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Urban forest management in New England: towards a contemporary understanding of tree wardens in Massachusetts communities

Richard W. Harper[a], David V. Bloniarz[a], Stephen DeStefano[b] and Craig R. Nicolson[a]

[a]Department of Environmental Conservation, University of Massachusetts, Amherst, MA, USA; [b]US Geological Survey, Massachusetts Cooperative Fish and Wildlife Research Unit, University of Massachusetts, Amherst, MA, USA

ABSTRACT

In the New England states, tree wardens are local officials responsible for the preservation, maintenance and stewardship of municipal public trees. This study explores the emerging professional challenges, duties and responsibilities of tree wardens, from the subject's point of view, by conducting in-person, semi-structured qualitative research interviews with 50 tree wardens throughout Massachusetts. Many of the findings corroborate previous literature, including that tree wardens are typically housed in a municipal department (often public works or highway), that tree wardens routinely interact with a wide variety of local organisations (representatives from other municipal departments, community volunteer associations) and that as community size increases, tree wardens typically have access to a greater pool of resources to carry out urban forest management. A newer finding is that the subject of urban forest health arose as a topic of great importance for tree wardens, as nearly all interviewees (n = 49) indicated that they monitor for urban forest pests and that they would like further continuing education concerning this subject.

KEYWORDS

Massachusetts; naturalistic; participatory; qualitative; tree warden; urban forestry

Introduction

The early Greek civilisation pioneered practices related to plant care that included the installation of trees and gardens. It was the Romans, however, who are largely credited with formalising early "arboriculture" (Johnston, 2015). They performed large-scale pruning, felling and clearing of trees to create space for public infrastructure, and to utilise wood resources for large-scale construction projects. They also carried out widespread planting and transplanting, as they installed trees and plants around their homes and urban landscapes, and established orchards for commercial-scale fruit production. They titled the individual responsible for the care of trees, an "arborator" (Capana, 1999). This term continued to be widely used until the seventeenth century, where it was eventually supplanted with "arborist" (Evelyn, 1664).

CONTACT Richard W. Harper rharper@eco.umass.edu

Through the industrial revolution and beyond, cities and towns grew rapidly in size and population. This expansion meant that interaction between the urban environment and the rural, often wooded, landscape was more likely (Miller, Hauer, & Werner, 2015). It was out of this relationship between the "built" and the "natural" ecosystem that the concept of the "urban forest", arose and with it the more defined practice of "urban forestry". An early, but comprehensive, understanding of urban forestry (according to Moeller, 1977), was as follows:

The *urban forest* is a flexible concept that encompasses rows of street trees and clusters of trees in city parks, green belts between cities, and eventually forests that are more remote from the inner city. The urban forest occupies that part of the urban ecosystem made up of vegetation and related natural resources found in urban, suburban and adjacent lands, regardless of ownership. As we move across the urban–rural gradient, the mix of benefits provided by the urban forest changes. The limits of the urban forest cannot be defined by a line on a map. More importantly, the *urban forest* provides a conceptual framework within which to organise a research programme to maximise the benefits that forests can contribute to improving urban environments. Though this definition was outlined over four decades ago, its application is still relevant today.

In recent decades, the size and scope of towns and cities of Massachusetts has expanded rapidly. At a rate of 5.0% growth from 1990 to 2000, Massachusetts ranked 4th nationwide among states that experienced the greatest increase in urban growth (Shifley et al., 2012). Massachusetts also ranked 2nd (behind New Jersey), as one of the nation's most urbanised states, with a population increase of 5.5% since 1990 (Shifley et al., 2012). In addition to housing 91% of the state's 6.7 million residents, these same urban settings also feature significant urban tree canopy cover (i.e. Boston 29%, Worcester 37%, Springfield 33%), with plans to increase this cover through local urban tree planting initiatives (Schwarz et al., 2015; J. Coop, MA DCR urban and community forestry programme, pers. comm.).

Since the environmental, economic and social importance of community trees planted in residential settings has been well-documented (McPherson et al., 2007), urban tree planting with the objective to increase tree canopy cover is positive news. Benefits derived from trees include annual air pollution removal equating to 711,000 metric tons nationwide, an estimated value of $3.8 billion USD (Nowak, Crane, & Stevens, 2006), and reduction of stress and improvement of physical and mental well-being of local citizenry (van den Berg, Maas, Verheij, & Groenewegen, 2010). Urban forests are also credited with increasing values of local properties and the reduction of stormwater run-off through rainfall interception (McPherson et al., 2007). Furthermore, citizens themselves also tend to feel very passionately about access to community green space and urban trees (Shroeder, Flannigan, & Coles, 2006), believing that these resources add beauty and value to towns, cities and neighbourhoods (Hull, 1992).

Urban trees are, however, presented with very challenging growing conditions (Jutras, Prasher, & Mehuys, 2010), and limited understanding and empirical data exist regarding their growth response in the built environment (Roman, 2014). What is known, however, is that though trees thrive in natural forested habitats for many centuries, those same species of trees located in urban environments often only live for as little as 10 years to perhaps nearly 30 years (Moll, 1989; Roman & Scatena, 2011). This reduced lifespan is associated with a number of factors including construction injury, invasive pests (Nowak & Greenfield, 2012), pollutants, temperature extremes (Jutras et al., 2010) and lack of available growing space

(Day, Wiseman, Dickinson, & Harris, 2010; N.L. Bassuk, Cornell University, pers. comm.). One of the main concerns related to the greatly reduced life-expectancy of urban trees, however, is that if they are not provided with the essential conditions to survive (Roman, 2014) and they fail to reach their optimal mature stature, many of the aforementioned environmental benefits may not be fully realised.

Urban forests and diversity

The urban environments that have been constructed over the centuries have been widely criticised as being notoriously lacking in organismic bio-diversity – from pollinators, to birds, to other wildlife. This is also the case for urban trees. Of the nearly 1.2 million street trees in Massachusetts, nearly half (49%) are in the genus *Acer*. On a higher taxonomic level, 65% of street trees belong to either the Aceraceae or Fagaceae (Cumming, Twardus, & Smith, 2006). This uniformity may mean that our urban forests lack core resiliency (Kimmins, 1997), and that they are susceptible to losses of large numbers of trees from any single disturbance, such as an invasive pest or a weather-related event (Clapp, Ryan, Harper, & Bloniarz, 2014).

These challenges – individually, let alone cumulatively – put urban forest managers in a difficult position as they face the important task of managing urban natural resources with a limited scientific knowledge base from which to draw. To add to this information deficit, urban foresters are routinely faced with important resource (i.e. budget) constraints that directly impact – and even limit – urban tree management efforts (Stobbart & Johnston, 2012).

Urban forestry in the United States

The United States Department of Agriculture – Forest Service (USDA FS) is the main federal agency responsible for administering the national urban and community forestry (UCF) assistance programme (Hauer & Johnson, 2008). USDA FS involvement in state-wide urban and community forestry formally commenced with the 1978 Cooperative Forestry Assistance Act. The Federal Farm Bill of 1990 substantively increased federal support for the UCF programme, at the state level (Hauer & Johnson, 2008), to the point where these federal resources have now become a critical component of urban forest management in the US. In 2011, the UCF programme provided technical and financial support to 7171 communities throughout each of the 50 states, the District of Columbia, US Territories and affiliated Pacific Island nations, reaching over 194 million residents (USDA FS, n.d.). To receive this federal funding, states must address four critical components as a basis for successful urban forest management, including (i) staffing an urban and community forestry programme coordinator (ii) coordinating volunteers/partner participants (iii) establishing an urban and community forestry council (iv) creating a 5-year strategic urban forestry plan (Hauer & Johnson, 2008).

Tree wardens and urban forestry in Massachusetts

In Massachusetts, the Department of Conservation and Recreation (DCR) administers the urban and community forestry programme (Rines, Kane, Dennis, & Ryan, 2010). The state urban forestry coordinator and staff work in direct cooperation with municipal tree wardens. The position of "tree warden" was first established in the US by the Massachusetts legislature

in 1896 (Ricard & Bloniarz, 2006; Ricard & Dreyer, 2005), where it was mandated that every town in Massachusetts must employ a tree warden (Rines et al., 2010). To this day, this position remains unique to the six states – Rhode Island, Connecticut, Massachusetts, Vermont, New Hampshire, Maine – that comprise the New England region of the US (Ricard & Bloniarz, 2006). Tree wardens are most appropriately identified as the local individuals with the "greatest responsibility" for the preservation and stewardship of public trees in municipalities (Ricard, 2005b) of Massachusetts, and other New England states (Ricard, 2005a). According to Ricard and Dreyer (2005) the

> "…municipal tree warden is arguably the most important human component of a city or town's community forestry program." A municipality "cannot conduct an effective community forestry program without the participation, perhaps even the leadership, of a well-qualified, active tree warden."

Since 2000, several research efforts have gathered information from, and about, Massachusetts tree wardens (Doherty et al., 2000; Rines et al., 2010; Rines, Kane, Kittredge, Ryan, & Butler, 2011), as well as tree wardens in neighbouring New England states (Ricard, 2005a, 2005b; Ricard & Bloniarz, 2006). Pioneering and insightful, these studies helped to establish an important baseline understanding related to the overall challenges and critical issues related to the position of tree warden. What previous studies have not attempted, however, is to "understand the world" from the tree warden's "point of view" using in-person, qualitative research interviews (Brinkmann & Kvale, 2015).

Qualitative research interviews

Interviews are employed in many sectors, including the social sciences, to supply detailed knowledge from individuals that are usually recognized experts in their field, concerning a specific topic (Elmendorf & Luloff, 2007). Interviewing may be regarded as a distinctive procedure that incorporates technique and skill, aimed at generating knowledge through the context of a social practice (Brinkmann & Kvale, 2015). Interviews that take place in a face-to-face setting may facilitate extended dialogue, spontaneity, and the discovery of underlying thoughts and emotions that may not otherwise be uncovered (Holloway & Galvin, 2017). Interview methodologies may range from being highly structured with detailed questions and topics to be covered, to being open and unstructured. Between these extremes is the semi-structured interview that according to Brinkmann and Kvale (2015),

> seeks to obtain descriptions of the life world of the interviewee with respect to interpreting the meaning of the described phenomena; it has a sequence of themes to be covered as well as some suggested questions. At the same time, there is openness to change of sequence and forms of questions in order to follow up on the specific answers given and the stories told by subjects.

Previous literature

Journals regularly featuring urban forestry-related content (Arboriculture and Urban Forestry, Urban Forestry and Urban Greening, Journal of Forestry, Northern Journal of Applied Forestry) were searched for published studies concerning Massachusetts tree wardens and tree wardens in New England states. Due to the specificity of the topic-matter, six studies were closely examined (Doherty, Ryan, & Bloniarz, 2000; Ricard, 2005a, 2005b; Ricard & Bloniarz, 2006;

Rines et al., 2010, 2011) for direct, local comparison to findings in this study. Other manuscripts were referenced for purposes of broader contrast and discussion.

In this study, we (1) explored the responsibilities and emergent challenges of Massachusetts tree wardens in a naturalistic (i.e. in-person, *in situ*) manner (Gillham, 2005) using a series of closed and open-ended semi-structured interview questions developed around pre-determined themes of interest, with participatory input from urban forestry specialists, (2) contrasted these findings with the existing literature to provide comparative contemporary context for the position of tree warden in the Commonwealth of Massachusetts.

Materials and methods

We employed a qualitative data collection and analysis approach, utilising data generated from semi-structured interviews with Massachusetts tree wardens.

Survey instrument and data collection

During the spring of 2013 an eight-question interview instrument (see Table 1) was constructed in a participatory manner, with input from academic and agency urban forestry specialists, and trialled (Dampier, Harper, Schwartzberg, & Lemelin, 2015). Interview candidates were selected in a purposive manner (Lemelin, Dampier, Harper, Bowles, & Balika, 2017), based on the following criteria:

(a) They would be able to provide expert knowledge regarding the functions and responsibilities associated with the position of tree warden,
(b) They would be in a position to provide expert input concerning the management of urban trees in Massachusetts,
(c) They were accessible and responsive to being interviewed and an in-person visitation.

The total number of interviews to be conducted was determined by the point at which "no new analytical insights" were "forthcoming" (Ritchie & Lewis, 2003), and the point at which a broad-based sampling of tree wardens had been obtained from across Massachusetts. It was determined that these requirements would likely be satisfied after obtaining 50 interviews with tree wardens in their respective communities.

From the autumn of 2013, through the spring of 2016, 50 interviews of active tree wardens were carried out in a naturalistic manner, from select municipalities throughout Massachusetts

Table 1. Interview questions and predetermined themes.

Question	Pre-determined Theme
(1) What best describes the position of Tree Warden in your community and how long have you occupied this position?	Position Structure
(2) Highlight the essential resources (staff, technical equipment, etc.) you have to help you do your job?	Occupational Resources
(3) What sort of groups (i.e. organisations, municipal departments) do you interact with regarding community tree-related issues?	Organisational Interactions
(4) Are you currently monitoring for pest-related problems?	Monitoring for Pests
(5) What are three educational/training needs?	Educational Needs
(6) How could this information best be disseminated to you?	Information Delivery
(7) What time of the year is training or programmatic information best made available?	Timing
(8) Would you be willing to share any of your local success stories with others?	Sharing Successes

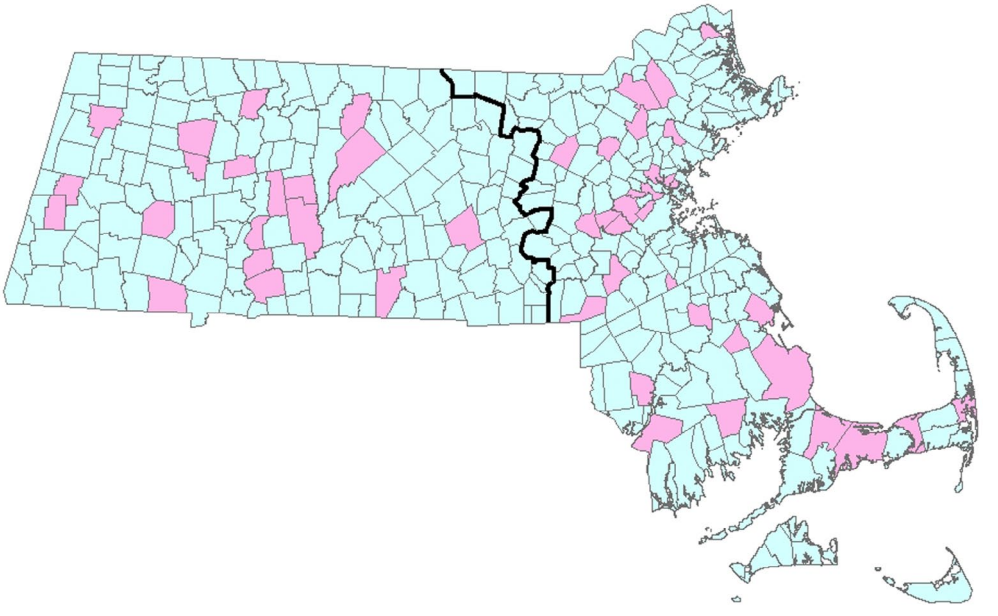

Figure 1. Representation of tree warden interviews by town. Note distinct "Western-Central" and "Eastern" regions of the state, as categorised by the Massachusetts Department of Conservation and Recreation's urban and community forestry programme.

(see Table 1). Appointments with the first author (RH) were scheduled with the respective tree warden, and a single interview typically took 15–30 min to complete. On the occasion where the tree warden was not available for a face-to-face meeting, the interview was conducted over the phone. Community visitations typically involved a post-interview tour of the municipality where specific urban trees, parks and green spaces were explored and discussed (see Figure 1).

To obtain a representative sample, tree wardens were selected from larger, more urbanised communities as well as smaller, less densely populated, rural communities. We adhered to the DCR's urban and community forestry programme delineation of central-western Massachusetts (Worcester County west) and eastern Massachusetts (east of Worcester County). Thus, interviews were carried out with tree wardens in communities throughout both regions of the Commonwealth (see Table 2).

Analysis

Field notes that had been taken during each of the interviews (Brinkmann & Kvale, 2015) were reviewed and checked for accuracy before being imported into the Computer-Assisted Qualitative Data Analysis Software (CAQDAS), NVivo 11 (2015) (QSR International; Melbourne, AUS). Interview questions were developed around predetermined themes of interest, as described by Gillies, Skea, and Campbell (2014), with the participation of agency urban foresters and urban forestry academics who reviewed and commented on the interview instrument before it was utilised (see Table 2). The significance and meaning of the

Table 2. Tree wardens from the following Massachusetts municipalities were selected for semi-structured, naturalistic interviews.

Central-Western MA		Eastern MA	
Municipality	Population	Municipality	Population
Worcester	183,016	Cambridge	109,694
Springfield	153,991	Fall River	88,712
Chicopee	55,300	Newton	88,287
Amherst	37,819	Brookline	58,732
South Hadley	17,514	Plymouth	58,271
Greenfield	17,456	Medford	57,437
Belchertown	14,649	Barnstable	45,193
Athol	11,584	Everett	44,231
Sturbridge	9268	Chelsea	38,861
Lenox	5025	Watertown	34,127
Cheshire	3235	Andover	33,201
Stockbridge	1947	Natick	32,786
Ashfield	1737	Needham	28,888
Granville	1521	North Andover	28,352
Whately	1496	Wellesley	27,982
Pelham	1321	Walpole	24,070
Chester	1308	Wilmington	22,325
Petersham	1234	Acton	21,929
Goshen	1054	Sandwich	20,675
–	–	Newburyport	17,926
–	–	Duxbury	15,059
–	–	Dennis	14,207
–	–	East Bridgewater	13,794
–	–	Bedford	13,320
–	–	Lynnfield	11,596
–	–	Wrentham	10,955
–	–	Dighton	7086
–	–	Orleans	5890
–	–	Rochester	5232
–	–	Avon	4356
–	–	Plympton	2820

participant responses that related to each of these predetermined themes (i.e. interview questions) was emergent and coded to generate a thematic framework.

Coding was performed in a systematic manner where a nested noding (i.e. initial "parent" nodes, followed by "child" nodes) structure (Dampier, Lemelin, Shahi, & Luckai, 2014) was generated based on interview data, pursuant to the predetermined themes from the interview instrument. New, emergent themes that were attached to the predetermined themes from the interview instrument were corroborated using text search and word frequency counts, and were double-checked with the second author (DB). Emerging themes were considered potentially valid when they appeared at least three times. If a theme occurred on one occasion ($n = 1$), it may have been an "accident"; a theme that occurred twice ($n = 2$) was considered to have been a "coincidence" (Dampier et al., 2014). To elicit deeper meanings from interview data, a follow-up round of NVivo-based querying (i.e. a matrix coding query) was carried out comparing responses of interviewees to other factors like participant geographical location within the state, or size (i.e. population) of the community. Illustrative quotes were also selected from participants to help clarify or reinforce a potentially emergent theme, and personal communications were also included from pertinent individuals.

Results and discussion

Position structure

A majority of the 50 sources, or interviewees ($n = 26$), reported that the position of tree warden was located in, or directly affiliated with, the "department of public works (DPW)". A substantial number of sources ($n = 8$) also indicated that the position of tree warden was associated with the local "highway department". These themes are consistent with Ricard and Bloniarz (2006), who reported that tree wardens in the New England states were commonly housed in DPW (44%) and highway departments (15%). Similarly, Rines et al. (2010) found that 76% of tree wardens in Massachusetts were housed in the DPW, highway department, or another municipal office. Tree wardens interviewed in our study were also often noted associating the terms "director" ($n = 13$) or "superintendent" ($n = 11$) with their position.

Occupational resources

Emergent themes were determined from a majority of the 50 interviewees ($n = 34$) concerning access to "occupational resources" that facilitated the day-to-day duties of a tree warden. These included "chipper(s)" ($n = 21$), a "tree crew" of 2–4 individuals ($n = 28$), and "trucks" ($n = 22$) of many types including water, dump, bucket and pickup trucks. A matrix coding query comparing community sizes of population 0–10,000, 10,001–20,000 and 20,001–30,000 residents revealed an increase in the number of tree wardens ($n = 10$, 16 and 18, respectively) who identified that these resources were available, as municipal population levels increased.

This is not surprising, as a direct relationship between increasing community size and available funds for urban forest management is consistent with findings of other studies (Grado, Measells, & Grebner, 2013; Rines et al., 2010; Stobbart & Johnston, 2012; Treiman & Gartner, 2004). The direct relationship between resource availability and population size may be due to a combination of factors including an increased tax base (Miller & Bates, 1978), increased awareness of the practice of urban forestry among residents (Grado et al., 2013), and the affiliated benefits of urban trees. It may also be associated with a general trend towards greater demand for public services and the level at which they are delivered to residents (Treiman & Gartner, 2005) in more populous communities.

Organisational interactions

Emergent themes pertaining to a number of local organisations that tree wardens interacted with was discernible from a clear majority ($n = 37$) of the interview participants. Some of the organisations identified included less formalised "community organizations" ($n = 19$) comprised of residents like local "shade tree committees" ($n = 13$), "garden clubs" ($n = 6$), "conservation groups" ($n = 9$) or more traditional organisations like "municipal departments" ($n = 29$), including the "DPW" ($n = 7$), "highway department" ($n = 9$), "water department" ($n = 8$), "parks department" ($n = 5$), "planning board" ($n = 8$) and local (i.e. conservation; historical; cemetery; open-space) "commissions" ($n = 13$). A matrix coding query indicated that tree wardens in the eastern part of the state are more likely to indicate a thematically identifiable "community organization" or "municipal department" ($n = 14$ and 19 respectively) than their counterparts

in the central-western portion of the state ($n = 5$ and 10, respectively). This would align with findings from other studies since citizens in larger, more populated communities (which are more common in eastern Massachusetts) tend to be more active and organised around environmental issues like urban green spaces and trees (Treiman & Gartner, 2005) and feature a higher occurrence of advocacy groups (Rines et al., 2011).

Monitoring for pests

With the exception of one individual, every tree warden interviewed indicated that "yes" ($n = 49$), they monitor by at least periodically visually inspecting urban trees for pests. This included *Anaplophora glabripennis* Motschulsky ("ALB", $n = 31$), *Agrilus planipennis* Fairmaire ("EAB", $n = 29$), *Adelges tsugae* Annand ("HWA", $n = 17$), *Operophtera brumata* L. ("winter moth", $n = 15$), *Lymantra dispar* L. ("gypsy moth", $n = 6$), *Ophiostoma novo-ulmi* Brasier ("DED", $n = 4$). According to a matrix coding query, some insect pests were identified in relative equal frequency between tree wardens in eastern Massachusetts and central-western Massachusetts (*A. glabripennis,* $n = 17$ and 14, respectively; *A. planipennis,* $n = 14$ and 15, respectively). However, some pests were referenced to in the eastern part of the state (*L. dispar,* $n = 6$; *O. brumata,* $n = 15$), but not identified at all ($n = 0$) from tree wardens located in the central-western part of Massachusetts. It is probable that the absence of a pest from entire regions of the state (let alone a local municipality), may lead tree wardens to not concern themselves with it, as they are likely more mindful of real-time pest-related occurrences within their own local jurisdiction. Hence, since *L. dispar* and *O. brumata* have been predominantly located in the eastern part of the state at the time interviews were conducted, tree wardens in more central-western communities do not appear to as readily identify these pests as concerns (see Figure 2).

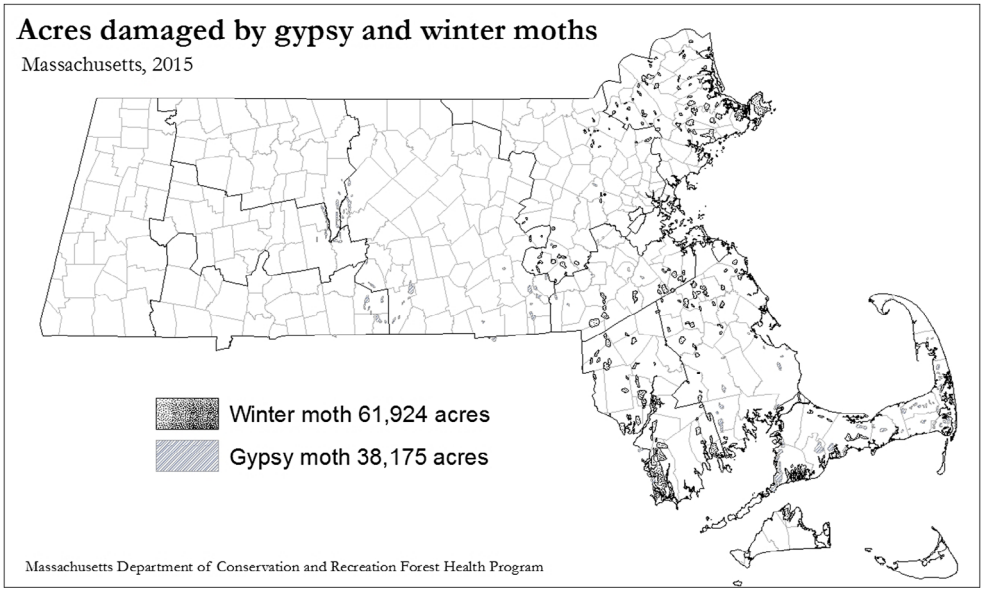

Figure 2. *L. dispar* and *O. brumata* in Massachusetts. These insect pests of importance have been typically predominant in eastern MA.

The high level of responses from the interview sources affirming that they monitor for urban forest pests is of interest. Though there are numerous other illuminating studies about tree wardens in Massachusetts and the New England region (Doherty et al., 2000; Ricard, 2005a, 2005b; Ricard & Bloniarz, 2006; Rines et al., 2010, 2011), there is a dearth of information concerning pest-related activities. According to Raymond Rose, Town of Wrentham tree warden,

"we used to have a full-time tree crew and a bigger budget when we were dealing with Dutch elm disease in the 1970s".

It would seem that urban forest pest issues affected not only resources ascribed to the community tree budget, but impacted the daily duties of municipal forestry staff, as individuals were presumably dedicated to the full-time removal of large numbers of trees that succumbed to pests like the aforementioned *O. novo-ulmi* in at least some Massachusetts communities. Currently, *Fraxinus* spp. comprise 5% of the urban street tree populations in Massachusetts (Cumming et al., 2006), but with the recent discovery of *A. planipennis*, an abundance of biomass will be locally generated in communities as these trees die. Hence, the subject of urban forest health and its impact on tree warden activities is timely and worthy of further examination.

Training, educational needs

Interview data in relation to "training and educational needs" (question 5) of tree wardens was disparate, however, nearly half of the participants ($n = 24$) indicated thematically identifiable subject matter including the desire for more information concerning urban forest "pests" ($n = 12$), urban forest "inventories" ($n = 4$) and urban "tree planting" ($n = 4$). These themes were generally not surprising as the University of Massachusetts Extension Plant Diagnostic Lab "regularly" receives questions about urban forest pest management (Dr. N. Brazee, University of Massachusetts Diagnostic Lab Director, pers. comm.) from urban forest practitioners. The DCR urban and community forestry programme "frequently" receives questions concerning the various perspectives related to urban tree planting, and also "very often" receives inquiries concerning the conducting of an urban forest inventory (M. Freilicher, DCR Urban & Community Forestry Programme, pers. comm.). Tree wardens also broadly identified the need for more information concerning "safety" ($n = 13$) with two affiliated sub-themes arising, including "electrical hazard awareness training" (i.e. EHAP)' ($n = 3$) and "hazard or risk trees" ($n = 3$). The somewhat lesser frequency regarding the occurrence of these two themes was intriguing. Electrical-related fatalities have been historically responsible for a substantial percentage (around 25%–30%) of overall fatalities in the tree care industry, though rates have been dropping in recent years (Gerstenberger, 2015). Furthermore, the topic of hazard, or risk trees, has received much attention as the issue of public safety and liability has escalated, and since the International Society of Arboriculture (ISA) released its *Tree Risk Assessment Qualification* (TRAQ) in 2011. Additionally, Ricard and Bloniarz (2006) concluded that tree wardens spend "most" of their time on activities like risk tree assessment and removal. The importance of this topic was also determined by Rines et al. (2010), who found that almost "all" tree wardens indicated that "removal of dead and hazard trees" was a "moderate or high" priority issue in their respective community. Our urban forests continue to age and decline, and nationwide the US is losing an estimated 4,000,000 urban trees per year (Nowak & Greenfield, 2012), hence the issue of hazard – or risk – trees is likely to continue

to be of increasing relevance to tree wardens. It is curious as to why this issue was not identified with more emphasis, and this would indeed be a topic worthy of further research.

Information delivery

Nearly all of the source responses concerning educational "information delivery" mechanism could be thematically categorised ($n = 46$). Over half of tree wardens responded that "electronic" media ($n = 27$) was an acceptable information delivery technique with a substantial number ($n = 19$) specifically indicating that a "web-based" format would be adequate. Over half of the tree wardens ($n = 31$) indicated that "in-person" delivery was also an acceptable mechanism for information exchange, specifically if the interaction was "local" ($n = 8$) and comprised of a "meeting" ($n = 6$) or "programme" ($n = 8$). A matrix coding query relating interviewees to geographic location indicated that tree wardens in the eastern part of the state emphasised the need for a mix between "electronic"-based materials and "in-person" information exchange ($n = 21$ and 17, respectively), but that tree wardens in the central-western part of the state indicated more of an emphasis on "in-person" information exchange ($n = 14$), compared to "electronic" based educational materials ($n = 6$). This may relate to previous statements and findings from other studies, concerning community size and resource availability. Since central-western Massachusetts is composed of smaller, more rural communities and full-time tree wardens tend to be located in larger, more populated communities (Rines et al., 2010), those in the central-western portion of the state are more likely to operate on smaller budgets, respond reactively to tree-related issues and be less likely to

Figure 3. Tree warden Alex Sherman instructs urban tree planting volunteers about planting a bare root specimen, Springfield, MA. Image © Richard W. Harper. Reproduced with permission.

Figure 4. Tree warden Dave Lefcourt demonstrates planting a balled and burlap urban tree with municipal employees in Newburyport, MA. Image © Richard W. Harper. Reproduced with permission.

have access to the infrastructure and resources that facilitate proactive urban forest management, including the Internet (A. Snow, tree warden – Town of Amherst, pers. comm.). As Melissa LeVangie, tree warden from the central-western Massachusetts Town of Petersham indicated concerning the transfer of educational information,

"person-to-person interaction is key … web-based methods should be used to complement any information gaps along the way".

This corroborates Ricard and Bloniarz (2006), who determined that tree wardens find interactions with other tree wardens and in-person attendance at more formal educational seminars to be highly valuable.

Timing (of programme delivery)

Tree wardens indicated that "spring" was the least popular time of the year to engage in educational or training activities ($n = 2$) followed by "fall"[autumn] ($n = 8$). On the other hand, "winter" ($n = 15$) and "summer" ($n = 14$), were identified as more appropriate times of the year to engage in professional development. This may be due to a number of factors, including the time commitment required by tree wardens that are involved with tasks associated with the commencement and close of the growing season, like spring and/or autumn tree planting (D. Lefcourt, tree warden – City of Cambridge, pers. comm.) (see Figures 3 and 4).

Since the position of tree warden is not a traditionally recognised, formal profession, priorities associated with the position may vary considerably from municipality to municipality based on a community's individual urban forest priorities (Ricard & Bloniarz, 2006). Overall, tree wardens expressed that they interact with a wide number of community organisations (see Figures 5 and 6), and municipal departments on a routine basis. Of further interest in this vein is the relationship between the local tree warden and the local utility (Doherty et al., 2000). Since it is estimated that street trees that are in the vicinity of utility lines are estimated to comprise 50% of the public urban forest (Moll, 1989), this is a notable relationship. The interaction between tree wardens and the utility provider was identifiable ($n = 8$) throughout responses in the interview questionnaire. According to Aggie Tuden, tree warden from the City of Medford,

"…our relationship with the utility company is an important and mutually beneficial one".

Additionally, according to Warren Archey, tree warden in the Town of Lennox,

"I have enjoyed a close relationship with the utility forester for many years".

Figure 5. Tree wardens regularly interact with local organisations interested in community beautification. Image © Richard W. Harper. Reproduced with permission.

Figure 6. Tree warden Alan Snow leads students on a community tree walk, Amherst, MA. Image © Richard W. Harper. Reproduced with permission.

Thus, it is apparent that a successful tree warden should have the capacity to effectively communicate with a wide number of individuals and organisations in their respective communities (Rines et al., 2010, 2011), including their utility partners (Doherty et al., 2000). And a successful tree warden should also have the capacity to embrace the dynamic state of their position, being able to balance a number of priorities that are subject to change, based on needs and occurrences in their local jurisdiction.

Conclusion

Though there is variation within Massachusetts communities, tree wardens are generally housed in a municipal department, like public works or the highway department, often in a senior management capacity. As the size of the community increases, the local tree warden typically has access to a larger pool of available resources; to successfully employ these resources to manage public shade trees, they often need to be able to interact with a wide range of local municipal departments, commissions and citizen volunteer groups. Tree wardens expressed the desire to receive continuing education, either in-person or web-based, preferably in the summer or winter months. Training content may vary widely but should include information pertaining to urban forest pest management, community tree inventories and urban tree planting. Nearly all tree wardens interviewed indicated that they routinely monitor for urban forest pests. Many of these urban forest priorities are worthy of further research, and the dynamic nature of the position of tree warden necessitates routine visitation, to assess training needs and priorities of these individuals who strive to preserve

and protect both public trees and public safety throughout the Commonwealth of Massachusetts.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Richard W. Harper is an extension assistant professor of Urban and Community Forestry in the Department of Environmental Conservation, University of Massachusetts, Amherst, MA. He administers a broad-based applied integrated research and extension programme aimed at addressing both emergent and long-term needs of urban forest managers. He currently teaches courses in urban forest management and urban plant health care.

David V. Bloniarz is a faculty member at the University of Massachusetts, Amherst. His primary work involves technology transfer and research initiatives related to urban natural resource structure, function and value. He works on the development of new tools and technologies that can be utilised by planners, managers and researchers, which are the primary focuses of the work undertaken by the Urban Natural Resources Institute (UNRI), where Bloniarz serves as its project director.

Stephen DeStefano is the leader of the U. S. Geological Survey's Massachusetts Cooperative Fish and Wildlife Research Unit, and a research professor in the Department of Environmental Conservation, University of Massachusetts, Amherst. He has worked on a variety of wildlife species and topics related to population dynamics, habitat relationships and wildlife–human interactions, with a focus on the influence of anthropogenic factors (development, disturbance) on wildlife and landscape conservation.

Craig R. Nicolson is a lecturer in the Department of Environmental Conservation, University of Massachusetts, Amherst. He studies the sustainability of ecological-social systems, addressing questions relating to how ecosystems change through time, and how people interact with natural resources. He predominantly works in two domains: sustainable urban systems, and water resource management, in collaboration with teams of scientists and stakeholders to develop holistic understandings of complex system dynamics.

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