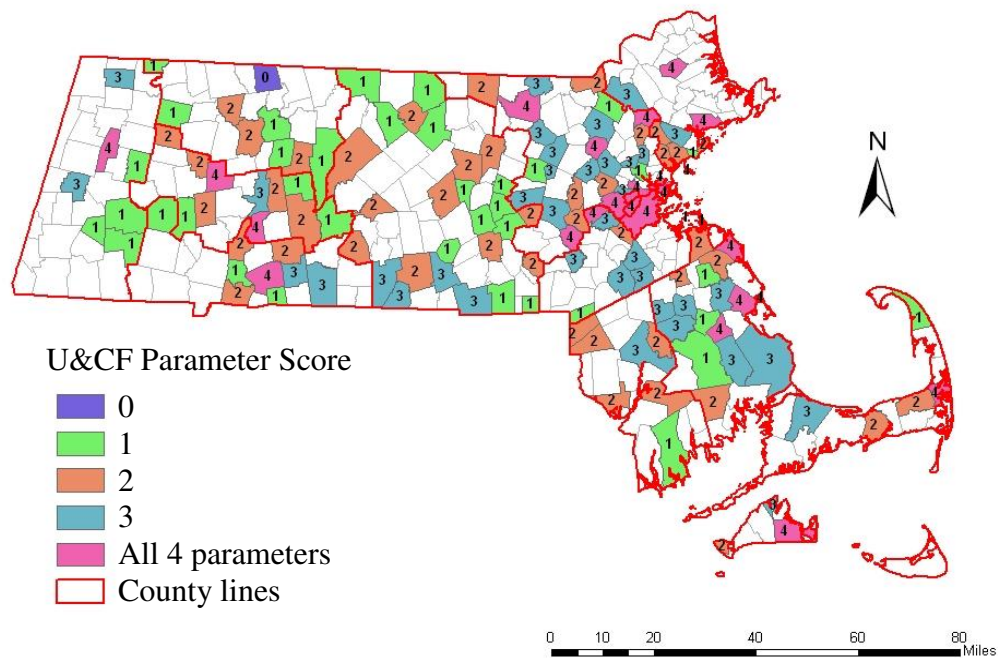
Results from questions regarding priority given to utility arboriculture operations (Question 9) and frequency of communication with a utility company (Question 10) were omitted from the analysis because it was later determined that a significant number of communities (approximately 50) handled their utility operations in house rather than contracting with an outside public utility company. Results from these question

components were believed to be unclear because communities that had their own utility departments were likely to interpret and answer the questions differently than communities that contracted with national or regional electric or gas companies.

Demographics of Responses

Responses were fairly evenly distributed throughout the Commonwealth and at least one response was received from every county except Nantucket. There was some tendency of responses to be clustered around more populated regions of the state, such as Metro-Boston, the South Shore and the South Central region (Figure 1).

Figure 1. FS U&CF Score among Communities that Responded to the Survey



There was also appeared to be a tendency for communities near larger population centers to have higher FS U&CF scores. Communities that responded to the survey tended to be those with larger populations, greater population densities and higher

median household incomes (Table 4). However, the range of respondents was fairly reflective of all communities. Median household income appeared to be skewed toward lower income levels, but this was due to the three highest-income communities in the state not participating in the survey. There were no significant differences between respondent communities and all communities in terms of land area, percentage of residents with a college education and population growth.

Table 4. Means, Test of Significance, and Ranges for Demographic Measures between Respondents and all Communities

Demographic Data	Means		Kruskal-Wallis test		Range	
	<i>Respondents</i>	<i>All</i>	χ^2	<i>Pr > χ^2</i>	<i>Respondents</i>	<i>All</i>
Population (2000)	22,234	18,089	7.7539	0.0054	93-589,041	86-589,041
Population density per square mile (2000)	1,430	1,264	4.6490	0.0310	9-16,037	6-16,868
Land Area (square miles)	22	22	0.3160	0.5740	1-96	1-96
Percentage of population with college degree (2000)	30%	29%	1.3959	0.2374	8%-58%	8%-58%
1999 household median income	\$59,568	\$58,315	3.8195	0.0507	\$25,500-\$121,693	\$22,344-\$153,918
Population Growth (1990-2000)	8.46%	9.24%	0.1057	0.7451	-19% to +71%	-52% to +71%
	N=143	N=351			N=143	N=351

* Significance of difference based on 95% confidence interval ($\alpha=0.05$). Demographic Data from Census 2000 and The Massachusetts State Data Center/Donahue Institute 2005

Respondent Role

In almost all cases, the person who completed the survey was the tree warden for their community (Table 5). The remaining respondents indicated that they were either the acting tree warden, answering the survey on the tree warden's behalf, or a member of

a committee that handled the role of tree warden. These results indicate that the survey successfully reached the intended individual in the community – the one who was generally most knowledgeable about the care of their community’s public trees – in over 95% of the cases.

Table 5. Respondent Role*

Role	Communities	
	#	%
I am the tree warden for my community	130	92%
I am acting tree warden for my community – the position of tree warden is currently open	4	3%
I am not the tree warden but am actively involved in urban and community tree management	5	4%
I am a member of a town committee that handles tree warden duties	2	1%
* two communities left this question blank		N=141

Tree Warden Position and Department

Over three-quarters of respondents indicated that their position of tree warden was a part-time role that was most frequently held by a municipal employee (Table 6). Compensation usually came in the form of a stipend or additional salary paid for handling tree warden duties. In other cases, tree wardens indicated that their tree warden duties were incorporated as part of their municipal job description and received no extra pay. Other tree wardens indicated that the tree warden position was purely voluntary and did not receive any compensation. Only a handful of respondents appeared to be employed to handle tree warden duties on a full time basis. A small number indicated working as subcontractors to their communities or as part of tree warden committees.

Table 6. Tree Warden Position and Department

Position	Communities	
	#	%
Full-time position	6	4%
Part-time position	111	76%
Volunteer	22	17%
Other (including subcontractor)	4	4%
Department		
Department of Public Works/Highway Division	84	59%
Other Municipal Departments (Parks & Recreation, Plant and Facilities, Municipal Grounds, Department of Natural Resources, Forestry Department, Tree Division)	24	17%
Department not specified	15	10%
Department of Tree Warden	9	6%
Other (Selectmen, Planning board, Tree Committee)	11	8%
		N=143

In most communities, tree wardens were affiliated with a municipal department, usually, the highway department or DPW. Other municipal departments mentioned by respondents included “parks & recreation,” “municipal grounds,” “department of natural resources and forestry,” or “forestry department” (Table 6). A small percentage referred to their department as “the department of the tree warden,” or simply as “tree warden,” presumably because they operated out of departments that were stand-alone departments or departments with their own budgets located within larger municipal departments. Several tree wardens did not specify a department, which may mean that they operated independently of the town, either as a volunteer or as a sub contractor. It could also have

meant that the tree warden was a town resident serving as a member of a town committee as a volunteer. The remaining respondents indicated a wide range of other organizations from which they operated, such as “selectman,” “planning board,” and “public safety.”

FS U&CF Performance Parameters

Only a small percentage of respondents indicated that their community had achieved all four FS U&CF performance parameters and thus had attained the status of “Sustaining Community” (Figure 1, Table 7). However, a large majority indicated that they had met between one and three of the FS U&CF parameters and had thus attained the status of “Developing Community.” An approximately equal number of Developing Communities met one, two or three of the four FS parameters. Only one community achieved a score of “0” meaning that their urban and community forestry program had not met any of the four FS parameters.

Table 7. Number and Percentage of Communities by Overall FS U&CF Parameter Score

FS U&CF Performance Score	Communities		
	#	%	Cum. %
All 4 Measures – Sustaining communities	22	15%*	15%
3 Measures – Developing Communities	37	26%	41%
2 Measures – Developing Communities	45	31%	72%
1 Measure – Developing Communities	38	27%	99%
0 – Non-Participating	1	1%	100%
			N=143

* Result based on communities indicating they have a local ordinance and/or answered the Chapter 87 enforcement question. Only one community did not meet this guideline

Community attainment of the four individual FS U&CF parameters – professional staff, advocacy/advisory groups, ordinances and management plans – as well as attainment of their associated components (tree inventories, types of professional staffing, local ordinances) varied widely (Table 8).

Table 8. Community Participation in Each of the 4 FS U&CF Performance Parameters and Associated Components

Performance Measures	FS U&CF Performance Components				FS U&CF Performance Parameter	
	#	%	#	%	#	%
Overall Professional Staffing					75	52%
○ Tree warden met one or more Professional qualification	53	37%				
• MCA Certification or equivalent*			23	16%		
• ISA Certification			14	10%		
• Natural resources degree from an accredited college or university			42	29%		
• Completed professional development training**			30	21%		
○ Have other individuals involved in tree care	78	55%				
• One or more other individuals met one or more professional qualification†			38	27%		
Ordinances					142	99%*
○ Chapter 87 Enforcement	141	98%				
○ Local Ordinances	101	71%				
Advisory or Advocacy Groups					58	41%
Management Plans					52	36%
○ Tree Inventories	89	62%				

* Result based on communities indicating they have a local ordinance and/or answered the Chapter 87 enforcement question. Only one community did not meet this guideline

** Professional development training meets MA U&CF professional staffing parameter for communities with populations of 10,000 or fewer people

† Percentages based on all respondents, not percentage of respondents with additional individuals

Professional Staff

A little more than half of respondents indicated that either they, or other individuals retained by their community for the purpose of caring for the community's public trees, had one or more qualifications that met the FS U&CF professional staff parameter (Table 8). Of communities that met this parameter, tree wardens (as opposed to other community employees, subcontractors or volunteers) were more commonly the individuals holding the necessary qualifications. A degree in a natural resources field was the most common type of qualification held by tree wardens followed by professional development training. Professional arborist certifications such as the Massachusetts Certified Arborist (MCA) or the International Society of Arboriculture Certified Arborist (ISA) were less common.

State and Local Ordinances

The FS ordinance parameter was met as long as a community had met either the guidelines of the state ordinance or had a local ordinance of their own and all but one community met the FS U&CF ordinance parameter. This was because tree wardens from two communities did not acknowledge enforcing the mandatory state ordinance under Massachusetts General Law Chapter 87 (MGL Chapter 87) by leaving the survey question (Question 17) blank but one of them indicated their community had a local ordinance (Table 8). In fact, most tree wardens indicated that their community had some form of a local ordinance, sub-division regulation, or official policy pertinent to the planting, maintenance, and protection of trees that supplemented MGL Chapter 87. Acknowledgement of MGL Chapter 87 did not imply strict enforcement. Less than two-thirds of respondents indicated that their community routinely enforced MGL Chapter 87

and about one-fifth indicated that it was occasionally or seldom enforced the state ordinance laws (Table 9).

Table 9. Enforcement Level of Massachusetts General Law Chapter 87

	% of Communities
• Routinely	59%
• Periodically	21%
• Occasionally	10%
• Seldom	10%
	N=141

Of respondents who indicated that they had some form of local ordinance, most indicated having regulations requiring the planting of new trees or the protection of existing trees during development. Of respondents who indicated that they had some form of local ordinance, most tree wardens also indicated that their community had general tree ordinances, but only half indicated that they had official policies pertaining to tree planting, protection and maintenance activities (Table 10).

Table 10. Type of Local Ordinances Held by Communities

Local Ordinance Type	Communities	
	% with Local Ordinance	% Overall
Have a local ordinance	100%	71%
General tree ordinances	64%	44%
Regulations requiring the planting of new trees During development	81%	57%
Regulations that protect existing trees during Development	69%	50%
Official policies pertaining to tree planting, protection and maintenance	49%	35%
	N=101	N=143

Advocacy and Advisory Groups and Management Plans

Less than half of respondents indicated that they work with groups or organizations in their community that advocate for, or provide advice on the planting, protection, and/or maintenance of community trees and forests (Table 8). Management plans to govern strategic management of urban & community trees and forest resources were the least frequently adopted of the FS U&CF parameters with just over a third of respondents indicating that their community had one. A greater percentage of tree wardens indicated their communities had completed some form of tree inventory, which were viewed by the FS as a necessary basis for a management plan.

Inter-Agency Communication

All tree wardens indicated that their community engaged in some form of communication with other departments in connection with the care of trees. Almost all tree wardens indicated that they or their department had ‘routine’ or ‘periodic’ communication with the highway or DPW department and most indicated that their communication with these departments was routine (Table 11). About three-quarters of tree wardens indicated having routine or periodic communications with parks/cemeteries departments with about half indicating that they had routine communication with this department. About three-quarters of tree wardens also indicated that they had routine or periodic communication with town leaders and with town planning boards. About half indicated having routine communication with tree departments and roughly a third of respondents left this question blank. Furthermore, about half of tree wardens indicated having routine or periodic communication with town conservation commissions and with about one-quarter indicated having routine communication with them. A minority of tree

wardens indicated they had communication with the engineering or buildings departments. One-fourth indicated that they never communicate with the buildings department.

Table 11. Frequency of Inter-Agency Communication

Department or Agency	Routinely	Periodically	Seldom	Never	N/A
Highway Department/DPW	76%	16%	4%	-	5%
Parks/Cemeteries	49%	16%	18%	8%	8%
Planning Board/Department	26%	34%	25%	8%	7%
Tree Department	56%	1%	3%	6%	34%
City/Town leaders	25%	41%	27%	4%	3%
City/Town Engineering	23%	18%	18%	15%	25%
Buildings Department	14%	17%	30%	25%	13%
Conservation Commission	24%	30%	32%	9%	5%

N=143

Some errors due to rounding

There was no association between overall community FS U&CF performance and a tree warden’s likelihood of having routine or periodic communications with highway departments/DPW or with buildings departments (Table 12): lower-performing communities were almost as likely to have routine or periodic communications with these departments as higher performing communities. Tree wardens from higher-performing were more likely to frequently communicate with the parks/cemeteries departments, the tree departments, with city/town leaders or engineering departments and also more likely to communicate frequently with planning boards/departments and with conservation commissions. Overall, tree wardens indicated that communication was most frequent with highway departments/DPW and least frequent with buildings departments.

Table 12. Frequency of Routine/Periodic Inter-Agency Communication by Community FS U&CF Performance Score

Department or Agency	FS U&CF Performance Score			
	4	3	2	1
Highway Department/DPW (r=0.0514, p=0.5521)	100%	92%	89%	89%
Parks/Cemeteries (r=0.2093, p=0.0164)	73%	81%	64%	47%
Planning Board/Department (r=0.2500, p=0.0037)	82%	68%	58%	42%
Tree Department (r=0.3154, p=0.0019)	59%	73%	58%	42%
City/Town leaders (r=0.2197, p=0.0094)	86%	81%	60%	47%
City/Town Engineering (r=0.3620, p=0.0002)	55%	54%	42%	21%
Buildings Department (r=0.0315, p=0.7287)	27%	38%	40%	18%
Conservation Commission (r=0.1946, p=0.0232)	59%	68%	56%	37%
				N=143

Interrelationship Among FS U&CF Parameters

Communities that met at least one FS U&CF performance parameter were more likely to have met other FS U&CF performance parameters. Associations among the FS U&CF parameters of professional staffing, management plans, advocacy and advisory groups, local ordinances and inventories were also all significantly positive. The strongest associations were between tree inventories and local ordinances with three-quarters of communities that had tree inventories also having local ordinances and between management plans and tree inventories with half of communities that had management plans also having tree inventories (Table 13 A & B). Although strong associations were expected between qualified tree wardens and qualified individuals and

professional staff, because both are subsets of professional staff, the association was stronger between qualified tree wardens and professional staff than that found between qualified individuals and professional staff (Table 13 C & D). Interestingly, there was no association between qualified tree wardens and qualified individuals ($r=0.1284$, $p=0.1265$). Positive associations were also found between tree inventories and advocacy/advisory groups ($r=0.2909$, $p=0.0004$) and between local ordinances and level of Chapter 87 enforcement ($r=0.2855$, $p=0.0006$). Positive but less strong associations

Table 13. Key Associations among the FS U&CF Performance Parameters and Their Components.

A. Tree Inventories and Local Ordinances				
		(r=0.3845, p<.0001)		
		Local Ordinance		
Tree Inventory		Yes	No	Total
	Yes	74%	33%	62%
	No	26%	67%	38%
		N= 101	N=42	N=143

B. Management Plans and Tree Inventories				
		(r=0.3845, p<.0001)		
		Tree Inventories		
Management Plans		Yes	No	Total
	Yes	49%	15%	36%
	No	51%	85%	64%
		N= 89	N=54	N=143

C. Qualified Tree Wardens and Professional Staff				
		(r=0.7307, p<.0001)		
		Professional Staff		
Management Plans		Yes	No	Total
	Yes	71%	0%	37%
	No	29%	100%	63%
		N= 75	N=68	N=143

D. Other Qualified Individuals Involved in the Care of Trees and Professional Staff				
		(r=0.4184, p<.0001)		
		Professional Staff		
Other Qualified Individuals		Yes	No	Total
	Yes	51%	0%	27%
	No	49%	100%	73%
		N= 75	N=68	N=143

were found between advocacy/advisory groups and management plans ($r=0.2638$, $p=0.0015$) and between professional staffing and management plans ($r=0.2540$, $p=0.022$). Other cases where there was a lack of association was between qualified tree wardens and the presence of other employees ($r=0.0317$, $p=0.7068$) and between local ordinances and the presence of qualified employees ($r=0.1099$, $p=0.1915$).

Tree Warden Opinion

Tree wardens generally felt that the FS U&CF parameters and inter-agency communication were important to the success of their community’s urban and community forestry initiatives. However fewer respondents agreed with the importance of advisory groups and management plans (Table 14) than with professional staff.

Table 14. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs

Performance Parameter	Opinion Level			
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree or Strongly Disagree
Professional degrees or certifications	27%	40%	24%	9%
Advisory or advocacy groups	16%	43%	32%	8%
Documented management plans	17%	39%	35%	7%
MGL Chapter 87	40%	38%	15%	2%
Inter-agency communication	34%	54%	11%	1%
				N=143

Tree wardens overwhelmingly viewed inter-agency communication and MGL Chapter 87 as important. Only a small percentage of tree wardens fully disagreed that any of the parameters listed in Table 14 were important to the success of their programs.

Tree Warden Opinion by Community FS U&CF Performance

Tree wardens from communities that had higher overall FS U&CF scores generally viewed three of the four FS U&CF performance parameters (professional staff, management plans, and advocacy/advisory groups) as well as inter-agency communication as important to the success of their community urban forestry programs (Table 15). The strongest association was with professional staff and least strong

Table 15. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Overall FS U&CF Performance Score

Importance of Parameter	FS U&CF Performance Score			
	4	3	2	1
Professional degrees or certifications ($r=0.2954$, $p=0.0003$)				
Strongly Agree	41%	32%	29%	11%
Agree	45%	43%	38%	37%
Neither Agree nor Disagree	14%	19%	27%	32%
Disagree/Strongly Disagree	0%	5%	7%	21%
Advisory or advocacy groups ($r=0.2597$, $p=0.0018$)				
Strongly Agree	32%	11%	18%	11%
Agree	55%	43%	53%	24%
Neither Agree nor Disagree	9%	38%	24%	50%
Disagree/Strongly Disagree	5%	5%	4%	16%
Documented management plans ($r=0.1674$, $p=0.0480$)				
Strongly Agree	23%	14%	27%	5%
Agree	59%	38%	33%	34%
Neither Agree nor Disagree	9%	41%	31%	50%
Disagree/Strongly Disagree	9%	8%	9%	11%
MGL Chapter 87 ($r=0.1326$, $p=.1225$)				
Strongly Agree	55%	41%	38%	34%
Agree	32%	46%	40%	34%
Neither Agree nor Disagree	14%	11%	13%	24%
Disagree/Strongly Disagree	0%	3%	9%	8%
Inter-agency communication ($r=0.2715$, $p=0.0011$)				
Strongly Agree	68%	24%	34%	21%
Agree	32%	68%	56%	53%
Neither Agree nor Disagree	0%	8%	9%	24%
Disagree/Strongly Disagree	0%	0%	0%	3%
	N=22	N=36	N=43	N=41

association was with management plans. There was no clear association between tree wardens' opinion of MGL Chapter 87 and community score because the majority of tree wardens viewed MGL Chapter 87 as important regardless of their communities' performance. All tree wardens from Sustaining Communities and from a vast majority of communities that had a score of 3 considered inter-agency communication important to their programs.

The relationship between tree wardens' opinions about the importance of several FS U&CF parameters and inter-agency communication and their communities' adoption of FS U&CF parameters varied considerably. There was a strong positive association between tree wardens' opinions about the importance of professional degrees and certifications and their community having professional staff. There was also a positive but less strong association between tree wardens' opinions about professional degrees and certifications and their communities having local ordinances (Table 16). Similarly, strong opinions about the importance of advocacy/advisory groups were positively associated with their communities having these groups and, to a lesser extent with having tree inventories, local ordinances and professional staff. However, tree wardens' opinions about the importance of management plans was not associated with their communities having management plans but were instead positively associated with having tree inventories, local ordinances and professional staff (Table 16). Tree wardens' opinions about MGL Chapter 87 were positively associated with local ordinances and tree inventories and tree wardens' opinions about inter-agency communication were positively associated with professional staff, management plans and tree inventories.

Table 16. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Individual FS U&CF Parameters and Components

Importance of Parameter	Performance Parameter and Components				
	Management Plans	Advisory/ Advocacy Groups	Local Ordinance	Professional Staff	Tree Inventory
Professional degrees or certifications	(r=0.1182, p=0.1596)	(r=0.0873, p=0.2997)	(r=0.2049, p=0.0141)	(r=0.4184, p=<.0001)	(r=0.0621, p=0.4609)
Strongly Agree	33%	26%	32%	43%	29%
Agree	40%	50%	41%	39%	38%
Neither Agree nor Disagree	21%	19%	22%	17%	27%
Disagree/Strongly Disagree	6%	5%	6%	1%	6%
Advisory or advocacy groups	(r=0.1349, p=0.1095)	(r=0.2900, p=0.0005)	(r=0.2000, p=0.0710)	(r=0.1393, p=0.0983)	(r=0.1675, p=0.0463)
Strongly Agree	21%	19%	19%	20%	19%
Agree	46%	60%	47%	44%	47%
Neither Agree nor Disagree	23%	19%	28%	29%	27%
Disagree/Strongly Disagree	8%	2%	6%	5%	7%
Documented management plans	(r=0.0785, p=0.3563)	(r=0.0902, p=0.2890)	(r=0.1826, p=0.0309)	(r=0.1972, p=0.0195)	(r=0.2428, p=0.0038)
Strongly Agree	19%	16%	18%	24%	21%
Agree	46%	48%	45%	40%	45%
Neither Agree nor Disagree	23%	29%	33%	28%	28%
Disagree/Strongly Disagree	12%	5%	4%	7%	6%
MGL Chapter 87	(r=0.0783, p=0.3633)	(r=0.1180, p=0.1698)	(r=0.1904, p=0.0259)	(r=0.0861, p=0.3171)	(r=0.1725, p=0.0439)
Strongly Agree	44%	47%	46%	44%	46%
Agree	40%	38%	39%	40%	38%
Neither Agree nor Disagree	12%	14%	12%	12%	11%
Disagree/Strongly Disagree	2%	0%	2%	3%	2%
Inter-agency communication	(r=0.2395, p=0.0041)	(r=0.1132, p=0.1795)	(r=0.1178, p=0.1626)	(r=0.2563, p=0.0021)	(r=0.1843, p=0.0281)
Strongly Agree	46%	38%	33%	43%	37%
Agree	50%	55%	61%	51%	56%
Neither Agree nor Disagree	4%	7%	5%	5%	6%
Disagree/Strongly Disagree	0%	0%	0%	0%	0%
	N=52	N=58	N=101	N=75	N=89

Almost all tree wardens who agreed or strongly agreed that MGL Chapter 87 was important to the success of their communities' urban forestry programs also indicated that their communities enforced the law routinely or periodically (Table 17). This was further

evidenced by the strong association between tree wardens’ opinions about MGL Chapter 87 and how actively it was enforced. Only a small percentage of tree wardens disagreed outright with the importance of MGL Chapter 87.

Table 17. Tree Warden Opinions About the Importance of MGL Chapter 87 by Level of Chapter 87 Enforcement

MGL Chapter 87 (r=0.4981, p<0.0001)	Chapter 87 Enforcement			
	Routinely	Periodically	Occasionally	Seldom
Strongly Agree	57%	23%	14%	7%
Agree	36%	60%	36%	14%
Neither Agree nor Disagree	6%	13%	43%	50%
Disagree/Strongly Disagree	0%	3%	7%	7%
				N=141*

*two respondents did not respond to the question

Tree Warden Opinion by Tree City USA Accreditation

There was a clear association between tree wardens’ opinions about the importance of the FS U&CF parameters and their components and TCUSA accreditation (Table 18). Interestingly, the strongest association was between tree wardens’ opinions about the importance of management plans and TCUSA accreditation even though the association was not particularly strong between opinions about management plans and FS U&CF performance. However, similar to FS U&CF performance, there was no clear association between tree wardens’ opinions about the importance of MGL Chapter 87 and TCUSA accreditation. Compared to all tree wardens from communities that had reach Sustaining Community status believing that inter-agency communication was important, almost all tree wardens from TCUSA-accredited communities viewed inter-agency communication as important.

Table 18. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Tree City USA Accreditation Status

Importance of Parameter	Tree City USA	
	Yes	No
Professional degrees or certifications ($r=0.2079$, $p=0.0127$)		
Strongly Agree	38%	23%
Agree	43%	39%
Neither Agree nor Disagree	14%	28%
Disagree/Strongly Disagree	5%	11%
Advisory or advocacy groups ($r=0.1689$, $p=0.0445$)		
Strongly Agree	21%	14%
Agree	50%	41%
Neither Agree nor Disagree	26%	35%
Disagree/Strongly Disagree	2%	10%
Documented management plans ($r=0.2607$, $p=0.0019$)		
Strongly Agree	26%	13%
Agree	50%	35%
Neither Agree nor Disagree	21%	41%
Disagree/Strongly Disagree	2%	12%
MGL Chapter 87 ($r=0.1103$, $p=0.1993$)		
Strongly Agree	48%	37%
Agree	40%	38%
Neither Agree nor Disagree	12%	17%
Disagree/Strongly Disagree	0%	3%
Inter-agency communication ($r=0.2141$, $p=0.0127$)		
Strongly Agree	45%	29%
Agree	50%	55%
Neither Agree nor Disagree	2%	15%
Disagree/Strongly Disagree	0%	1%
	N=42	N=101

Tree wardens who agreed that any one of the parameters was important were significantly more likely to agree that other performance measures were also important. For example, respondents who agreed that inter-agency communication was important also believed that advocacy groups ($r=0.5610$, $p<0.0001$), professional staff ($r=0.4620$, $p<0.0001$), and management plans ($r=0.4276$, $p<0.0001$) were important. Similarly,

respondents who agreed that management plans were important also believed that advocacy/advisory groups ($r=0.5016$, $p<0.0001$) and MGL Chapter 87 ($r=0.3542$, $p<0.0001$) were important. Lastly, respondents who agreed that advocacy/advisory groups were important also believed that having professional staff was important ($r=0.3228$, $p<0.0001$).

Tree Warden Position

Tree Warden Position by Community FS U&CF Performance

Although a direct, linear relationship did not exist between overall FS U&CF performance of a community and tree warden position (Table 19), a large majority of communities that had a FS U&CF score of 4 had full-time tree wardens. Neither was there a clear association between tree warden position and the FS parameter for professional staff nor with several aspects of professional staff, but again, communities that had full-time tree wardens were more likely to have achieved a particular qualification. The lack of association was due to the greater achievements of volunteer tree wardens, compared to part-time tree wardens.

Positive associations were found between tree warden position and other aspects of professional staff including whether or not a tree warden was certified or had completed some form of professional development training. Positive associations were also found with the presence of additional individuals, and whether or not these individuals were qualified. Furthermore, there were positive correlations between tree warden position and the presence of tree inventories, local ordinances and whether or not the community was TCUSA accredited.

Table 19. Community FS U&CF Performance and Tree City USA Accreditation Status by Tree Warden Position

	Tree Warden Position		
	Full-Time	Part-Time	Volunteer
Overall FS U&CF Performance (r=0.1282, p=0.1271)			
All 4 Measures – Sustaining Communities	83%	12%	9%
3 Measures – Participating Communities	0%	28%	27%
2 Measures – Developing Communities	17%	32%	32%
1 Measure – Developing Communities	0%	28%	27%
Individual Performance Measures			
Overall Professional Staffing (r=0.0362, p=0.6681)	100%	49%	59%
Tree warden met one or more professional qualification (r=0.0045, p=0.9567)	100%	31%	50%
<ul style="list-style-type: none"> • MCA Certification or equivalent* (r=0.2100, p=0.0119) • ISA Certification (r=0.2015, p=0.0158) • Natural resources degree from an accredited college or university (r=-0.0230, p=0.7849) • Completed professional development training**(r=0.2249, p=0.0069) 	67%	15%	9%
	33%	11%	0%
	83%	23%	41%
	83%	20%	14%
Have other individuals involved in tree care (r=0.2073, p=0.0130)	67%	59%	23%
One or more other individuals met one or more professional qualification* (r=0.1699, p=0.0426)	67%	27%	9%
Chapter 87 Enforcement: (r=0.0624, p=0.4621)			
<ul style="list-style-type: none"> • Routinely • Periodically • Occasionally • Seldom 	83%	58%	45%
	17%	23%	18%
	0%	11%	9%
	0%	9%	18%
Local Ordinances (r=0.1320, p=0.1161)	100%	71%	59%
Advisory or Advocacy group (r=0.1115, p=0.1848)	83%	40%	27%
Management Plan (r=0.1233, p=0.1424)	83%	35%	27%
Tree Inventory (r=0.1942, p=0.0201)	100%	64%	41%
Tree City USA (r=0.2517, p=0.0024)	100%	29%	14%
	N=6	N=111	N=22
* Percentages based on all respondents, not percentage of respondents with other individuals			
** Professional development training meets MA U&CF professional staffing parameter for communities With populations of 10,000 or fewer people			

Although all communities with full-time tree wardens had local ordinances, tree inventories, qualified tree wardens and TCUSA accreditation, the fact that there was no positive association with tree warden position and tree warden qualification was evidenced by the higher percentage of volunteer tree wardens being qualified than part-time tree wardens.

Tree Warden Position by Tree Warden Opinion

Although there was no clear association between tree warden position and tree warden opinion, all full-time tree wardens either agreed or strongly agreed that professional staff, advocacy/advisory groups, management plans and inter-agency communication were important to the success of their programs and a large majority viewed Chapter 87 as important (Table 20). This lack of association can be largely explained by a lack of apparent difference in opinions between part-time and volunteer tree wardens as evidenced by the similar proportions of part-time and volunteer tree wardens either agreeing or strongly agreeing about the importance of each of the parameters and about inter-agency communication. Although all full-time tree wardens felt that management plans were important, part-time and volunteer tree wardens generally had low opinions about the importance of management plans.

Community Work Priorities

Tree wardens were asked to prioritize among six areas of tree-related work that they or other individuals in their community would be expected to encounter as part of their routine duties (Table 21). Priorities were based on the amount of attention they or their departments paid to undertaking the task and the percentage of the urban and community forestry expenditures allotted to it. Almost all tree wardens gave moderate to

high priority to managing dead or hazard trees. The priority assigned to all other tree-related activities was much lower. Approximately half of all tree wardens gave moderate to high priority to preventative tree maintenance (e.g. pruning, cabling, crown reduction,

Table 20. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Tree Warden Position

	Tree Warden Position		
	Full-Time	Part-Time	Volunteer
Professional Staff (r=0.0888, p=0.2917)			
Strongly Agree	50%	22%	45%
Agree	50%	41%	32%
Neither Agree nor Disagree	0%	27%	14%
Disagree/Strongly Disagree	0%	10%	9%
Advocacy or Advisory Groups (r=0.0876, p=0.2997)			
Strongly Agree	50%	14%	18%
Agree	50%	42%	41%
Neither Agree nor Disagree	0%	35%	32%
Disagree/Strongly Disagree	0%	7%	9%
Management Plans (r=0.1308, p=0.1235)			
Strongly Agree	50%	16%	14%
Agree	50%	37%	41%
Neither Agree nor Disagree	0%	39%	32%
Disagree/Strongly Disagree	0%	5%	14%
MGL Chapter 87 (r=0.0609, p=0.4798)			
Strongly Agree	50%	38%	41%
Agree	33%	40%	36%
Neither Agree nor Disagree	17%	18%	5%
Disagree/Strongly Disagree	0%	1%	9%
Inter-agency Communications (r=0.0769, p=0.3631)			
Strongly Agree	83%	31%	36%
Agree	17%	56%	50%
Neither Agree nor Disagree	0%	13%	9%
Disagree/Strongly Disagree	0%	0%	5%
	N=6	N=111	N=22

and fertilizing) and tree planting activities. Work inspections were given moderate to high priority by most tree wardens. Priorities assigned to public-facing activities, such as public outreach and education or addressing policy issues were lower with less than one third of tree wardens giving these activities moderate or high priority (Table 21).

Table 21. Community Tree-Related Work Priorities*

Work Activity	Priority	Percentage of Communities
Preventative Tree Maintenance	High	14%
	Moderate	35%
	Low	35%
	No	17%
		N=136
Dead and Hazard Tree Removal	High	74%
	Moderate	21%
	Low	4%
	No	1%
		N=141
Inspections of Work Performed	High	24%
	Moderate	40%
	Low	21%
	No	15%
		N=139
Tree Planting	High	17%
	Moderate	32%
	Low	37%
	No	15%
		N=142
Public Education & Outreach	High	4%
	Moderate	27%
	Low	41%
	No	28%
		N=138
Addressing Policy Issues	High	6%
	Moderate	22%
	Low	40%
	No	32%
		N=139
*Some error due to rounding		

Priorities by Community FS U&CF Performance

Overall community FS U&CF scores were positively associated with tree-related work priorities except for dead and hazard tree removal (Table 22). The majority of tree wardens in communities that met all four FS U&CF parameters gave moderate to high priorities to all other work activities. Conversely, with the exception of hazard tree removal, the majority of tree wardens in communities that met only one of the FS U&CF

Table 22. Community Tree-Related Work Priorities by Overall FS U&CF Performance Score

Work Activity	FS U&CF Score			
	4	3	2	1
Preventative Tree Maintenance ($r=0.2617$, $p=0.0021$)				
Moderate to high priority	73%	51%	50%	31%
Low to no priority	27%	49%	50%	69%
Dead and Hazard Tree Removal ($r=0.1056$, $p=0.2128$)				
Moderate to high priority	100%	91%	98%	95%
Low to no priority	0%	9%	2%	5%
Inspections of Work Performed ($r=0.1830$, $p=0.0311$)				
Moderate to high priority	82%	69%	61%	53%
Low to no priority	18%	31%	39%	47%
Tree Planting ($r=0.3162$, $p<0.0001$)				
Moderate to high priority	77%	50%	44%	35%
Low to no priority	23%	50%	56%	65%
Public Education & Outreach ($r=0.2767$, $p=0.0010$)				
Moderate to high priority	55%	31%	34%	13%
Low to no priority	45%	69%	66%	87%
Addressing Policy Issues ($r=0.2700$, $p=0.0013$)				
Moderate to high priority	64%	19%	33%	11%
Low to no priority	46%	81%	67%	89%
	N=22	N=36	N=43	N=41

parameters generally gave low or no priority to these activities. The lack of association between FS U&CF performance and prioritization of dead and hazard tree removal may be explained by an overwhelming majority of tree wardens prioritizing this task regardless of their communities overall performance. Public outreach and education and addressing issues of public policy concerning the management of community trees received the lowest priority ratings in each performance category.

The priorities that tree wardens assigned to the tree-related work tasks based on their community's achievement of individual FS U&CF performance parameters or associated components were generally positive but varied by which parameters they had attained (Table 23). Tree wardens from communities that had management plans and/or tree inventories generally gave the highest priorities to preventative tree maintenance while tree wardens from communities with local ordinances and tree inventories generally gave the highest priorities to work inspections, tree planting, and initiatives associated with public education and outreach and addressing policy issues. Local ordinances and tree inventories were also the only measures that were positively associated with prioritization of dead and hazard tree work; the presence of management plans, advocacy/advisory groups, and professional staff appeared to have no significant bearing. There was no association between advocacy/advisory groups and prioritization of preventative maintenance. Nor was there an association between professional staff and the prioritization of work inspections. It is important to keep in mind that this analysis did not consider each of these parameters in isolation; the relative impacts of the performance parameters or the influence that other performance parameters might have had could not be determined.

Table 23. Community Tree-Related Work Priorities by FS U&CF Parameters and Components

Work Activity	FS U&CF Parameters				
	Management Plans	Advocacy/ Advisory Groups	Local Ordinances	Professional Staff	Tree Inventory
Preventative Tree Maintenance	(r=0.2378, p=0.0053)	(r=0.0833, p=0.3346)	(r=0.2163, p=0.0114)	(r=0.2187, p=0.0105)	(r=0.2707, p=0.0014)
Moderate to high priority	64%	55%	55%	58%	59%
Low to no priority	36%	45%	45%	42%	41%
Dead and Hazard Tree Removal	(r=0.1074, p=0.2049)	(r=0.0846, p=0.3187)	(r=0.1578, p=0.0616)	(r=0.2134, p=0.8017)	(r=0.1818, p=0.0310)
Moderate to high priority	96%	96%	96%	96%	97%
Low to no priority	4%	4%	4%	4%	3%
Inspections of Work Performed	(r=0.1609, p=0.0585)	(r=0.1446, p=0.0893)	(r=0.2156, p=0.0042)	(r=0.0769, p=0.3684)	(r=0.2432, p=0.0039)
Moderate to high priority	73%	75%	71%	69%	72%
Low to no priority	27%	25%	29%	31%	28%
Tree Planting	(r=0.1941, p=0.0206)	(r=0.2688, p=0.0012)	(r=0.2905, p=0.0005)	(r=0.2265, p=0.0067)	(r=0.3350, p<0.0001)
Moderate to high priority	60%	59%	55%	57%	58%
Low to no priority	40%	41%	45%	43%	42%
Public Education & Outreach	(r=0.1487, p=0.0818)	(r=0.2153, p=0.0112)	(r=0.2851, p=0.0007)	(r=0.2414, p=0.0043)	(r=0.3473, p<0.0001)
Moderate to high priority	38%	39%	38%	42%	41%
Low to no priority	62%	61%	62%	58%	59%
Addressing Policy Issues	(r=0.1743, p=0.0406)	(r=0.1992, p=0.0187)	(r=0.3029, p=0.0003)	(r=0.1999, p=0.0183)	(r=0.3524, p<0.0001)
Moderate to high priority	37%	43%	33%	38%	38%
Low to no priority	63%	57%	67%	62%	62%
	N=52	N=58	N=101	N=75	N=89

Priorities by Professional Qualification

Qualified individuals (apart from the tree warden) were more strongly associated with prioritization of preventative tree maintenance and tree planting, while the presence of qualified tree wardens was more strongly associated with prioritization of public

Table 24. Community Tree-Related Work Priorities by Tree Warden Qualification and by Presence of Other Qualified Individuals

Work Activity	Tree Warden Qualified	Other Individuals Qualified	Type of Tree Warden Qualification			
			ISA	MCA	Degree	Dev. Training
Preventative Tree Maintenance	(r=0.1900, p=0.0267)	(r=0.2682, p=0.0016)	(r=0.1840, p=0.0320)	(r=0.1611, p=0.0610)	(r=0.1284, p=0.1363)	(r=0.0913, p=0.2904)
Moderate to high priority	60%	71%	69%	65%	55%	55%
Low to no priority	40%	29%	31%	35%	45%	45%
Dead and Hazard Tree Removal	(r=0.0837, p=0.3240)	(r=0.0826, p=0.3301)	(r=0.0897, p=0.2091)	(r=0.1313, p=0.1208)	(r=0.0827, p=0.3298)	(r=0.0485, p=0.5679)
Moderate to high priority	98%	95%	100%	100%	98%	100%
Low to no priority	2%	5%	0%	0%	2%	0%
Inspections of Work Performed	(r=0.0660, p=0.4400)	(r=0.0731, p=0.3930)	(r=0.2024, p=0.0169)	(r=0.1135, p=0.1835)	(r=0.0450, p=0.5991)	(r=0.1758, p=0.0385)
Moderate to high priority	66%	74%	93%	81%	59%	83%
Low to no priority	34%	26%	7%	19%	41%	17%
Tree Planting	(r=0.1872, p=0.0257)	(r=0.2297, p=0.0060)	(r=0.0791, p=0.3495)	(r=0.0049, p=0.9540)	(r=0.1416, p=0.0928)	(r=0.0639, p=0.4503)
Moderate to high priority	63%	58%	64%	48%	61%	55%
Low to no priority	37%	42%	36%	52%	39%	45%
Public Education & Outreach	(r=0.2253, p=0.0079)	(r=0.1792, p=0.0355)	(r=0.0671, p=0.4344)	(r=0.0663, p=0.4401)	(r=0.1714, p=0.0445)	(r=0.1873, p=0.0279)
Moderate to high priority	47%	42%	36%	39%	46%	48%
Low to no priority	53%	58%	64%	61%	54%	52%
Addressing Policy Issues	(r=0.1492, p=0.0795)	(r=0.1088, p=0.2024)	(r=0.0990, p=0.2462)	(r=0.0562, p=0.5113)	(r=0.0672, p=0.4318)	(r=0.1183, p=0.1654)
Moderate to high priority	41%	37%	29%	35%	41%	37%
Low to no priority	59%	63%	71%	65%	59%	63%
	N=75	N=38	N=14	N=23	N=42	N=30

outreach and policy development (Table 24). There were no associations between professional qualifications and dead or hazard tree removal. The type of qualification (arborist certification, a professional degree, professional development training) held by tree wardens was associated with priorities given to different tree-related tasks. Tree wardens with arborist certifications (MCA or ISA) were more likely to prioritize preventative tree maintenance, while tree wardens with professional degrees were more likely to prioritize tree planting and public outreach and education activities. Completing professional training was associated with prioritization of work inspections as well as public education and outreach (Table 24).

Priorities by Tree Warden Position

All full-time tree wardens gave moderate to high priorities to preventative tree maintenance activities and to dead and hazard tree removal work (Table 25). However, the only positive associations between tree wardens positions and work priorities was with prioritization of preventative tree maintenance. Much of this lack of association may be explained by little apparent differences between part-time and volunteer tree wardens in terms of work prioritization. In the case of preventative maintenance, full-time tree wardens gave the highest priorities to this activity and volunteer tree wardens gave the lowest.

Tree City USA

At the time this survey was conducted, 22% (78) of the 351 Massachusetts communities had attained TCUSA accreditation status. Forty-two of these communities were among those that responded to the survey for a response rate of 29% among TCUSA-accredited communities.

Table 25. Community Tree-Related Work Priorities by Tree Warden Position

Work Activity	Tree Warden Position		
	Full-time	Part-time	Volunteer
Preventative Tree Maintenance ($r=0.1978$, $p=0.0210$)			
Moderate to high priority	100%	49%	24%
Low to no priority	0%	51%	76%
Dead and Hazard Tree Removal ($r=0.0028$, $p=0.9742$)			
Moderate to high priority	100%	96%	95%
Low to no priority	0%	4%	5%
Inspections of Work Performed ($r=0.0604$, $p=0.4803$)			
Moderate to high priority	83%	62%	75%
Low to no priority	17%	38%	25%
Tree Planting ($r=0.0111$, $p=0.8950$)			
Moderate to high priority	50%	48%	43%
Low to no priority	50%	52%	57%
Public Education & Outreach ($r=0.0708$, $p=0.4092$)			
Moderate to high priority	83%	28%	25%
Low to no priority	17%	72%	75%
Addressing Policy Issues ($r=0.0791$, $p=0.3548$)			
Moderate to high priority	83%	24%	24%
Low to no priority	17%	76%	76%
	N=6	N=111	N=22

TCUSA Accreditation and Community FS U&CF Performance

TCUSA-accreditation was positively associated with overall FS U&CF performance (Table 26). About one-third of TCUSA-accredited communities attained a FS U&CF score of 4, which was four times greater than that for non TCUSA-accredited communities. TCUSA-accreditation was also positively associated with each of the four FS U&CF parameters and associated components with the exception of communities retaining additional individuals involved in tree care. TCUSA-accredited communities were twice as likely to have management plans and advocacy/advisory organizations and

Table 26. Community FS U&CF Performance by Community Tree City USA Accreditation Status

	Tree City USA	
	Yes	No
Overall FS U&CF Performance (r=0.3926, p<.0001)		
All 4 Measures – Sustaining Communities	33%	8%
3 Measures – Developing Communities	36%	22%
2 Measures – Developing Communities	21%	36%
1 Measure – Developing Communities	10%	34%
Individual FS U&CF Measures & Their Components		
Overall Professional Staffing (r=0.2758, p=0.0009)	74%	44%
Tree Warden met one or more professional Staffing qualification: (r=0.3635, p<.0001)	64%	26%
• MCA Certification or equivalent (r=0.2525, p=0.0023)	31%	10%
• ISA Certification(r=0.2610, p=0.00016)	21%	5%
• Natural resources degree from an accredited college or university(r=0.2247, p=0.0070)	45%	23%
• Completed professional development training*(r=0.2334, p=0.0050)	36%	15%
Have other individuals involved in tree care (r=0.2187, p=0.0087).	71%	48%
• One or more other individuals met one or more professional qualifications** (r=0.1682, p=0.0446)	38%	22%
Overall Ordinance		
Chapter 87 Enforcement: (r=0.3444, p<.0001)		
• Routinely	83%	48%
• Periodically	14%	24%
• Occasionally	2%	13%
• Seldom	0%	14%
Local Ordinances (p=0.2473, p=0.0029)	88%	63%
Advisory or Advocacy group (r=0.2803, p=0.0007)	62%	32%
Management Plan (r=0.2786, p=0.0008)	57%	28%
Tree Inventory (r=0.3756, p<.0001)	90%	51%
	N=42	N=101
* Professional development training meets MA U&CF professional staffing parameter for communities with populations of 10,000 or fewer people		
**Percentages based on all respondents, not on percentage of respondents who indicated having additional staff		

were more than twice as likely to have tree wardens who met professional qualifications. TCUSA-accredited communities were also more likely to have local ordinances and to enforce MGL Chapter 87 more actively. Almost all TCUSA-accredited communities routinely or periodically enforced MGL Chapter 87. Almost all TCUSA-accredited communities also had completed one or more tree inventories compared to about half that for non TCUSA-accredited communities.

TCUSA Accreditation and Inter-Agency Communication

Frequency of inter-agency communication varied somewhat based on community TCUSA-accreditation status. There were no associations between TCUSA accreditation and communities' level of communication with highway departments/DPW, planning boards/departments, buildings departments, or conservation commissions (Table 27).

Table 27. Frequency of Routine/Periodic Communication by Community Tree City USA Accreditation Status

Department or Agency	Tree City USA	
	Yes	No
Highway Department/DPW (r=0.0208, p=0.8104)	95%	90%
Parks/Cemeteries (r=0.2606, p=0.0026)	86%	56%
Planning Board/Department (r=0.1365, p=0.1173)	69%	55%
Tree Department (r=0.2821, p=0.0056)	83%	47%
City/Town leaders (r=0.1834, p=0.0307)	81%	60%
City/Town Engineering (r=0.2645, p=0.0059)	67%	31%
Buildings Department (r=0.1174, p=0.1938)	43%	27%
Conservation Commission (r=0.1409, p=0.1019)	62%	50%
		N=143

However, there was a positive association between TCUSA-accreditation and frequency of communication with parks/cemetery departments, tree departments, community leaders, or engineering departments.

TCUSA Accreditation and Tree Warden Work Priorities

With the exception of inspections of work performed, there were positive associations between TCUSA accreditation and work priorities including dead and hazard tree removal (Table 28). Tree wardens from TCUSA-accredited communities were

Table 28. Community Tree-Related Work Priorities by Community Tree City USA Accreditation Status

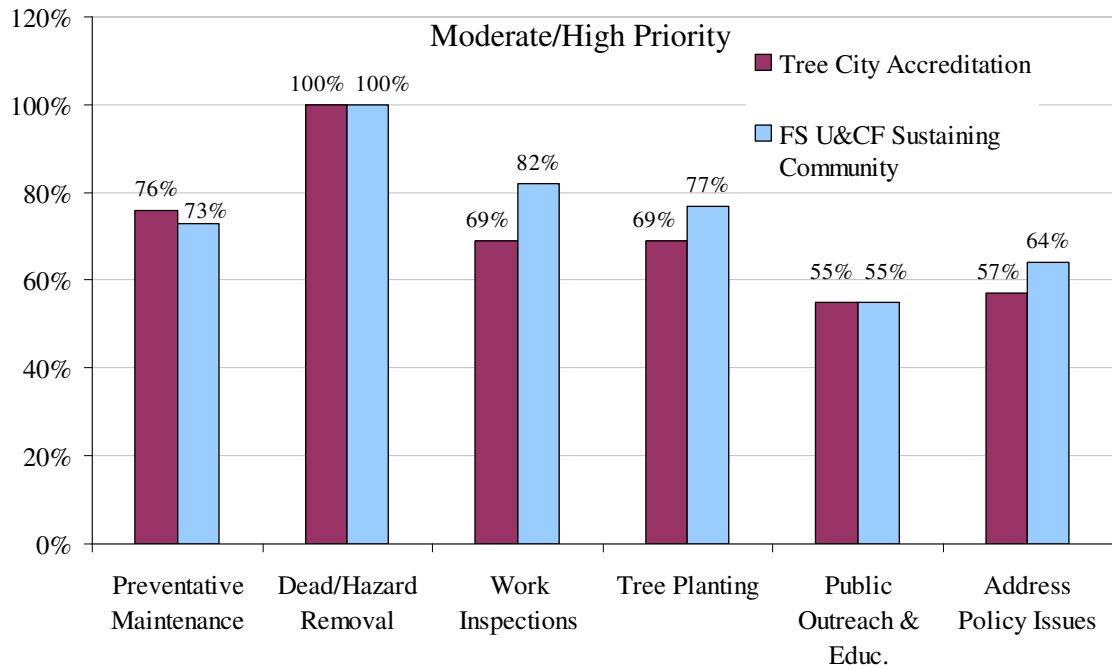
Work Activity	Tree City USA	
	Yes	No
Preventative Tree Maintenance ($r=0.4313$, $p<0.0001$)		
Moderate to high priority	82%	35%
Low to no priority	18%	65%
Dead and Hazard Tree Removal ($r=0.1760$, $p=0.0638$)		
Moderate to high priority	100%	94%
Low to no priority	0%	6%
Inspections of Work Performed ($r=0.1176$, $p=0.1682$)		
Moderate to high priority	72%	60%
Low to no priority	28%	40%
Tree Planting ($r=0.3325$, $p<0.0001$)		
Moderate to high priority	69%	40%
Low to no priority	31%	60%
Public Education & Outreach ($r=0.3200$, $p<0.0001$)		
Moderate to high priority	56%	21%
Low to no priority	44%	79%
Addressing Policy Issues ($r=0.4275$, $p<0.0001$)		
Moderate to high priority	57%	15%
Low to no priority	43%	85%
	N=42	N=101

generally more likely to assign higher priorities to tree-related tree work activities. The association between TCUSA accreditation and prioritization of preventative tree maintenance was especially strong, with an overwhelming majority of tree wardens from TCUSA-accredited communities giving this activity moderate or high priority (Table 28). Similarly, tree wardens from TCUSA-accredited communities were almost four times as likely to give moderate or high priorities to addressing policy issues.

Comparison of TCUSA Accreditation and FS U&CF Performance

Prioritizations of the six tree-related tasks were similar between FS U&CF Sustaining Communities and TCUSA-accredited communities (Figure 2). Furthermore, tree wardens in all Sustaining Communities and TCUSA-accredited communities gave moderate to high priority to hazard and dead tree removal operations. About half of communities in both programs gave moderate to high priority to public outreach and

Figure 2. Sustaining Communities (FS U&CF Score of 4) and Tree City USA-Accredited Communities by Tree-Related Work Priorities



education activities. Sustaining Communities appeared to be more likely to give higher priorities to work inspections, tree planting and addressing policy issues and TCUSA-accredited communities appeared to give higher priorities to preventative tree maintenance. However, it was unclear if these differences were statistically significant.

Community Population

Population was used as an indicator of community size and population density in Massachusetts because population was highly correlated with population density ($r=0.8836$, $p<0.0001$) and population density was well correlated with land area of communities ($r=0.5381$, $p<0.0001$). Although the two population categories – communities with greater than 10,000 people and communities with 10,000 or fewer people – were used in the tables that follow, the correlation analysis (r values) was based on underlying population data for each community.

Tree Warden Position and Department by Population

There were positive associations between tree warden position and community population size (Table 29) with all full-time and most part-time tree wardens being from communities with populations greater than 10,000 and most volunteer tree wardens being from communities with populations of 10,000 or less. There was also a significant association between tree warden department and community population with tree wardens residing in the highway departments/DPW, and other municipal departments being more significantly likely to be from more populated communities. Conversely, tree wardens operating from stand-alone departments or who did not specify a department were more likely to be from less populated communities.

Table 29. Tree Warden Position and Department by Community Population

Position (r=0.3623, p<0.0001)	Population	
	≤10,000	>10,000
Full-time	0%	100%
Part-time	40%	60%
Volunteer	68%	32%
Other (including subcontractor)	75%	25%
Department (r=0.1933, p=0.0207)		
Department of Public Works/Highway Division	36%	64%
Other Municipal Departments (Parks & Recreation, Plant and Facilities, Municipal Grounds, Department of Natural Resources, Forestry Department, Tree Division)	42%	58%
Department not specified	67%	33%
Department of Tree Warden	56%	44%
Other (Selectmen, Planning board, Tree Committee)	64%	36%
	N=62	N=81

Community FS U&CF Performance by Population

Community FS U&CF performance was positively associated with community population size; larger communities were more likely to have higher FS U&CF performance scores (Table 30). Although the percentage of communities that met all four FS U&CF performance parameters appeared to differ only slightly between the two population categories, more populated communities, in general, had higher overall FS U&CF scores; more populated communities were more likely to have met either two or three of the FS parameters and less populated communities were more likely to have met only one.

More populated communities were more likely to meet the requirements for each of the FS U&CF performance parameters and their components (Table 30). More

Table 30. Community FS U&CF Performance and Tree City USA Accreditation Status by Community Population

Performance Measures	Population	
	≤10,000	>10,000
Overall FS U&CF Performance (r=0.3015, p=0.0003)		
All 4 Measures – Sustaining Communities	15%	16%
3 Measures – Developing Communities	18%	32%
2 Measures – Developing Communities	27%	35%
1 Measure – Developing Communities	39%	17%
Individual Measures & Their Components		
Overall Professional Staffing (r=0.1574, p=0.0605)	50%	54%
Tree warden met one or more professional staffing qualification (r=0.2293, p=0.0059)	29%	42%
• MCA Certification or equivalent*	10%	21%
• ISA Certification	6%	12%
• Natural resources degree from an accredited college or university	23%	35%
• Completed professional development training**	16%	25%
Have other individuals involved in tree care (r=0.3021, p=0.0002)	37%	68%
• One or more individuals met one or more professional qualifications* (r=0.1634, p=0.0512)	21%	31%
Chapter 87 Enforcement: (r=0.2696, p=0.0012)		
• Routinely	52%	64%
• Periodically	20%	22%
• Occasionally	13%	7%
• Seldom	15%	6%
Local Ordinances (r=0.3993, p=<.0001)	55%	83%
Advisory or Advocacy groups (r=0.2729, p=0.0010)	29%	49%
Management Plans (r=0.1756, p=0.0360)	27%	43%
Tree Inventories (r=0.2806, p=0.0007)	52%	70%
Tree City USA (r=0.5267, p=<.0001)	10%	44%
	N=62	N=81
* Percentages based on all respondents, not percentage of respondents with additional individuals		
** Professional development training meets MA U&CF professional staffing parameter for communities with populations of 10,000 or fewer people		

populated communities more frequently met the FS U&CF professional staffing parameter by either having a qualified tree warden and/or other qualified individuals (apart from the tree warden) involved in the care of trees. However, this positive association was not as strong as that found when qualified tree wardens and other qualified individuals were considered individually. This may be explained by the lack of correlation between qualified tree wardens and other qualified individuals ($r=0.1284$, $p=0.1265$). More populated communities were also more likely to have more active enforcement MGL Chapter 87, and to have local ordinances, advocacy or advisory groups, management plans and tree inventories. They also tended to be TCUSA accredited. Although more populated communities were more likely to have other individuals retained for the care of trees, there was little correlation between communities having qualified tree wardens and one or more of these other individuals being qualified.

Inter-Agency Communication by Population

Tree wardens' frequency of communication with highway departments/DPW, city/town leaders or with conservation commissions was not associated with community population (Table 31). However, there were positive correlations between population and frequency of communication with tree departments, parks/cemeteries departments, planning boards/departments, buildings departments, and especially with engineering departments. Tree wardens from communities with populations over 10,000 were four times more likely to routinely or periodically interact with these departments than tree wardens from communities with populations of 10,000 or fewer. Similarly, tree wardens from communities with over 10,000 people were almost twice as likely to routinely or periodically communicate with their parks/cemeteries departments (Table 31).

Table 31. Frequency of Routine/ Periodic Inter-Agency Communication by Community Population

Department or Agency	Population	
	≤10,000	>10,000
Highway Department/DPW (r=-0.0217, p=0.8020)	92%	91%
Parks/Cemeteries (r=0.4043, p=<.0001)	44%	81%
Planning Board/Department (r=0.1907, p=0.0279)	52%	65%
Tree Department (r=0.3130, p=0.0020)	44%	68%
City/Town leaders (r=0.0781, p=0.3611)	63%	69%
City/Town Engineering (r=0.4060, p=<.0001)	15%	62%
Buildings Department (r=0.2254, p=0.0119)	19%	41%
Conservation Commission (r=0.1256, p=0.1451)	47%	59%
		N=143

Tree Warden Opinion by Population

There were positive associations between tree wardens' opinions and community population size (Table 32). Tree wardens from more populated communities were significantly more likely to view the FS U&CF parameters and inter-agency communication as important to the success of their programs. This was particularly evident with management plans where a strong majority of respondents from communities with populations above 10,000 either agreed or strongly agreed that management plans were important to their programs, whereas only about a third of respondents from communities with populations of 10,000 or fewer expressed the same sentiment. The vast majority of tree wardens believed inter-agency communication was

important in both population categories, although tree wardens from more populated communities tended to give this a higher level of importance.

Table 32. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Community Population

Attribute	Population	
	≤10,000	>10,000
Professional Staff (r=0.1677 p=0.0453)		
Strongly Agree	24%	30%
Agree	35%	43%
Neither Agree nor Disagree	26%	22%
Disagree or Strongly Disagree	15%	5%
Advocacy/Advisory Groups (r=0.2131, p=0.0109)		
Strongly Agree	10%	21%
Agree	40%	46%
Neither Agree nor Disagree	37%	28%
Disagree or Strongly Disagree	13%	4%
Management Plans (r=0.4676, p<0.0001)		
Strongly Agree	3%	27%
Agree	34%	43%
Neither Agree nor Disagree	45%	27%
Disagree or Strongly Disagree	15%	1%
MGL Chapter 87 (r=0.2540, p=0.0027)		
Strongly Agree	32%	46%
Agree	40%	37%
Neither Agree nor Disagree	18%	14%
Disagree or Strongly Disagree	3%	1%
Inter-agency Communication (r=0.1836, p=0.0288)		
Strongly Agree	31%	36%
Agree	52%	56%
Neither Agree nor Disagree	16%	7%
Disagree or Strongly Disagree	2%	0%
	N=63	N=81

Community Work Priorities by Population

There was a positive association between work priorities and community population with tree wardens from more populated communities giving higher priorities to all tree-related activities (preventative tree maintenance, tree planting, work inspections, public outreach and education and addressing policy issues) except dead and hazard tree removal (Table 33). Almost all tree wardens indicated that dead and hazard tree removal work was high on their list of priorities regardless of community population size.

Table 33. Community Tree-Related Work Priorities by Community Population

Work Activity	Pop ≤10,000	Pop >10,000
Preventative Tree Maintenance (r=0.2913, p=0.0006)		
Moderate to high priority	39%	56%
Low to no priority	61%	44%
Dead and Hazard Tree Removal (r=0.1084, p=0.2007)		
Moderate to high priority	97%	95%
Low to no priority	3%	5%
Inspections of Work Performed (r=0.2159, p=0.0107)		
Moderate to high priority	53%	71%
Low to no priority	47%	29%
Tree Planting (r=0.1780 p=0.0341)		
Moderate to high priority	46%	51%
Low to no priority	54%	49%
Public Education & Outreach (r=0.2523, p=0.0028)		
Moderate to high priority	24%	36%
Low to no priority	76%	64%
Addressing Policy Issues (r=0.3123, p=0.0002)		
Moderate to high priority	21%	33%
Low to no priority	79%	67%
	N=62	N=81

Community Median Household Income

Community median household income was used to assess community wealth with urban and community forestry performance, work priorities and tree warden's opinions about the FS U&CF parameters and inter-agency communication.

Community FS U&CF Performance by Income

Community FS U&CF performance was positively associated with community wealth; communities with higher median household incomes were more likely to have better performing urban and community forestry programs as evidenced by their overall FS U&CF score (Table 34). About half of communities with median household incomes over \$62,500 scored a 3 or 4, compared to roughly a third for communities with household incomes under \$62,500. Although the three median household income categories were used in the tables that follow, the correlation analysis (r values) was based on the underlying median household income data for each community.

Although there was a positive association between community affluence and professional staff, there was no clear association between affluence and qualification of tree wardens (with the exception of MCA) or qualification of other individuals involved in tree care. This apparent lack of associations with these components of professional staff may have been due to small sample sizes. There were also no associations between affluence and presence of management plans, tree inventories or additional individuals involved in the care of trees. There were, however, positive associations between affluence and the presence of local ordinances, advocacy/advisory groups and MGL Chapter 87 enforcement level.

Table 34. Community FS U&CF Performance and Tree City USA Accreditation Status By Community Median Household Income

Performance Measures	Median Household Income		
	≤\$50,000	\$50,001-\$62,500	>\$62,500
Overall FS U&CF Performance (r=0.1935, p=0.0206)			
All 4 Measures – Sustaining Communities	19%	4%	24%
3 Measures – Developing Communities	12%	33%	30%
2 Measures – Developing Communities	36%	33%	26%
1 Measure – Developing Communities	31%	29%	20%
Individual Measures & Their Components			
Overall Professional Staffing (r=0.1873, p=0.0251)	45%	47%	64%
Tree warden met one or more professional staffing qualifications (r=0.1280, p=0.1276)	33%	33%	44%
<ul style="list-style-type: none"> • MCA Certification or equivalent* (r=0.1746, p=0.0394) • ISA Certification (r=0.1214, p=0.1486) • Natural resources degree from an accredited college or university (r=0.0610, p=0.4692) • Completed professional development training (r=0.1090, p=0.1950) 	10%	14%	24%
	5%	12%	12%
	31%	24%	34%
	14%	20%	28%
Have other individuals involved in tree care (r=0.1211, p=0.1496)	43%	65%	54%
One or more individuals met one or more professional qualifications (r=0.0909, p=0.2803)	23%	24%	32%
Level of Chapter 87 enforcement (r=0.2133, p=0.0111)			
<ul style="list-style-type: none"> • Routinely • Periodically • Occasionally • Seldom 	45%	59%	68%
	19%	18%	26%
	17%	10%	4%
	14%	14%	2%
Local ordinances (r=0.2020, p=0.0156)	57%	71%	82%
Advocacy or Advisory groups (r=0.2546, p=0.0021)	29%	31%	60%
Management Plans (r=0.0560, p=0.5065)	43%	33%	34%
Tree Inventories (r=0.0580, p=0.4914)	69%	57%	62%
Tree City USA (r=0.1149, p=0.1717)	24%	36%	27%
	N=42	N=51	N=50
*Percentages based on all respondents, not percentage of respondents with additional individuals			

Inter-Agency Communication by Income

Although frequency of communication between tree wardens and highway departments/DPW or tree departments was greater in more affluent communities, frequency of communication with other departments appeared unrelated to community wealth (Table 35). Tree wardens in communities with household incomes over \$62,500 exhibited high levels of interaction with highway departments/DPW while low levels of interaction were found between tree wardens and the buildings departments in communities for which the median household income was between \$50,000 and \$62,500.

Table 35. Frequency of Routine/ Periodic Inter-Agency Communication by Community Median Household Income

Department or Agency	Community Median Household Income		
	≤\$50,000	\$50,001-\$62,500	>\$62,500
Highway Department/DPW (r=-0.1529, p=0.0756)	88%	92%	94%
Parks/Cemeteries (r=0.0881, p=0.3171)	52%	71%	70%
Planning Board/Department (r=0.0480, p=0.5829)	69%	47%	64%
Tree Department (r=0.2199, p=0.0322)	43%	61%	66%
City/Town leaders (r=0.0146, p=0.8642)	69%	59%	72%
City/Town Engineering (r=0.0291, p=0.7657)	38%	37%	46%
Buildings Department (r=0.0560, p=0.5367)	29%	27%	38%
Conservation Commission (r=0.0520, p=0.5474)	52%	55%	54%
	N=42	N=51	N=50

Tree Warden Opinion by Income

Tree wardens from communities with higher household incomes were more likely to agree that advocacy/advisory groups and MGL Chapter 87 were important parameters to the success of their urban and community forestry programs. Otherwise, there was no clear association between community affluence and tree wardens' opinions about the

importance of FS performance parameters or inter-agency communication (Table 36). Almost all tree wardens from communities with median household incomes agreed or strongly agreed that MGL Chapter 87 was an important bylaw. Opinions about management plans were lowest; about half of respondents felt management plans were important regardless of community wealth.

Table 36. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Community Median Household Income

Performance Measures	Community Median Household Income		
	≤\$50,000	\$50,001-\$62,500	>\$62,500
Professional Staff (r=0.1048, p=0.2128)			
Strongly Agree	26%	25%	30%
Agree	38%	39%	42%
Neither Agree nor Disagree	26%	24%	22%
Disagree or Strongly Disagree	10%	12%	6%
Advocacy/Advisory Groups (r=0.1764, p=0.0358)			
Strongly Agree	17%	14%	18%
Agree	38%	37%	54%
Neither Agree nor Disagree	29%	41%	26%
Disagree or Strongly Disagree	17%	6%	2%
Management Plans (r=0.0174, p=0.8379)			
Strongly Agree	17%	22%	12%
Agree	36%	35%	46%
Neither Agree nor Disagree	33%	35%	36%
Disagree or Strongly Disagree	12%	6%	4%
MGL Chapter 87 (r=0.1746, p=0.0413)			
Strongly Agree	36%	35%	48%
Agree	33%	37%	44%
Neither Agree nor Disagree	21%	20%	6%
Disagree or Strongly Disagree	5%	2%	0%
Inter Agency Communication (r=0.0921, p=0.2754)			
Strongly Agree	33%	35%	32%
Agree	50%	53%	58%
Neither Agree nor Disagree	14%	12%	8%
Disagree or Strongly Disagree	2%	0%	0%
.	N=42	N=51	N=50

Community Work Priorities by Income

Communities with higher median household incomes were positively associated with prioritization of work inspections, tree planting and public outreach and education activities, although the association with public education and outreach was not particularly strong. There was no association between community affluence and addressing policy issues, preventative tree maintenance, or dead or hazard tree removal (Table 37). Almost all tree wardens prioritized dead and hazard tree removal regardless of community affluence. Roughly one third of tree wardens prioritized public education and outreach and addressing policy issues across the three income categories.

Table 37. Community Tree-Related Work Priorities by Community Median Household Income

Work Activity	1999 Median Household Income		
	≤\$50,000	\$50,001-\$62,500	>\$62,500
Preventative Tree Maintenance ($r=0.0207$, $p=0.8111$)			
Moderate to high priority	54%	48%	45%
Low to no priority	46%	52%	55%
Dead and Hazard Tree Removal ($r=0.0168$, $p=0.8430$)			
Moderate to high priority	93%	98%	96%
Low to no priority	7%	2%	4%
Inspections of Work Performed ($r=0.2226$, $p=0.0085$)			
Moderate to high priority	48%	59%	76%
Low to no priority	52%	41%	24%
Tree Planting ($r=0.1562$, $p=0.0634$)			
Moderate to high priority	48%	41%	56%
Low to no priority	52%	59%	44%
Public Education & Outreach ($r=0.1416$, $p=0.0974$)			
Moderate to high priority	31%	24%	36%
Low to no priority	69%	76%	64%
Addressing Policy Issues ($r=0.1286$, $p=0.1314$)			
Moderate to high priority	31%	25%	32%
Low to no priority	69%	75%	68%
	N=42	N=51	N=50

Community Education

The percentage of community residents holding a college degree was used to assess community education with urban and community forest management performance, community work priorities and tree warden opinions about the importance of the FS U&CF parameters and inter-agency communication. Although the three education categories were used in the tables that follow, the correlation analysis (r values) was based on the underlying data for each community.

Community FS U&CF Performance by Education

Overall community FS U&CF scores were positively associated with higher community education (Table 38). One fourth of communities with over 35% of college-educated residents met all four FS parameters, which was five times greater than that for communities that had less than 25% of residents who were college educated.

The strongest correlation among the individual FS U&CF parameters and associated components was found with professional staffing with almost three-quarters of communities with over 35% of college-educated residents having qualified tree wardens and/or other qualified individuals, compared to about a third of that for communities with less than 25% of college-educated residents. There were also positive associations with the various types of tree warden qualifications with the exception of MCA certification. Communities with more educated populations were also more likely to enforce MGL Chapter 87 more actively, retain local ordinances and to be TCUSA accredited. There were no associations between community education and the adoption of management plans, tree inventories, or advocacy/advisory groups (Table 38).

Table 38. Community FS U&CF Performance and Tree City USA Accreditation Status by Percentage of College-Educated Residents

Performance Measures	Percentage of Population with College Degree		
	≤25%	26% - 35%	>35%
Overall FS U&CF Performance (r=0.2714, p=0.0010)			
All 4 Measures – Sustaining Communities	5%	19%	25%
3 Measures – Developing Communities	25%	26%	27%
2 Measures – Developing Communities	30%	37%	27%
1 Measure – Developing Communities	38%	19%	20%
Individual Measures & Their Components			
Overall Professional Staffing (r=0.3718, p=<.0001)	32%	60%	70%
Tree warden met one or more professional staffing qualifications (r=0.3382, p<0.0001)	21%	37%	57%
<ul style="list-style-type: none"> MCA Certification or equivalent* (r=0.2571, p=0.0019) ISA Certification (r=0.0978, p=0.2451) Natural resources degree from an accredited college or university (r=0.2268, p=0.0064) Completed professional development training** (r=0.1734, p=0.0384) 	9%	12%	30%
	9%	7%	14%
	21%	23%	30%
	13%	23%	30%
Have other individuals involved in tree care (r=0.0969, p=0.2499)	48%	60%	57%
One or more individuals met one or more professional qualifications (r=0.1846, p=0.0273)	16%	35%	32%
Level of Chapter 87 enforcement (r=0.2116, p=0.0118)			
<ul style="list-style-type: none"> Routinely Periodically Occasionally Seldom 	46%	65%	66%
	25%	19%	18%
	17%	5%	11%
	14%	9%	5%
Local ordinances (r=0.1409, p=0.0933)	63%	77%	75%
Advocacy or Advisory groups (r=0.2382, p=0.0042)	29%	42%	55%
Management Plans (r=0.0426, p=0.6131)	35%	42%	32%
Tree Inventories (r=0.0192, p=0.8197)	57%	77%	55%
Tree City USA (r=0.1759, p=0.0357)	23%	23%	43%
	N=56	N=43	N=44

Inter-Agency Communication by Education

With the exception of communications with tree departments, there were no associations between community education and level of inter-agency communication (Table 39). Tree wardens communicated frequently with highway departments/DPW regardless of community education level with nine out of ten tree wardens indicating that they communicated routinely or periodically with this department. Two thirds of tree wardens from communities with >35% of college-educated residents indicated they routinely or periodically communicated with tree departments compared to about half of tree wardens from communities with ≤25% of college-educated residents. Communication with buildings departments was universally low with about one third of tree wardens indicating having routine or periodic communication with this department in each education category (Table 39).

Table 39. Frequency of Routine/ Periodic Inter-Agency Communication by Percentage of College-Educated Residents

Department or Agency	Percentage of Population with College Degree		
	≤25%	26% - 35%	>35%
Highway Department/DPW (r=-0.1096, p=0.2038)	89%	91%	95%
Parks/Cemeteries (r=0.0024, p=0.9784)	61%	65%	70%
Planning Board/Department (r=0.5318, p=0.5432)	54%	74%	52%
Tree Department (r=0.1969, p=0.0558)	52%	56%	66%
City/Town leaders (r=0.0803, p=0.3471)	57%	77%	68%
City/Town Engineering (r=0.1328, p=0.1728)	36%	44%	45%
Buildings Department (r=0.0068, p=0.9407)	27%	33%	31%
Conservation Commission (r=0.0426, p=0.6221)	46%	65%	52%
	N=56	N=43	N=44

Tree Warden Opinion by Education

Tree wardens from more educated communities were more likely to view professional staffing as important with four out of five tree wardens from communities with >35% of college-educated residents viewing professional staff as important, compared to roughly half of tree wardens from communities with ≤25% of college-educated residents (Table 40). There was also a positive association between education

Table 40. Tree Warden Opinions about Importance of FS U&CF Parameters and Inter-Agency Communication to Success of Urban Forestry Programs by Percentage of College-Educated Residents

Performance Measures	Percentage of Population with College Degree		
	≤25%	26% - 35%	>35%
Professional Staff (r=0.2653, p=0.0014)			
Strongly Agree	18%	28%	39%
Agree	41%	35%	43%
Neither Agree nor Disagree	27%	30%	14%
Disagree or Strongly Disagree	14%	7%	5%
Advocacy/Advisory Groups (r=0.1391, p=0.0987)			
Strongly Agree	14%	12%	23%
Agree	36%	47%	50%
Neither Agree nor Disagree	38%	35%	23%
Disagree or Strongly Disagree	11%	7%	5%
Management Plans (r=0.0586, p=0.4914)			
Strongly Agree	14%	21%	16%
Agree	36%	42%	41%
Neither Agree nor Disagree	39%	30%	34%
Disagree or Strongly Disagree	9%	5%	7%
MGL Chapter 87 (r=0.1210, p=0.1591)			
Strongly Agree	38%	35%	48%
Agree	36%	40%	41%
Neither Agree nor Disagree	20%	16%	0%
Disagree or Strongly Disagree	2%	2%	2%
Inter Agency Communication (r=0.1609, p=0.0558)			
Strongly Agree	25%	37%	41%
Agree	57%	53%	50%
Neither Agree nor Disagree	16%	9%	7%
Disagree or Strongly Disagree	2%	0%	0%
.	N=56	N=43	N=44

and tree wardens' opinions about advocacy/advisory groups with about three quarters of tree wardens from communities with >35% college-educated residents viewing advocacy/advisory groups as important compared to about half from communities with ≤25% college-educated residents. In addition, there was a positive association between education and tree wardens' opinions about the importance of inter-agency communication. There was, however, no association between community education and tree warden opinions about the importance of management plans or MGL Chapter 87.

Table 41. Community Tree-Related Work Priorities by Percentage of College-Educated Residents

Work Activity	Percentage of Population with College Degree		
	≤25%	26% - 35%	>35%
Preventative Tree Maintenance (r=0.1372, p=0.1111)			
Moderate to high priority	36%	56%	50%
Low to no priority	64%	44%	50%
Dead and Hazard Tree Removal (r=0.0296, p=0.7274)			
Moderate to high priority	89%	98%	98%
Low to no priority	11%	2%	2%
Inspections of Work Performed (r=0.0939, p=0.2713)			
Moderate to high priority	50%	70%	68%
Low to no priority	50%	30%	32%
Tree Planting (r=0.2879 p=0.0005)			
Moderate to high priority	36%	53%	59%
Low to no priority	64%	47%	41%
Public Education & Outreach (r=0.2050, p=0.0159)			
Moderate to high priority	23%	28%	41%
Low to no priority	77%	72%	59%
Addressing Policy Issues (r=0.2126, p=0.0210)			
Moderate to high priority	16%	30%	27%
Low to no priority	84%	70%	73%
	N=56	N=43	N=44

Community Work Priorities by Education

Tree wardens from more educated communities tended to give higher priority to activities associated with public outreach and education, addressing policy issues and with tree planting, which had the strongest association with more than half of communities with >35% college-educated residents giving tree planting moderate to high priority (Table 41). There was no association between community education and preventative tree maintenance, dead or hazard tree removal, or inspections of work performed. Prioritization of addressing policy issues was particularly low among tree wardens from communities with $\leq 25\%$ of college-educated residents with only one out of six tree wardens giving this activity moderate to high priority.

CHAPTER 4

MANAGEMENT DISCUSSION

The aim of this study was to establish a benchmark of urban and community forestry management performance among Massachusetts communities. The four performance parameters of community forestry management performance – professional staff, ordinances, management plans, and advocacy/advisory groups – were developed under the new FS U&CF CARS program launched in 2006. One of the key goals of this study was to identify which parameters or their components (tree inventories, local ordinances, types of training and certification) were most relevant to community forestry management performance. The results offer a basis for comparing future levels of community participation in U&CF programs in Massachusetts and represent a first step toward identifying the impact of these parameters over time and gauging future tree warden feedback about their effectiveness.

Response Rate and Demographic Characteristics

The response rate for this survey was between the response rates of two recent surveys of tree wardens in New England that employed similar survey fielding methods. Ricard & Bloniarz (2006) reported a 35% response rate for a survey of respondents conducted throughout the six New England states, and Ricard (2005) reported a 57% response rate for survey tree wardens in Connecticut. Community tree wardens are unique to New England (Ricard & Bloniarz 2006), which made it possible for these studies to target a designated individual in each community (the tree warden) who was expected to have the most knowledge of their community's urban forestry programs.

The response rate of similar surveys of urban and community forestry programs conducted in other states was generally higher: 54% in Mississippi (Grado et al. 2006), 58% in Utah (Kuhns et al. 2005), 60% in Missouri (Trieman & Gartner 2004), and 71% in Pennsylvania (Elmendorf et al. 2003). However, because there was not a tree warden equivalent in communities in states outside of New England, these studies often targeted a range of officials, sometimes more than one official in a community, who may have varying degrees of awareness and knowledge about local urban forestry programs. Respondents who did not have professional training in tree care may have not accurately represented urban forest management issues in these surveys.

Community FS U&CF Performance

Communities that responded to the survey appeared to be fairly representative of all communities in Massachusetts in terms of key demographic measures (population, population density, land area, education, income, population growth rate). Other measures, however, manifested a bias toward communities with larger populations, greater population densities, and higher median household incomes. Because communities with larger populations or greater median household incomes generally had higher FS U&CF scores, it was possible that the results of this study overstated the actual performance of the state to some degree. This bias may be due to positive self-selection among tree wardens who completed the survey, because they were more willing to reveal the performance of their community if they were able to meet more of the FS criteria, who had positive feelings toward the FS U&CF program (Clark & Matheny 1998) or who were more knowledgeable about urban and community forestry programs in general. It is also important to keep in mind that demographic measures serve only as proxy indicators

of community response patterns. Therefore, any conclusions about overall state performance based on these survey results should be made with caution. Although population was used in Massachusetts as a measure of community size and density, correlations between population, land area, and population density may not apply to other states. For example, Galvin & Bleil (2004) found that population was not correlated with population density in Maryland.

Although numerous surveys have been conducted about urban and community forestry programs at the municipal level across the country, a review of the literature showed no other studies that measured municipal urban and community forestry management performance using the new 2006 FS U&CF performance parameters as benchmarks. Thus, only general comparisons were made between the results of these studies and this one.

Results of studies conducted outside of New England suggested that the quality, scope and level of community adoption of urban and community forestry programs varied widely and that urban and community forestry program performance in other states is often lower than in Massachusetts. In Missouri, for example, 10% of communities had management plans, 22% had tree ordinances and 7% had a degreed forester on staff (Trieman & Gartner 2004). Only 20% of communities in Illinois had tree inventories but fewer still (11%) were up to date (Schroeder et al. 2003). Elmendorf et al. (2003) reported that fewer than half of communities in Pennsylvania performed systematic tree maintenance, 43% had a tree inventory, and only 29% had tree management plans. These values are substantially below those reported in the present study. At least one state, however, reported similar findings to Massachusetts: in

California, over 90% of staff was certified and 65% of respondents indicated their community had a tree ordinance (Thompson 2006).

The finding that more populated communities in Massachusetts achieved higher overall FS U&CF performance scores was consistent with other studies. Cities in Pennsylvania were more likely to have tree care programs than less populated boroughs or townships (Reeder & Gerhold 1993). Similarly, Schroeder et al. (2003) found that smaller communities in Illinois lacked key components of effective tree programs including a paucity of educated staff to manage them. Communities in Utah with populations over 10,000 generally had more actively managed programs than those with populations of 10,000 and under (Kuhns et al. 2005). Furthermore, larger communities in Oregon tended to have more elements of active urban forestry programs than smaller ones (Reis et al. 2007).

In Massachusetts, community population size was a better predictor of community performance than community wealth or education. Greater financial resources, a more active citizenry, and broader public awareness of the benefits of public trees may be the cause. These factors were cited in other studies as reasons for more active programs in larger communities. Miller and Bate (1978) reported that community size influenced the amount of tax revenue available for urban and community forestry programs. Reis et al. (2007) also found that larger communities tended to have a larger tax base from which to fund urban forestry programs and that more urbanized communities generally had more tree-lined roads per capita than more rural communities, which often served as an impetus for more resources being allocated to tree care programs. This phenomenon also points to why more urban communities were more

likely to be TCUSA accredited (Galvin & Bleil 2004); larger communities were more likely to meet \$2 per capita minimum requirement of the program. Elemendorf et al. (2003) found that the support of community residents and town leaders was instrumental to successful programs and that residents in larger communities were generally more likely to support additional funding for urban and community forestry programs. Trieman & Gartner (2005) also found that residents of larger communities were more willing to consider additional taxes to support urban tree care programs. They also found that residents in larger communities tended to be more proactive about urban tree programs because they were usually more politically active, tended to be better informed, and generally had higher expectations of municipal services. Closer interaction of trees and people in more densely populated communities and the relative scarcity of trees in more urbanized areas were likely catalysts. Community awareness of outside funding sources increased the likelihood of seeking state assistance in Mississippi (Grado et al. 2006), and larger communities were more likely to take advantage of outside funding opportunities. These findings agree with those of Reis et al. (2007) that communities that took advantage of state assistance in Oregon did a better job managing their urban and community forestry programs suggests that greater community awareness can lead to higher urban and community forestry management performance and that larger communities are more likely to take advantage of outside assistance.

Although not as strong as that with population size, the associations between FS U&CF performance and community wealth and education were significant. Other studies in other states found that community performance were related to wealth and education. Dickerson et al. (2001) found that communities in Illinois with higher mean per-capita

incomes and higher percentage of college-educated residents were more likely to have ordinances focused on the protection and maintenance of existing community trees. The positive association between community wealth and urban forest management performance may be attributed to wealthier residents being more concerned with maintaining community aesthetics and being more willing to fund programs to care for the trees. Lorenzo et al. (2000) found that community residents in higher household income brackets in a suburb of New Orleans were willing to pay more in additional taxes for the preservation of trees and community forests.

Faster population growth means more rapid development at the expense of the urban canopy. Based on U. S. Census Bureau data (2007), between 1990 and 2000, communities in Massachusetts with 10,000 or fewer people grew 12.4%; communities with populations over 10,000 grew 4.5%. There were no clear associations between population growth and either the overall FS U&CF score, any of the individual parameters, except that faster-growing communities were more likely to have a qualified tree warden ($r=0.2369$, $p=0.0044$), specifically one who held a professional degree ($r=0.2322$, $p=0.0053$). The positive association between community growth and tree warden qualification may be partly explained by faster-growing communities attaining populations over 10,000 and the requirement that tree wardens in Massachusetts communities with populations over 10,000 (MGL Chapter 41) meet professional qualifications at the time of election or reappointment. The lack of association between the other FS U&CF parameters and overall FS U&CF score and community population growth rate may also be due to insufficient data. Community growth may be associated with *improvements* in urban and community program performance, something that could

not be determined using results from a single point in time. Results from future surveys of urban and community forestry performance among Massachusetts communities could be used to measure *changes* in community performance over time that might reveal some interesting associations that a snapshot of community FS U&CF performance might not reveal. This lack of association between the tree warden's survey responses and community population growth could also mean that population growth was not an indicator of urban and community forestry program performance. However, a positive association between TCUSA accreditation and community population growth ($r=0.2635$, $p=0.0015$) supports the likelihood that faster growing communities have higher-performing programs.

Community Work Priorities

The priority ratings that tree wardens were asked to give for six commonly encountered tree-related management tasks served as proxy measures of the relative importance of these tasks based on the time commitment and budgets communities allocated to them. The priority ratings also served as a means to gauge the relative emphasis Massachusetts communities placed on various aspects of urban and community forestry management.

Massachusetts communities in which preventative tree maintenance, tree planting, and public outreach activities were given high priorities could be considered to have programs that were proactive toward the management of the health of the urban canopy. But since public safety was found by Ricard (2005) and Ricard & Bloniarz (2006) to be a tree warden's primary role it was expected that all Massachusetts communities would give their dead and hazard tree removal operations a high priority rating regardless of

community performance. But prioritizing the removal of hazard trees could signify two things. It could indicate a well-executed program that involved systematic identification, prioritization and timely mitigation of hazard trees or active management of other hazards created by trees, such as the repair of cracked sidewalks and the alleviation of obstructed views of traffic signals. Paradoxically, it could also indicate that the community does not have sufficient resources to take on proactive tree care tasks and thus focuses all of its attention and resources on hazard tree mitigation. The reasons behind communities' priority ratings for hazard tree mitigation were not revealed in this study, except for anecdotal evidence that smaller communities typically perform hazard tree management in a reactive manner as the need arises. However, the fact that roughly one-quarter of tree wardens indicated that their community gave hazard tree removal work a moderate or low priority rating suggests that improvements in this area could be realized through program assistance. Helping communities develop more proactive and systematic approaches to assessing and correcting hazard tree conditions could realize important cost benefits in terms of developing more optimized work plans (Thompson 2006), improving resource allocations, and reducing exposure to potential litigation from accidents or personal injury (Groninger et al. 2002). Given that tree wardens, in general, considered hazard tree mitigation to be their primary responsibility, it was not likely that preventative maintenance, planting, and public outreach activities were performed at the expense of undertaking hazard tree work. Thus, tree wardens who indicated that hazard tree removal work was their only priority were less likely to have programs that were proactive toward the protection, maintenance or enhancement of public trees (usually due to insufficient funding (Ricard & Bloniarz 2006)) and tree wardens who prioritized most

of or all of the tree-related tasks including hazard tree removal were likely to preside over proactive, well-managed programs that balanced management for urban canopy health with public safety. Tree wardens from smaller, more rural communities in Massachusetts were more likely to indicate hazard tree work as their only priority.

A positive relationship between community FS U&CF score and the priority Massachusetts tree wardens gave to tree-care related tasks was evident as it was in other states, such as Illinois and Pennsylvania (Elmendorf et al. 2003; Schroeder et al. 2003). The association in Massachusetts was especially clear between FS U&CF score and tree planting, public outreach and policy development activities. Local ordinance and tree inventories had the strongest overall association with work priorities and were the only components of the FS U&CF program that were positively related to higher priorities given to conducting dead and hazard tree removal operations; no associations were found between priorities for hazard tree removal and the other FS U&CF parameters, particularly the presence of professional staff.

In contrast, TCUSA-accredited communities on average tended to give significantly higher priorities to hazard tree mitigation work, which suggests that the TCUSA program does more to encourage communities to develop hazard tree mitigation programs as part of maintaining their accreditation. This suggests that the current FS U&CF program does not fully address hazard tree mitigation activities and there may be ways that the FS could better assist communities with developing more proactive hazard tree mitigation programs through placing greater emphasis on helping them develop systematic tree inventories and establishing stronger local ordinances.

Conducting an inventory of the trees and assessing their condition is an important component of a well-executed hazard tree mitigation program, because tree wardens need to know what they have before they can develop a systematic plan for identifying, prioritizing and correcting hazard tree conditions. Tree inventories appeared to be the only aspect of the current FS program that addresses this need. Local ordinances may be instrumental to a hazard mitigation program because a long-term approach to hazard tree mitigation involves avoiding hazards by planting the right tree in the right place. Setback regulations and selecting the right tree species can mean the difference between street trees that become greater assets or greater liabilities over time. However the positive association between local ordinances and priorities for hazard tree mitigation may also be due to tree inventories because many communities that had local ordinances also had tree inventories.

Although all parameters were positively correlated with the prioritization of activities related to developing community awareness and education and influencing the direction of public policy, the association was also most strong between the presence of tree inventories and local ordinances. Communities that went beyond enforcement of MGL Chapter 87 by developing their own set of local ordinances were more likely to give higher priorities to public education and outreach and to addressing policy issues, and knowing the type, condition, age, species and location of trees by conducting a street tree inventory would enable them to form a more concrete set of guidelines for community awareness and education programs.

Professional Staff

Development of guidelines for professional staff has been an important issue in Massachusetts for some time. In 1987, the Massachusetts Shade Tree Advisory Committee outlined new guidelines for tree warden qualifications and duties to DCR. In 1996, Massachusetts General Law Chapter 41 (MGL Chapter 41) was updated to include language regarding tree warden qualifications which states that tree wardens in communities with more than 10,000 people, “shall be qualified by training and experience in the field of arboriculture” (Massachusetts General Laws, Chapter 41, Section 106 2007). This broad wording was intended to give communities leeway on formulating tree warden qualifications based on community population size, wealth, and landmass (MTWFA 2007). Subsequent to the update of MGL Chapter 41, more definitive guidelines for tree warden education and experience were developed (Ryan & Bloniarz 1999). These guidelines were intended to encourage communities to require tree wardens to meet new qualifications at the time of appointment or re-appointment and also included recommendations for training guidelines for tree wardens in communities with fewer than 10,000 people.

The FS professional staff parameter was met if either the tree warden or another individual retained by the community for the management of public trees had one or more of the following qualifications: a degree in a natural resources field; an arborist certification; or professional development training. Based on these guidelines, tree wardens from communities with populations greater than 10,000 were expected to have either a professional degree or certification; tree wardens from communities with 10,000 or fewer residents were expected only to complete professional development training.

Most tree wardens in this study indicated that professional staffing was an important part of a successful urban forestry program, especially those from more populated communities or communities with higher percentages college-educated residents. Ricard and Bloniarz (2006) found that tree wardens throughout New England were willing to acquire new knowledge, and Ricard (2005) reported that tree warden professionalism had increased in Connecticut due to the availability of voluntary training and certification programs.

Tree Warden Position and Department

The position of tree warden in Massachusetts was predominantly a part-time role held mostly by individuals who worked in other municipal departments, most commonly highway departments or the DPW. This finding was consistent with the finding of Ricard & Bloniarz (2006) that tree wardens in all New England states were predominantly individuals working at either highway departments or the DPW. Only a small number of communities retained full-time, salaried tree wardens and these were generally the largest and most densely populated communities. On the opposite end of the spectrum, less populated, rural communities often had unpaid volunteers as tree wardens who were generally unaffiliated with any municipal department. Many of these volunteer positions may have been held by individuals who were employed by commercial tree care companies, conservation groups, or consulting firms. Based on anecdotal tree warden feedback, some small communities retained tree wardens on a sub-contract basis and either paid a small retainer or an hourly rate on an as-needed basis. There appeared to be no clear differences in tree warden position or department based on the wealth or education level of community residents.

All full-time tree wardens were qualified. This was likely because they were employed exclusively to manage public trees and other vegetation and were expected to exhibit a high degree of knowledge and expertise. Full-time tree wardens worked in Sustaining Communities (FS U&CF score of 4) and most had multiple degrees and certifications. Most part-time tree wardens, on the other hand, were not qualified. This was likely due to their role as tree warden not being their primary responsibility. Most of these individuals were employed by the community full-time in another municipal function, and handled tree warden duties on a part-time or as-needed basis. Some held professional degrees or completed professional development training but very few held arborist certifications. Volunteer tree wardens were more likely to be qualified than part-time tree wardens. This was likely because many volunteer tree wardens were employed in the green industry in some capacity, such as commercial tree care, landscaping, urban forestry consulting or conservation.

The lack of a clear relationship between tree warden position and the community FS U&CF performance parameters suggested that urban and community forestry management performance had less to do with whether a tree warden was a full-time or part-time employee, contractor, or volunteer and more to do with their level of training or background. Also, no direct conclusions could be drawn about how a tree warden's position influenced their opinion about the importance of the FS U&CF measures or inter-agency communication. This may well be due to the very small sample size of full-time tree wardens who responded to the survey.

Other Qualified Individuals

Many communities retained individuals in addition to the tree warden for the care of municipal trees. These individuals included in-house crews, volunteers, consultants or sub-contractors. In roughly half the cases, tree wardens indicated that one or more of these individuals met the FS parameter for professional staff by having either a professional degree, being a certified arborist or having completed professional development training. The criteria for professional staff were met if either the tree warden or at least one other individual had at least one qualification. More populated communities were more likely to retain qualified tree wardens, and less populated communities were more likely to retain qualified individuals. This inverse association between qualified tree wardens and qualified individuals by community size and the lack of correlation between the presence of qualified tree wardens and other qualified individuals likely contributed to the apparent small difference in overall professional staff between more populated and less populated communities. The reason for this may be because more populated communities were more likely to maintain in-house crews that conduct tree work as part of other responsibilities, most likely associated with public works, and often have not received explicit training in caring for trees. Less populated communities, on the other hand, appeared to be more likely to sub-contract work out to private contractors (commercial tree care companies or utility companies), which often employ individuals specifically trained in the field of arboriculture. Communities could meet the FS professional staffing qualification if they employed a contractor that demonstrated having at least one qualified individual on staff. Rural communities often contract out their tree work because they do not have enough work to keep a full-time

crew employed year round and sub-contracting work out enables communities to access tree experts and avoiding the costly overhead of maintaining and training in-house crews.

Professional Qualifications and Work Priorities

A high percentage of tree wardens believed that professional qualifications, whether held by the tree warden or by other individuals were important to the overall success of their urban and community forestry programs. The finding that qualified tree wardens and other qualified individuals were associated with different work priorities suggests that having qualified individuals working in the town may not take the place of having a qualified tree warden. Qualified tree wardens were more likely than qualified individuals to focus more on public outreach activities that build public awareness and understanding of the importance of urban trees and engage municipal officials, residents and other constituencies in the formulation of new tree protection and maintenance policies. The finding that certified tree wardens were more associated with tree maintenance and professional degrees and professional development training were more associated with public outreach activities suggests that tree wardens that held both may bring a broader focus and a higher set of standards to urban forestry programs that consider the long-term benefits of proactive urban tree management. Communication with other municipal departments and the public were identified in the Shade Tree Advisory Committee Report (1987) as “people-related” tasks that are an important part of tree warden responsibilities.

Examples of professional training in Massachusetts include the MTWFA Professional Development Series Courses, MAA Tree School and the University of Massachusetts Extension Green School. The arborist certification is a means for

individuals to demonstrate their proficiency in the direct care of trees, thus it was not a surprise that preventative tree maintenance activities, such as pruning, cabling, crown reduction, fertilizing, were emphasized among certified arborists. The MCA program is a voluntary certification given by the Massachusetts Arborist Association and is recognized principally in Massachusetts. The ISA certification is a voluntary certification given by the ISA but is recognized throughout the United States. Issues concerning public outreach and policy development were more likely to be addressed in two or four year professional degree programs.

Professionally trained and certified tree wardens also lend credibility to their communities' urban and community forest management programs. Their ability to demonstrate a higher commitment to professionalism and articulate the value of urban trees are important to setting long-term priorities for their communities' urban and community forestry programs. Public speaking skills, the ability to proactively engage the public through general communication channels (publications, newspaper articles, postings) and development of volunteer programs are also important (Schroeder et al. 2003; Trieman & Gartner 2004; Grado et al. 2005). Based on Ricard's (2005) study of tree warden education programs in Connecticut, tree wardens voluntarily took advantage of opportunities to improve their skills in a wide range of areas including tree risk assessment, insect and disease management, tree identification and public relations. The same study found that the majority of Connecticut tree wardens believed that tree warden training should be made mandatory. Tree wardens from communities in Massachusetts with higher percentages of college-educated residents generally placed a higher premium

on the importance of training and certification to the success of their urban forestry programs. Community population and community wealth were not significant factors.

State and Local Ordinances

The majority of tree wardens indicated that their communities had their own local ordinances, sub-division regulations and/or written policies for the planting, maintenance and protection of trees. This finding suggests that Massachusetts communities as a group have been proactive about the care and protection of public trees by developing supplemental ordinances that exceed the state requirement of enforcing MGL Chapter 87. Communities that maintained local ordinances were more likely to prioritize preventative tree maintenance and tree planting activities as well as place greater importance on developing public education and outreach programs and addressing issues of public policy regarding urban trees. The finding that more populated and wealthier communities were more likely to maintain local ordinances and more actively enforce MGL Chapter 87 may be connected with larger community per-capita tree care budgets, which were likely a function of higher tax revenues from higher property values commonly found in wealthier communities or simply from a larger tax base generated by more densely populated communities.

Management Plans and Inventories

The finding that management plans received the lowest overall importance rating and were least frequently adopted of the four FS U&CF parameters agreed with a survey of cities across the U.S. which found that over 80% of U.S. cities did not possess urban forestry management plans (Kielbaso 1990).

The low importance tree wardens assigned to management plan suggests that the majority of respondents do not view management plans as integral to urban tree management. This may be due to a lack of expertise or resources for getting a management plan completed, especially in less populated communities. Prior negative experiences with management plans that were developed at considerable expense but never implemented may be one reason that tree wardens in Massachusetts were skeptical about their utility and potential benefits. The finding that most of the management plans in Massachusetts communities were over eight years old suggests that most communities do not keep their plans updated. Also, the lack of correlation between respondents' opinions of the importance of management plans and the likelihood of their communities having one suggests that there may also be some disconnect between the perception of what a management plan will do and actual experience with them. Tree wardens have indicated, anecdotally, that they were not clear about what value completing a management plan would bring to their programs. This suggests that management plans may not represent a good fit with community program priorities in spite of the emphasis placed on them by the National Arbor Day Foundation, DCR and the FS.

The significant correlation between respondents' views of the importance of management plans and the likelihood of their communities having completed some form of tree inventory or tree assessment rather than a management plan suggests that many tree wardens view inventories as a more practical surrogate to management plans, especially among smaller communities where work on public shade trees was often performed as time and budgets permit.

Tree wardens from more populated communities were significantly more likely to view management plans as important to their programs; community wealth and education did not appear to be factors. More populated communities were also more likely to have management plans. This may be due to more populated communities having the budget and staff necessary to develop management plans and many of these plans may pertain to parks and public lands rather to street tree management. Also, more populated communities were more likely to have both a management plan and a tree inventory, which could mean that the tree inventory may be an integral part of the management plan, thus suggesting that these management plans may be more integral to proactive street tree management.

This study found that TCUSA accreditation had a stronger positive association with tree wardens' opinion about management plans than FS U&CF performance. This may be attributed to the criteria for communities to have management plan as part of TCUSA accreditation having been in existence longer than that formulated by the FS U&CF program.

However, the adoption of management plans appeared to be on the rise. An earlier survey of Massachusetts tree wardens conducted in the mid-1990s found that 17% of communities with populations over 10,000 had management plans (Doherty et al. 2000), which is much lower than the 43% of communities with populations over 10,000 that indicated having management plans in this study. Results of this study also showed a lot of management plans being completed in 2005 and 2006, which may be the result of greater emphasis placed on management plans by the FS.

Tree Inventories

According to the new FS U&CF definition, management plans should be based on a professionally conducted tree assessment or tree inventory (2006). Thus tree inventories were considered in this study to be one of the component criteria of the FS U&CF management plan parameter. However, tree wardens were asked about tree inventories as a separate element to determine their frequency of adoption, type of inventories completed, and association with work priorities.

Because of the FS definition and because tree inventories were considered by (Bloniarz et al., 2001) to be a fundamental component of a good management plan, it was expected that all communities that had management plans would also have tree inventories. This was not the case. Sixty-two percent of respondents indicated that their community had completed some form of tree inventory or resource assessment, compared to 36% that indicated that they had a management plan. It is noteworthy that 15% of the communities that had management plans did not have tree inventories, which would mean that these communities had technically not met the criteria of the FS U&CF parameter for management plans. The discrepancy was probably due in part to the earlier FS U&CF PMAS parameters not explicitly indicating that tree inventories should form the basis of management plans (Eric Seaborn, pers. comm., 4/13/07). The discrepancy could also have been due to tree wardens misunderstanding the survey question, which asked them to indicate how many tree assessments/inventories had been *completed* by their community. Tree wardens with tree inventories in progress, but not completed, may have misinterpreted the question's intent and answered it in the negative. Furthermore,

this discrepancy may be due to misconceptions about what management plans should contain, as mentioned earlier.

Tree inventories and management plans are often viewed as essential tools in developing well-executed urban forestry programs (Doherty et al. 2000). Management plans that do not have some type of tree inventory or assessment can not be incorporated as easily into a daily work routine or be used to improve hazard tree removal operations because there would be no concrete tree data from which to design a daily work schedule. In contrast, management plans that do incorporate an inventory that captures the number, age, species and condition of trees provides a foundation for incorporating a systematic work process for managing hazard trees and maintaining the healthy trees (Bloniarz et al. 2001). That more communities had tree inventories than management plans may be attributed to tree wardens believing that a well-executed tree inventory is all they need to get their work done. Lack of time and budgets were often mentioned as reasons why a communities had not developed a management plans.

Tree wardens indicated a broad variety of tree inventory and assessment approaches ranging from complete tree inventories, which entailed a thorough, on-the-ground assessment of all the community's public trees, to analysis based on remote sensing (satellite) images of the overall composition of the urban canopy from above. Partial or site-specific inventories that involved the assessment of a particular area of a community, for example a downtown area or a main street, were the most popular. Windshield inventories, otherwise known as drive-by assessments, were also common, generally because of financial constraints and the belief among many tree wardens that windshield surveys were nearly as effective as conducting assessments on foot in terms

of identifying hazard trees (Rooney et al. 2005). Many communities also had completed an open space survey, which many appeared to associate with their open space plan.

A complete computer-based tree inventory management system that is automatically updated as work is performed and that can be used to manage work priorities and schedules on a day-to-day basis represents the best means to proactively manage urban trees for canopy health and public safety (Bloniarz et al. 2002). In spite of the value of a complete and continuously updatable tree inventory, only 7% of communities indicated having completed one (the survey did not ask if it was computerized). The low adoption of this type of inventory is likely due to financial and labor constraints or to the belief that simpler or smaller-scale inventories, such as windshield surveys, were sufficient for what they need to accomplish (Rooney et al. 2005), especially in more rural communities where hazard tree mitigation is often the primary work priority.

Like management plans, the adoption rate of tree inventories has increased over the past several years. Doherty et al. (2000) found that only 38% of Massachusetts communities with populations over 10,000 had street tree inventories, compared to 70% communities with populations greater than 10,000 found in this study.

Advocacy and Advisory Groups

Communities with tree committees, garden clubs, improvement associations, land conservation trusts, natural resources commissions, or parks and recreation departments, all met the FS parameter for advocacy/advisory groups. Most communities in Massachusetts, particularly less populated communities, did not have advocacy or advisory groups, and tree wardens, in general, did not believe they were important to

their success in carrying out their duties (Ricard & Bloniarz 2006). The presence of advocacy and advisory groups were most closely associated with priorities given to tree planting and public outreach activities. Many tree wardens indicated that these groups' principal activities appeared to be more involved with community beautification efforts through planting trees and other vegetation than with hazard tree assessment or preventative maintenance operations. Communities with greater populations, larger household incomes and higher percentages of college-educated residents were more likely to have advocacy and/or advisory groups. Since these groups were generally made up of volunteers, the presence of these groups points to greater community awareness and involvement in the care of its trees, which, indirectly, may be an important indicator of a proactive program. Increased use of volunteers in general has been associated with greater community environmental awareness and increased political involvement (Bloniarz & Ryan 1996). Greater public involvement was also linked to the development of more proactive and sustainable urban and community forestry programs (Trieman & Gartner 2005).

Inter-Agency Communication

Most Massachusetts tree wardens rated inter-agency communication as important to the success of their community forestry programs, especially those from more populated communities. Although not a component of the FS U&CF program, inter-agency communication was included in this study because it was viewed by DCR as a potentially important measure of urban and community forestry management performance and because it had been included as one of the six measures of community performance in the MA U&CF program (DCR 2006). Clark & Matheny (1998)

identified public agency cooperation and interaction among citizens, government and private constituencies as important components of their forest sustainability model. The fact that tree wardens in Massachusetts indicated that inter-agency communication was an important component to developing a proactive and self-sustaining community forestry program suggests that it is an important parameter to track.

If greater frequency of inter-agency communication is an indicator of greater levels of interaction and cooperation among community constituents, then it could be an indicator of greater awareness and broader focus within communities on the health of urban trees. Clark & Matheny (1998) described greater community interaction as promoting greater awareness about the care of trees, including those on private property – especially with the participation of private landowners. Tree wardens from more populated communities indicated a greater frequency of inter-agency communication with a wider range of other departments than less populated communities. This finding maybe due to greater levels of communication being one of the factors of higher urban forest management performance in larger communities. However, it could also be due in part to larger communities often having more departments and agencies involved with the care of urban trees.

Since managing public trees generally involves the participation of multiple constituencies (such as conservation commissions, highway departments/DPW, parks and recreation departments, utility companies and community residents), it was not surprising that inter-agency communication was common to all communities. Communications commonly occurring between tree wardens and highway departments/DPW may be due to most tree wardens being employed within one of these two departments and working

with DPW staff to complete work orders. Most tree wardens also indicated having routine or periodic communication with town leaders, which may be an indicator of developing popular awareness of the importance of maintaining urban trees. It was not clear how increased inter-agency communication might relate to budgetary allocations for urban and community forestry programs. But the association established between community awareness and likelihood of communities to seek state assistance (Grado et al. 2006) and greater willingness of residents to support urban and community forestry initiatives (Trieman & Gartner 2005) suggests that there could be a connection between level of inter-agency communication and level of funding provided by communities for developing and sustaining urban and community forestry programs. Future research could explore this link.

Frequency of communication varied considerably among departments by community FS U&CF performance, TCUSA accreditation status, and by community population, wealth and education. The frequency of inter-agency communication tree wardens had with highway departments/DPW did not appear to vary by community FS U&CF performance nor by TCUSA accreditation status, but frequency of communication with parks/cemeteries departments, tree departments, community leaders and engineering departments did. In addition, tree wardens from communities with higher FS U&CF scores tended to communicate more frequently with planning boards/departments and with conservation commissions. Tree wardens from more populated communities tended to communicate more frequently with parks/cemeteries departments, planning boards/departments, tree departments, engineering and buildings department while tree wardens from wealthier communities tended to communicate more frequently with

highway departments/DPW and tree departments. Community education was associated only with frequency of communication with tree departments. Together, these findings suggest that community size may be a bigger factor in overall frequency of inter-agency communication.

Tree Warden Opinion

The finding that tree wardens from communities that achieved higher FS U&CF scores were more likely to have higher opinions about the importance of the FS U&CF parameters and inter-agency communication to the success of their programs was not surprising because tree wardens that have embraced performance measures were naturally more likely to be those who have higher opinions of them. Since the responses to the survey came from a single point of contact in each community it is likely that the results were biased toward tree wardens from higher-performing communities having a more positive view of the importance of the parameters (e.g. tree wardens who had received some form of qualified training being more likely to believe that training is important). This would have had the effect of emphasizing the value of this training than otherwise might have been found if multiple viewpoints had been collected within each community. However, tree wardens' perceptions about the importance of the four FS U&CF performance parameters and inter-agency communication could have been the driving force for why their community had met more of the parameters. Although causation can not be determined from the results of this study, it is possible that tree wardens' viewpoints might be a meaningful influence the development of their community's urban forestry program.

Tree City USA

The finding that TCUSA-accredited communities in Massachusetts had higher performing urban and community forestry programs was supported by findings from other studies. Trieman & Gartner (2005) found that TCUSA communities in Missouri were more likely to have tree ordinances and management plans, and Reis et al. (2007) found that TCUSA communities in Oregon were more likely to have inventories and ordinances and to have received state assistance. Although the criteria differ to some degree between the two programs, this study found that the work priority levels were almost identical in Massachusetts communities that had achieved TCUSA accreditation and/or had achieved FS U&CF Sustaining Community status. Based on this result, it appears that one program could have served as a proxy for the other. This was the case in spite of only a 64% overlap of communities having met all the parameters of both programs. The results were not surprising since the mission of both programs is to encourage communities to develop urban and community forestry programs to sustain and improve urban canopy health. Both programs require communities to have local ordinances or abide by a state ordinance and to have some form of work plan or management plan. It is important to note that TCUSA accreditation was more closely associated with population than the FS U&CF program due to larger, more urbanized communities being more likely to be TCUSA accredited. This may be explained by larger communities more likely having a tax base to support the annual \$2 per capita expenditure requirement for urban and community forestry programs that communities must demonstrate on an annual basis in order to maintain TCUSA accreditation.

CHAPTER 5

MANAGEMENT IMPLICATIONS AND CONCLUSIONS

In terms of the individual FS parameters and their components, local ordinances and tree inventories were most universally adopted in community programs. Local ordinances and tree inventories were also the most positively linked to tree-related work priorities and were the only measures that were related to higher community priorities for dead and hazard tree management. Ricard and Bloniarz (2006) have described previously that tree wardens must balance activities that protect and maintain the health of public shade trees, (such as preventative maintenance, work inspections and tree planting), with maintaining public safety through the assessment and correction of hazard trees. The findings from this study suggest that inventories and local ordinances more fully reflect the competing priorities that tree wardens face than any of the other performance measures that make up the 2006 FS U&CF program because they were the only two performance measures that appeared to address community efforts to maintain public safety as well as to improve urban canopy health. The other FS U&CF performance parameters appeared to be associated mainly with community priorities for tasks associated with urban canopy health.

At the other end of the spectrum, management plans and advocacy/advisory groups appeared to have the lowest rate of community adoption and to have somewhat weaker associations with tree-related work priorities. In addition, tree wardens viewed management plans and advocacy/advisory groups as the least important of the four FS U&CF parameters in the development of their urban and community forestry programs. However, it is important to keep in mind that all of the FS U&CF parameters and their

components had some degree of positive impact on urban and community performance. Management plans, for example, were positively associated with preventative tree maintenance and advocacy/advisory groups were positively associated with tree planting activities even though tree wardens rated them as less important overall.

Massachusetts is experiencing one of the fastest rates of urbanization in the country. Loss of open space due to urbanization has been identified by the former USDA FS Chief Dale Bosworth as one of the four primary threats facing the future of forest sustainability in the U.S. (Bosworth 2003). Massachusetts lost approximately 5% of open land to urbanization between 1990 and 2000, the fourth fastest rate of loss in the nation (Nowak et al. 2005). The process of urbanization in modern day America, which generally takes the form of urban sprawl, is well documented. Fragmentation due to urban sprawl not only results in the loss of open land from direct conversion to development but also to the disruption of continuous open land due to fragmentation from the creation of roads, power lines and business districts that support them (Stein et al. 2006). Furthermore, urbanization is permanent. Unlike the wide-scale deforestation that took place in New England over 100 years ago to build croplands and pastures, trees and forests cannot regenerate after roads, sidewalks, shopping malls and homes are constructed.

Much of the land fragmentation from urban development in Massachusetts is occurring in rural communities, especially those close to urban centers. Less populated communities in Massachusetts have exhibited faster population growth over the past several decades as urban centers continue to expand. Analysis of U. S. Census Bureau (2007) data in this study found that Massachusetts communities with populations less

than 10,000 grew more than twice as fast as those with populations greater than 10,000 between 1980 and 2000.

While smaller communities in Massachusetts are experiencing faster rates of urbanization and population growth, the results of this study clearly showed that less populated rural communities were not able to meet the criteria of the FS U&CF parameters as fully as more populated communities in the state. Tree wardens from smaller, more rural communities cited lack of sufficient funding and shortage of qualified personnel as their main barriers to carrying out urban and community forestry initiatives that would improve the health of trees in their communities. These findings were similar to those of Groninger et al. (2002) who cited low knowledge of tree maintenance, high costs of running a municipal tree program, lack of a tree inventory, low community participation, and a lack of ordinances that clarify the division of rights and responsibilities among constituencies as the primary barriers for small rural communities in developing proactive urban and community forestry programs.

Evidence of higher population growth and urbanization in smaller communities in this and other studies highlight the need for state and Federal urban and community forestry assistance programs that more actively reach out to smaller communities in Massachusetts. The priorities in smaller and faster growing communities would more likely be associated with preserving and protecting trees during new development compared to larger communities which generally have higher priorities for maintaining the health of existing trees from the stresses of urban environments such as soil compaction, lack of growing space, paucity of available water, and effects from pollution. Groninger et al. (2002) suggested that promoting the role of urban forestry as a means to

attract economic development, provide more information and training, and encourage more community volunteering could lead to improved urban and community forestry management in smaller communities. This seeming contradiction of preserving trees by attracting economic development stems from the concept that the aesthetics and quality of life that healthy trees bring to a community can help attract new business that could, in turn, provide new funding to support the community's urban and community forestry programs. The challenge, of course, is not to allow any new development to come at the expense of the very trees that made the community attractive in the first place.

While federal and state assistance programs could be tailored more toward smaller communities, this should not be done at the expense of larger communities. Continued support of urban and community forestry programs in major urban areas, where most of the voting public resides is instrumental to continuing to build public awareness among the greatest number of people about the value and importance of protecting urban and community trees. Since public awareness of the value of public trees has been linked to greater community support of urban forestry programs (Elmendorf et al. 2003 and Trieman & Gartner 2005) and the greater likelihood of communities to actively seek outside assistance for their programs (Grado et al. 2006), state and federal programs can continue to leverage their resources by improving urban and community performance in urban areas through grant awards, technical assistance, and public awareness campaigns. It has been suggested by McKinney (2002) that building higher public awareness and understanding about the importance of conservation of natural ecosystems in urban centers can lead to greater awareness and conservation efforts in the conservation of natural ecosystems beyond urban boundaries. The fact that

the percentage of the human race that lives in areas considered urban continues to grow, make this approach particularly relevant.

The spatial distribution of communities that responded to the survey based on FS U&CF performance in Massachusetts (Figure 1) suggests a possible clustering effect where rural communities with higher performing urban and community forestry programs were more likely to be adjacent to urban communities with well-developed urban forestry programs. This apparent pattern of higher performing communities being more likely to border major metropolitan regions in Massachusetts with high-performing programs may be the result of a bandwagon effect where lower performing communities were influenced by adjacent higher performing ones through sharing of knowledge, experience, viewpoint and resources. The characteristics of this association may be similar to a pattern found with volunteers noted by Wall et al. (2006) where growth of volunteer involvement in urban and community forestry programs increased the likelihood of additional participation in adjacent communities. Future research could explore this concept of a bandwagon effect further. Encouraging greater urban and community program performance in larger cities may be found to result in increased urban and community forestry performance in surrounding communities.

Federal and state programs may also want to emphasize greater resource and knowledge sharing between larger communities with more developed programs with smaller neighboring communities with less developed programs. Such cooperation could take advantage of the possible bandwagon effect while also better leveraging state and federal resources in terms of promoting more efficient use of resources and encouraging increased cost sharing among communities. Promoting the concept that urban ecosystems

do not stop at political boundaries could form the foundation of cost and resource sharing initiatives. Thus a two-pronged approach that continues to support urban communities coupled with developing more proactive approaches to addressing the needs of rural communities may result in a greater overall return on program investment in an environment of limited program resources.

In addition to targeting the differing set of needs of smaller and larger communities in Massachusetts, results of this study point to several other possible ways to enhance the impact of urban and community forestry programs all around the state with little additional cost to state and Federal agencies. Broadening the scope of MGL Chapter 87 to increase tree warden enforcement powers and to encourage communities to develop local ordinances designed to preserve trees during development could result in the preservation of more trees, especially in faster-growing communities where new development is prevalent. Stronger tree protection and conservation guidelines designed to encourage developers and private landowners to incorporate tree protection and replacement specifications as an integral part of construction project planning (Fisette & Ryan 2001) could result in significant reductions in the number of trees removed or damaged during construction projects. Encouraging greater community involvement in tree protection and planting activities could yield important long-term benefits in terms of greater public support of urban tree programs and encourage private landowners becoming more interested in conserving trees on private property. Increasing the participation of private land owners could result in many more trees being protected in urban areas because, according to an estimate by Kielbaso (1990), nine out of ten urban trees reside on private property.

Publicity campaigns based on the growing literature supporting the benefits of trees to the quality of life in cities should result in increasing positive public awareness that could lead to greater support for legislation for expanded funding for urban and community forestry programs. Growing scientific data and quantification of the social, economic and environmental benefits of trees will also help justify more sustained funding over time.

The finding by Ricard (2005) and Ricard and Bloniarz (2006) that tree wardens voluntarily seek additional training and prefer to receive training in the company of their peers suggest that seminars for tree wardens and other community officials on *how to* develop tree inventories and create local ordinances to enhance their communities' programs may be an effective means to target tree wardens in smaller communities. In addition, seminars that encourage knowledge-sharing and communication among tree wardens would likely be well attended by tree wardens. Developing a web-based tool that allows tree wardens to share information and knowledge about urban and community forestry programs could also help to develop better technology and knowledge transfer that could result in greater community communication and collaboration. Finally, the state could develop a program of roving foresters/consultants who can work closely with individual communities to help them understand the cost-benefit of developing proactive self sustaining urban forestry programs and help them with the necessary steps to develop such programs.

This survey of Massachusetts tree wardens offers a number of important insights into current levels of community FS U&CF performance and the relative strength of the individual performance parameters and their associated components. Massachusetts has

long recognized the importance of its urban forests and the current study helps to understand better the views of tree wardens and current levels of community performance, while providing baseline data to which the results of future studies can be compared. Studies involving follow-on surveys of tree wardens to measure community FS U&CF performance will enable DCR to track the direction of overall state performance and monitor the impact of program changes on community performance over time.

APPENDIX: SURVEY MAILINGS

Massachusetts Urban & Community Forestry Program Study

We Seek Your Help!

9 June 2006

<sal> <first name> <last name>
<title>
<address 1>
<address 2>
<city>, MA <zip>

Dear <sal> <first name>

In a few days you will receive a brief questionnaire in the mail for an important research project being conducted by the *University of Massachusetts* in partnership with The *Massachusetts Department of Conservation and Recreation (DCR)*.

We seek your opinion and feedback to help DCR tailor its technical assistance, education and funding programs to better meet your community's needs in managing urban & community forestry programs.

All Massachusetts Tree Wardens and Tree Committees are being contacted. Please give this your attention as soon as you receive it. It should only take 12 – 15 minutes to complete.

Your responses will also help DCR meet Massachusetts Urban & Community Forestry Program reporting requirements to the USDA Forest Service in order to receive Federal fund allocations for 2006. Currently 75% to 80% of all Federal funds received by the state are passed onto communities in the form of grants.

This study is also part of a new awards program under development by DCR to recognize communities that achieve improvement and attainment in four key performance areas – staff training, tree inventory management plans, advocacy/advisory groups and ordinances. Except for those needed to satisfy the USDA reporting requirement, individual responses will be analyzed in aggregate form. *Individual responses will **not** be made public.*

The goal of this awards program is to lift Massachusetts' overall urban & community forestry performance, which may result in larger shares of USDA Forest Service funding allocations in the future. Our goal is to help **Massachusetts become Number One.**

This program is separate from the existing *Tree City USA program* with which many communities are already involved.

If you have any questions about this study, please contact me at 617-626-1468 or at eric.seaborn@state.ma.us

Sincerely,

Eric Seaborn, Coordinator
Urban and Community Forestry

P.S. As a token of our appreciation, your community will – upon return of a completed questionnaire – **be entered into a raffle for \$3,000 worth of trees funded from the Mass ReLeaf Trust Fund.**

Massachusetts Urban & Community Forestry Program Study

16 June 2006

<sal><first name><last name>
<title>
<address 1>
<address 2>
<city>, MA <zip>

Dear<sal> <first name>:

We need your assistance! Your opinion and feedback is essential to helping the *Massachusetts Department of Conservation and Recreation* (DCR) tailor its education, technical support and funding programs to better meet your community's needs in managing urban & community forestry programs.

Your responses will also help DCR meet Massachusetts Urban & Community Forestry Program reporting requirements to the USDA Forest Service in order to receive Federal fund allocations for 2006.

We are contacting all Tree Wardens and Tree Committees in the State. Please take 12-15 minutes now to complete it and return it in the self-addressed stamped envelope provided. Your response counts!

This study is also part of a new awards program under development by DCR to lift Massachusetts' overall urban & community forestry program performance, which may result in larger shares of the USDA Forest Service funding allocations in the future. *Your individual responses will not be made public.*

If you have any questions please contact me at 617-626-1468 or eric.seaborn@state.ma.us.

Sincerely,

Eric Seaborn, Coordinator
Urban and Community Forestry

P.S. As a token of our sincere appreciation we will, upon receipt of your completed questionnaire, enter your community into a raffle for **\$3,000** worth of trees funded from the Mass ReLeaf Trust Fund (*To be entered properly, please correct any errors or omission to the contact information above*).

PLEASE BEGIN ON NEXT PAGE



Q1. Which of the following best describes your role? (Check only one):

<i>Your Role</i>	Check Only One
I am the tree warden for my community	<input type="checkbox"/>
I am <i>acting</i> tree warden for my community – the position of tree warden is currently open	<input type="checkbox"/>
I am <i>not</i> the tree warden but am actively involved with urban & community tree management <i>and</i> can answer questions on the tree warden’s behalf: Please give your title: _____	<input type="checkbox"/>
I am a member of a town committee that handles tree warden duties for my community	<input type="checkbox"/>
Other (Please specify) _____	<input type="checkbox"/>
I am not the tree warden or acting tree warden, nor can I answer questions on the tree warden’s behalf – in this case <i>please pass this questionnaire on to the appropriate person or contact Eric Seaborn at eric.seaborn@state.ma.us or at 617-626-1468.</i>	<input type="checkbox"/>

Q2. Which of the following best describes the position of tree warden in your community? (Check only one):

<i>Tree Warden Position Type</i>	Check Only One
Full-time salaried position	<input type="checkbox"/>
Part-time salaried position	<input type="checkbox"/>
Stipend position	<input type="checkbox"/>
Part-time responsibility that is <i>part</i> of a full-time salaried position	<input type="checkbox"/>
Contract/Consultant position – hired on an as-needed basis	<input type="checkbox"/>
Volunteer position	<input type="checkbox"/>
Position of Tree Warden is handled by a town committee	<input type="checkbox"/>
Other, (please describe) _____	<input type="checkbox"/>

Q3. In which municipal department or agency does the role of tree warden reside?

Name of Department or Agency: _____

Q4. Does the tree warden currently have any of the following degrees and/or certifications? (Check all that apply): (If tree warden duties are represented by committee, please indicate if committee members have any of the following degrees and/or certifications?)

<i>Tree Warden Degrees and Certifications</i>	Check All That Apply
International Society of Arboriculture (ISA) Certified Arborist,	<input type="checkbox"/>
Massachusetts Certified Arborist (MCA)	<input type="checkbox"/>
Associates, Bachelor’s or Master’s degree from an accredited college or university in a natural resources field, such as <i>Park Management, Arboriculture, Urban forestry, Landscape Design, or Horticulture, other</i> _____	<input type="checkbox"/>
Completed professional courses, such as <i>MAA Tree School, UMass Extension Green School, MTWFA Professional Development Series (PDS) courses</i>	<input type="checkbox"/>
No degrees at this time	<input type="checkbox"/>
Other (Please Specify): _____	<input type="checkbox"/>

Q5. Other than the tree warden, does your community employ or contract with other individuals who are regularly and routinely involved with the planting, protection and maintenance of urban & community trees and forests?

(By urban & community trees, we mean any trees that fall under the jurisdiction of the tree warden such as street trees and trees on public lands, such as parks, cemeteries, municipal buildings, and open land.)

- Yes
- No, if no staff GO TO Q8

Q6. If yes, please write the number of individuals for each employment category, '0' = no individuals and 'DK' = don't know:

<i>Employment Category</i>	Number of Individuals
Full time salaried position	
Part time salaried position	
Independent Contractor	
Consultant	
Volunteer	

Q7. Do any of these individuals currently have any of the following degrees and/or certifications? Please write the number of individuals who have each degree or certification. '0' = no individuals and 'DK' = don't know:

<i>Degrees or Certifications</i>	Number of Individuals
International Society of Arboriculture (ISA) Certified Arborist, Massachusetts Certified Arborist (MCA)	
Associates, Bachelor's or Master's degree from an accredited college or university in a natural resources field, such as <i>Park Management, Arboriculture, Urban forestry, Landscape Design, or Horticulture</i>	
Completed professional courses, such as <i>MAA Tree School, UMass Extension Green School, MTWFA Professional Development Series (PDS) courses</i>	
No degrees at this time	
Other (Please specify): _____	

Q8. To what extent do you agree or disagree with the following statement:

Having individuals with professional degrees or certifications employed or retained by my community is important to the success of my community's urban & community tree and forest programs.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q9. What *level of priority* does your community currently give to each of the following types of tree-related work? (By priority we mean receive budget dollars and/or attention from your department.)

<i>Types of Tree-Related Work</i>	High priority	Moderate priority	Low priority	Not a Priority
Preventative tree maintenance (pruning, cabling, crown reduction, fertilizing)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dead and hazard tree removal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Utility arboriculture operations (e.g. line clearing and ROW maintenance)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspections of work performed by contractors /developers and reviewing site plans	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tree Planting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public Education & Outreach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Addressing policy issues – e.g. updating/creating new ordinance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q10. How would you best describe the *frequency* of communication between your department and other municipal agencies and departments regarding the planting, protection and or maintenance of your urban & community trees and forests?

<i>Communication with Agencies and Municipal Departments</i>	Routinely	Periodically	Seldom	Never
Highway Department/DPW	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parks/Cemeteries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Planning Board/Department	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tree Department	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
City/Town leaders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Utility Company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
City/Town Engineering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buildings Department	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conservation Commission	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q11. To what extent do you agree or disagree with the following statement:

Having good inter-agency communications is important to the success of my community's urban & community tree and forest programs.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q12. Please list the name and principal activity of any groups or organizations in your community that advise/advocate for the planting, protection and/or maintenance of your community trees (e.g. tree board, tree commission, horticultural club, garden club or non-profit organization, friends of trees). If no groups GO TO Q13

Name: _____

Principal Activity: _____

Name: _____

Principal Activity: _____

Name: _____

Principal Activity: _____

Name: _____

Principal Activity: _____

Q13. To what extent do you agree or disagree with the following statement:

Having advisory/advocacy groups is important to the success of my community's urban & community tree programs

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q14. Does your community have one or more documented management plans that guide the strategic management of your urban & community trees and forest resources (e.g. Community or Urban Forestry Management Plan, Open Space Plan, Natural Resource Management Plan, etc.)?

If yes, *a)* please list by title, then *b)* indicate whether or not it is currently in active use, and *c)* the month and year it was last updated. If no document management plans GO TO Q15.

a) Documented Management Plan(s) (please list by title)	b) Currently in active use?	c) Last Updated: Month/Year
	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__

Q15. Has your community completed any of the following types of tree assessments / inventories? Check *a)* for each type your community has completed, *b)* whether or not it is in active use, and *c)* the month and year it was last updated.

<i>Tree Assessment/inventory type</i>	<i>Completed?</i>	<i>Currently in active use?</i>	<i>Last Updated: Month/Year</i>
Complete tree inventory	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
Partial tree inventory (e.g. downtown core, main streets)	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
Site specific tree inventory (e.g. park, common)	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
Windshield tree survey	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
Open space survey	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
GIS analysis	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
Satellite analysis	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
Statistical sample summary	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__
Other (specify)_____	<input type="checkbox"/> yes <input type="checkbox"/> no	<input type="checkbox"/> yes <input type="checkbox"/> no	__/__/__

Q16. To what extent do you agree or disagree with the following statement:

Having a documented management plan developed from a professionally-based resource assessment is important to the success of my community's urban/community tree programs.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q17. To what extent do you currently enforce M.G.L Chapter 87, *The Shade Tree Law*?

Routinely	Periodically	Occasionally	Seldom
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q18. Does your community have its own local ordinances, sub-division regulations and/or written policies that pertain to the planting, maintenance and protection of trees? (Check all that apply):

Ordinances, sub-division regulations, written polices	
Local tree ordinance	<input type="checkbox"/> yes <input type="checkbox"/> no
Regulations requiring the planting of new trees during development	<input type="checkbox"/> yes <input type="checkbox"/> no
Regulations that protect existing trees during development	<input type="checkbox"/> yes <input type="checkbox"/> no
Written policies pertaining to tree planting, protection and maintenance	<input type="checkbox"/> yes <input type="checkbox"/> no
Other _____	<input type="checkbox"/> yes <input type="checkbox"/> no

Front

Department of Conservation and Recreation
251 Causeway Street, Suite 600
Boston MA 02114-2119
617-626-1250 617-626-1351 Fax
www.mass.gov/dcr

<first name> <last name>
<title>
<address 1>
<address 2>
<city>, MA <zip>

Back

Over a week ago a questionnaire seeking your opinion and feedback concerning Urban & Community Forestry programs was mailed to you. All Tree Wardens across the Commonwealth have been contacted.

If you've already completed and returned the questionnaire to us, please accept our sincere thanks. If not, please do so today. We appreciate your help and your response is a key part to helping DCR tailor community technical assistance, education and funding programs.

If you did not receive a questionnaire, or if it was misplaced, please contact me at 617-626-1468 or eric.seaborn@state.ma.us and I will mail another questionnaire to you today.

**Eric Seaborn, Coordinator
Department of Conservation and Recreation
251 Causeway Street, Suite 600
Boston MA 02114-2119**

Massachusetts Urban & Community Forestry Program Study

19 July 2006

<first name> <last name>
<title>
<address 1>
<address 2>
<city>, MA <zip>

Dear <first name>:

About three weeks ago we sent you a questionnaire asking for your opinion and feedback to help DCR tailor its education, technical support and funding programs to better meet your community's needs in managing urban & community forestry programs. To the best of our knowledge, it has not yet been returned.

Feedback from other community tree wardens has shown there are a wide variety of perspectives. We think the results are going to be very useful to DCR for developing future programs to better meet community needs.

We are writing again because of the importance that your questionnaire has for getting accurate results. It is only by hearing from nearly every tree warden in the State that we can be sure that the results are truly representative. Your responses will also help DCR meet Massachusetts Urban & Community Forestry Program reporting requirements to the USDA Forest Service in order to receive Federal fund allocations for 2006.

Several tree wardens have written us to say they have not received the questionnaire or that that it went to an incorrect name or a wrong address. If any of these applies to you, please contact me at 617-626-1468 or eric.seaborn@state.ma.us.

We hope that you will fill out and return the questionnaire soon. Feedback from others has indicated that it takes less than 12 minutes to complete. But if for any reason you prefer not to answer it, please let us know by returning a note or a blank questionnaire in the enclosed stamped envelope.

Sincerely,

Eric Seaborn, Coordinator
Urban and Community Forestry
Department of Recreation and Conservation

REFERENCES

- Akbari, H. 2002. Shade Trees Reduce Building Energy Use and CO² Emissions from Power Plants. *Environmental Pollution*. 116:119-126.
- Bloniarz, D.V, S. Phalen, and H. D. P. Ryan. 2001. How to Conduct a Street Tree Inventory. *Tree City USA Bulletin*. National Arborday Foundation. No.23.
- Bloniarz, D. V., and H. D. P. Ryan. 1996. The Use of Volunteer Initiatives in Conducting Urban Forest Resource Inventories. *Journal of Arboriculture*. 22(2):75-82
- Bosworth, D. 2003. Is America On Track Toward Sustainable Forests? Society of American Foresters, Annual Convention, October 6, 2003.
www.fs.fed.us/news/2003/speeches/10/sustainableforests.shtml
- Clark, J. R., and N. P. Matheny. 1998. A Model of Urban Forest Sustainability: Application to Cities in the United States. *Journal of Arboriculture* 24(2): 112-120.
- Cubbege, F. W., O’Laughlin, and C. S. Bullock. 1993. *Forest Resource Policy*. Wiley & Sons, New York, NY.
- Dillman, D.A. 2000. *Mail and Internet Surveys: The Tailored Design Method*. Wiley & Sons, New York, NY.
- Dickerson, S., D., J. W. Groninger, and J. C. Mangun. 2001. Influences of Community Characteristics on Municipal Tree Ordinances in Illinois, U.S. *Journal of Arboriculture*. 27(6): 318-325.
- Doherty, K. D., H. D. P. Ryan, and D. V. Bloniarz. 2000. Tree Wardens and Utility Arborists: A Management Team Working for Street Trees in Massachusetts. *Journal of Arboriculture*. 26(1): 38-47.
- Dwyer, J. F., E. G. McPherson, H. W. Schroeder, and R. A. Rowntree. 1992. Assessing the Benefits and Costs of the Urban Forest. *Journal of Arboriculture*. 18(5): 227-234.
- Elmendorf, W. F., V. J. Cotrone, and J. T. Mullen. 2003. Trends in Urban Forestry Practices, Programs, and Sustainability: Contrasting a Pennsylvania, U.S. Study. *Journal of Arboriculture*. 29(4):237-247.
- ESRI. 2006. ArcGIS 9.1 is a trademark of ESRI. Redlands, CA.
- Fisette. P and H. D. P. Ryan. 2001. Saving Trees During Construction. *Journal of Light Construction*. September, 2001: 41-47.

- Galvin, M. F. and D. Bleil. 2004. Relationships Among Tree Canopy Quantity, Community Demographics, and Tree City USA Program Participation in Maryland, U.S.A. *Journal of Arboriculture*. 30(6):321-327.
- Goodman, I. 2006. Goodman Research Group. Cambridge, MA.
- Grado, S. C., D. L. Grebner, M. K. Measells, and A. L. Husak. 2006. Status, Needs, and Knowledge Levels of Mississippi's Communities Relative to Urban Forestry. *Journal of Arboriculture*. 32(1):24-32.
- Groninger, J. W., D. D. Close and C. M. Basman. 2002. Can Small, Rural Communities Practice Urban Forestry? *Journal of Forestry*. 100(11):23-28.
- Kielbaso, J.J., B. Beauchamp, K. Larison and C. Randell. 1988. Trends in Urban Forestry Management. Baseline Data Report 20(1), International City Management Association. Washington, D.C.
- Kielbaso, J. J. 1990. Trends and Issues in City Forests. *Journal of Arboriculture*. 16(3):69.
- Kuhns, M. R., D. K. Reiter, and B. Lee. 2005. Characteristics of Urban Forestry Programs in Utah, U.S. *Journal of Arboriculture*. 31: 285-95.
- Lohr, V. I., C. H. Pearson-Mims, J. Tarnai, and D. A. Dillman. 2004. How Urban Residents Rate and Rank the Benefits and Problems Associated with Trees in Cities. *Journal of Arboriculture*. 30(1):28-35.
- Lorenzo, A. B., C. A. Blanche, Q. Yadong, and M. M. Guidry. 2000. Assessing Resident's Willingness to Pay to Preserve the Community Urban Forest: A Small City Case Study. *Journal of Arboriculture*. 26(6):319-325.
- Maco, S. E. and G. McPherson. 2002. Assessing Canopy Cover Over Streets and Sidewalks in Street Tree Populations. *Journal of Arboriculture*. 28(6): 270-276.
- Maco, S. E. and G. McPherson. 2003. A Practical Approach to Assessing Structure, Function, and Value of Street Tree Populations in Small Communities. *Journal of Arboriculture*. 29(2): 84-97.
- Massachusetts Department of Conservation and Recreation. 2006. Urban & Community Forestry program. Online at <http://www.mass.gov/dcr/stewardship/forestry/urban>; last accessed July 2007
- Massachusetts General Laws Chapter 41, Section 106. 2007. General Laws of Massachusetts. <http://www.ma.gov/legis/laws/mgl>; last accessed July 2007

- Massachusetts General Laws Chapter 87. 2007. General Laws of Massachusetts. <http://www.ma.gov/legis/laws/mgl>; last accessed July, 2007.
- Massachusetts Office of Geographical and Environmental Information. 2007. Massachusetts Geographical Information System <http://www.mass.gov/mgis/>; last accessed July, 2007.
- Massachusetts State Data Center/Donahue Institute. 2005. University of Massachusetts President's Office. Boston, MA. www.massbenchmarks.org/statedata/data.htm; last accessed July, 2007.
- McKinney, M. L. 2002. Urbanization, Biodiversity, and Conservation. *BioScience*. 52(10): 883-890.
- McPherson, E. G., J. R. Simpson, P. J. Peper, and X. Qingfu. 1999. Benefit-Cost Analysis of Modesto's Municipal Urban Forest. *Journal of Arboriculture*. 25(5): 235-248.
- Microsoft Corporation .2003. Excel is a trade mark of Microsoft Corporation.
- Miller, R. W. 1997. *Urban Forestry, Planning and Managing Urban Greenspaces*. Prentice Hall, Upper Saddle River, NJ.
- Miller, R. W. and T. R. Bate. 1978. National Implications of an Urban Forestry Survey in Wisconsin. *Journal of Arboriculture*. 4(6):125-127.
- Minitab Inc. 2003. MINITAB statistical software, release 14 for Microsoft Windows, State College, PA.
- Massachusetts Tree Wardens and Foresters Association. 2007. www.masstreewardens.org; last accessed July, 2007.
- Nowak, D. J. 1994. Understanding the Structure of Urban Forests. *Journal of Forestry*. 92(10): 42-46(5).
- National Arbor Day Foundation. Tree City USA program. Available online at: www.arborday.org/programs/treeCityUSA.cfm; last accessed July, 2007.
- Nowak, D.J., J. T. Walton, J. F. Dwyer, L. G. Kaya and S. Myeong. 2005. The Increasing Influence of Urban Environments on U.S. Forest Management. *Journal of Forestry*. December 2005: 377-382.
- Nowak, D. J., M. H. Noble, S. M. Sisinni, and J. F. Dwyer. 2001. People and Trees: Assessing the U.S. Urban Forest Resource. *Journal of Forestry*. 99(3):37-42.
- Parry, J. 2007. USDA Forest Service Urban and Community Forestry Program. Northeastern Area. Durham, HN. www.na.fs.fed.us/urban.

- Reeder, E.C., and H.D. Gerhold. 1993. Municipal Tree Programs in Pennsylvania. *Journal of Arboriculture*. 19:12-19.
- Reis, P. D., A. S. Reed, and S. J. Kresse. 2007. The Impact of Statewide Urban Forestry Programs: a Survey of Cities in Oregon. *U.S. Journal of Arboriculture*. 33(3): 168-175.
- Ricard, R. M. 2005. Connecticut's Tree Wardens: A Survey of Current Practices, Continuing Education, and Voluntary Certification. *Northern Journal of Applied Forestry*. 22(4):248.
- Ricard, R. M. and Bloniarz, D. V. 2006. Learning Preferences, Job Satisfaction, Community Interactions, and Urban Forestry Practices of New England (USA) Tree Wardens. *Urban Forestry & Urban Greening*. 5:1-15.
- Rooney, C. J., H.D.P. Ryan, D. V. Bloniarz, and B.C. P. Kane. 2005. The Reliability of a Windshield Survey to Locate Hazards in Roadside Trees. *Journal of Arboriculture*. 31(2):89-94.
- Ryan, H. D. and D. Bloniarz. 1999. New Tree Warden Qualifications. Massachusetts Tree Warden's Association. *BARK*, April: 6-7.
- Report of the Shade Tree Advisory Committee. 1987. Submitted to James Gutensohn, Commissioner, Commonwealth of Massachusetts Department of Environmental Management (now DCR).
- SAS Institute Inc. 2002-2003. Statistical software, release 9.1 for Microsoft Windows, Cary, NC.
- Seaborn, E. 2007. Massachusetts Department of Conservation and Recreation, 251 Causeway Street, Boston, MA 02114 www.mass.gov/dcr/stewardship/forestry/urban.
- Schoeneman, R. S. and P. D. Ries. 1994. Managing the Forests Where We Live. *Journal of Forestry*. 92(10): 6-10.
- Schroeder, H.W., T.L. Green and T.J. Howe. 2003. Community Tree Programs in Illinois, U.S.: A Statewide Survey and Assessment. *Journal of Arboriculture*. 29:218-225.
- Sheskind, D. 2004. *Handbook of Parametric and Non-parametric Statistical Procedures*. 3rd Ed. Chapman & Hall/CRC. Boca Raton, FL.
- Stein, S. M., R. E. McRoberts, R. J. Alig, M. D. Nelson, D. M. Theobald, M. Eley, M. Dechter & M. Carr. 2006. *Forests on the Edge: Housing Development on America's Private Forests*. Forest Service, Washington, DC.

- Thompson, R. P. 2006. The State of Urban and Community Forestry in California. Urban Forest Ecosystems Institute Technical Report No. 13. San Luis Obispo, CA.
- Tree City USA. 2007. The National Arbor Day Foundation. Nebraska City, NE.
- Treiman, T., and J. Gartner. 2004. Community Forestry in Missouri, U.S.: Attitudes and Knowledge of Local Officials. *Journal of Arboriculture*. 30(4):205-213.
- Treiman, T., and J. Gartner. 2005. What Do People Want From Their Community Forests? Results of a Public Attitude Survey in Missouri. *U.S. Journal of Arboriculture*. 31(5):243-250.
- U.S. Census Bureau. 2007. Statistical Abstract of the United States. Government Printing Office. Washington DC. www.census.gov/compendia/statab; last accessed July, 2007.
- U.S. Department of Agriculture Forest Service Urban & Community Forestry Program. 2007. Performance-Based Methodology for Allocating Urban & Community Forestry Program Funds. USDA Forest Service Northeastern Area. www.na.fs.fed.us/urban/index.shtm; last accessed July, 2007.
- U. S. Department of Agriculture Forest Service. 1998. Highlights of the Massachusetts Forest Inventory. USDA Forest Service Northern Research Station Forest Inventory & Analysis. Newtown Square, PA. www.fs.fed.us/ne/fia/states/ma/index.html; last accessed July, 2007.
- Wall, B. A., T. J. Straka, and S. E. Miller. 2006. An Econometric Study of the Factors Influencing Participation in Urban and Community Forestry Programs in the United States. *Journal of Arboriculture*. 32(5):221-228.
- Warriner, K., Goyder, J., Gjertsen, H., Hohner, P., & McSpurren, K. 1996. Charities, No; Lotteries, No; Cash, Yes: Main Effects and Interactions in a Canadian Incentives Experiment. *Public Opinion Quarterly*. 60:542-562.