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Human Dimensions of Roadside Forest Management to Reduce Utility Infrastructure Vulnerability

Danielle Proulx Kloster

University of Connecticut, 2020

During major storm events in 2011 and 2012 (Tropical Storm Irene, Storm Alfred, Hurricane Sandy), approximately 90% of power outages in Connecticut were caused by falling trees or limbs. The storms brought attention to the vulnerability of utility infrastructure and, in response, more focus was placed on vegetation management. People play a role in each step of the vegetation management process: government and utility officials planning for infrastructure resilience, tree crews conducting the management, and property owners mediating management by consenting or objecting to proposed tree pruning and removal. My research explored the human dimensions of roadside vegetation management.

Media coverage of storms can provide context for government and public response. I analyzed the gatekeeping, agenda setting, and framing roles of the *New York Times* and local newspapers when covering storm-related power outages. Government and utility officials focused on structural, large-scale solutions, while residents and businesses focused more on individual actions. Additionally, *The New York Times* featured residents' perspectives more frequently than did local newspapers, which influenced framing of storm impacts and solutions suggested.

In response to the storms, utility companies expanded vegetation management efforts, which generated large quantities of wood. Disposal of wood from utility vegetation management can be costly. I interviewed utility-contracted tree crews to explore opportunities for a wood recovery program as related to utility vegetation management. While participants had positive

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attitudes toward such a program, potential issues were identified, including the time required, safety concerns, and physical obstacles. Results suggested that wood recovery could be effective for reducing wood waste and providing community benefits, particularly in urban areas.

Utility vegetation management is mediated by property owners' decisions to consent or object to tree pruning or removals, which may be influenced by perceived tree amenities and disamenities. I conducted semi-structured interviews with homeowners who had consented or objected to a utility tree removal between 2014 and 2017. Participants most often identified attractiveness, shade, and privacy as amenities, and risk to power lines, trees being dead or diseased, and risk to people as disamenities. These perceptions played a role in participants' decision-making about utility vegetation management.

Human Dimensions of Roadside Forest Management to Reduce Utility Infrastructure Vulnerability

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B.S., State University of New York College of Environmental Science and Forestry, **2012**

M.S., State University of New York College of Environmental Science and Forestry, **2014**

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APPROVAL PAGE

Doctor of Philosophy Dissertation

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INTRODUCTION

Throughout history, humans have relied on forests for aesthetic, cultural, spiritual, provisional, and other services (Nature Communications, 2018). Trees and woods in close proximity to where people live – the residential forest (Kendra & Hull, 2005) – provide many benefits to communities, including improved environmental quality, higher property values, health benefits, and attractive aesthetics (Ulrich, 1979; Dwyer et al., 1992; Kweon et al., 1998; Thompson et al., 1999; Nowak & Dwyer, 2007; Donovan & Butry, 2010; van den Berg et al., 2010). Conversely, these trees can also impose disamenities on communities. Disamenities (i.e., structures and functions of ecosystems negative to human well-being; Lyytimäki & Sipilä, 2009) of trees in residential areas can include allergens, leaf debris, and maintenance costs (Lyytimäki & Sipilä, 2009; Escobedo et al., 2011; Kirkpatrick et al., 2013; Kitchen, 2013; Dobbs et al., 2014; Delshammar et al., 2015; Lyytimäki, 2015; Conway & Yip, 2016).

One disamenity of trees is the potential risk to power lines and other infrastructure. Several major storms in 2011 and 2012 led to widespread power outages through the northeastern United States (U.S.), including the state of Connecticut. In 2011, Tropical Storm Irene and Storm Alfred, an atypical winter storm, both caused extensive damage to trees in New York and New England, many of which fell on adjacent power infrastructure. The following year, Hurricane Sandy generated coastal flooding in New York City and along the Connecticut coast, which damaged electrical equipment and flooded substations. As a result, the New York metropolitan area experienced prolonged power outages. During these storm events, approximately 90% of power outages in Connecticut were caused by falling trees or tree limbs (McGee et al., 2012). In response, utility companies in Connecticut intensified vegetation management efforts to mitigate future vulnerability. Vegetation management involves many

different stakeholders that can influence how management takes place and, as a result, shapes the residential forest. Media coverage of storm-related power outages can drive public and private response and, in turn, government and utility officials plan for infrastructure resilience. Tree crews are responsible for conducting tree pruning and removals, while individual homeowners and landowners mediate management by consenting or objecting to pruning and removals. My research explored some of the human dimensions of roadside vegetation management.

The storms of 2011 and 2012 brought attention to the vulnerability of utility infrastructure in the region, particularly in anticipation of increased storm intensity in the future (Coumou & Rahmstorf, 2012; Min et al., 2011). In this way, the storms acted as focusing events (i.e., instances of sudden and rare damages affecting a specific area; Birkland, 1998). Media coverage of focusing events like these storms can influence the public response and government policy decisions (Spencer & Triche, 1994; Birkland, 1998; Ashlin & Ladle, 2007; Miles & Morse, 2007; Bohensky & Leitch, 2014; Nelson et al., 2015).

In my first chapter, I evaluated how the media covered the perceptions of different stakeholder groups related to storm damage to power infrastructure, and ways to address the damage. Specifically, I assessed media coverage of storm-related power outages in the northeastern United States (U.S.) from 2010 to 2014, the time period surrounding the major storms of 2011 and 2012. I investigated how media coverage featured different stakeholder groups, portrayed causes of outages, framed responsibility for outages, and suggested solutions to power infrastructure vulnerability.

In response to the storms, the two main utility companies in Connecticut – Eversource Energy and The United Illuminating Company (UI) – began widespread enhanced tree trimming (ETT) practices, which is the clearance of trees or tree limbs within eight feet of either side of

the power lines from ground to sky (Eversource, 2019). This vegetation management practice generates large quantities of wood from the roadside trees that are pruned or removed. Some of the wood is used as firewood or mulch by property owners and other end-users, but the remainder must be disposed of by utility companies and their contracted arborists (Fratanduono et al., 2013). This cost of disposal could be viewed as a disamenity of trees after removal, but potential exists for trees to continue to provide amenities in the form of wood products (Bratkovitch, 2001; Bratkovitch, 2014). As a result, there is interest from the utility companies, as well as municipalities, to explore opportunities for wood recovery that would minimize waste and disposal costs and generate benefits for the community (Donnelly & Doria, 2014). UI and the Town of North Haven, CT, initiated a wood product recovery pilot program in 2015. My second chapter used the context of this pilot program to evaluate the perceptions and experiences of utility-contracted tree crews regarding a wood recovery program, including the perspectives of crews involved in the pilot program and crews not engaged in wood recovery efforts.

In managing the roadside forest, utility companies and communities must balance between the amenities provided by trees and the disamenities imposed on the community (State Vegetation Management Task Force, 2012). Utility vegetation management is largely mediated by property owners who can consent or object to planned pruning and removal operations. Thus, it is important for managers to understand how residents perceive the amenities and disamenities of their trees and how those perceptions influence their decision-making about tree pruning and removal. In my third chapter, I assessed the amenities and disamenities of roadside trees that residents identified as important, and how residents made decisions to consent or object to utility tree removals on their property, using the Means-End Chain theory as a theoretical framework.

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CHAPTER ONE: A NATIONAL AND LOCAL MEDIA PERSPECTIVE ON RESPONSIBILITY FOR AND SOLUTIONS TO STORM-RELATED POWER OUTAGES IN THE NORTHEASTERN UNITED STATES

Abstract

Major storms in the northeastern United States in 2011 and 2012 caused widespread power outages, bringing attention to the vulnerability of utility infrastructure as a result of extreme weather and environmental change. Media coverage of such focusing events provides context for and can affect government and public response. My objective was to analyze gatekeeping, agenda setting, and framing in the New York Times (NYT) and local newspapers covering power outages related to large storm events in 2011 and 2012 (Tropical Storm Irene, October snowstorm, Hurricane Sandy). Government and utility officials focused on structural solutions to mitigate future storm impacts, whereas residents and businesses targeted individual actions. NYT interviews included residents more frequently than local newspapers, influencing coverage of impacts and solutions. Geographic differences between NYT and local newspapers' foci may relate to coverage of solutions to and responsibility for outages. My findings demonstrate the importance of collective action toward shared solutions.

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Introduction

Environmental changes are suspected to be contributing to intensification of storms in the northeastern United States (U.S.) (Coumou & Rahmstorf, 2012; Min et al., 2011) that result in widespread power outages. In August 2011, Tropical Storm Irene caused extensive power outages throughout New York and New England. Two months later, an atypical winter storm, Storm Alfred (i.e., 'the October Snowstorm'), resulted in heavy snow reaching depths of two feet in some parts of Connecticut and Massachusetts. This early snowstorm occurred while leaves were still on the trees. As a result, the weight of the snow exacerbated damage to trees, many of which fell on adjacent power infrastructure. In October 2012, Hurricane Sandy caused coastal flooding, which damaged electrical equipment and substations in flooded areas and led to prolonged power outages in the New York metropolitan area. High winds caused damage further inland from Ohio to Maine.

These storms were focusing events (Birkland, 1998), which brought media attention to the vulnerability of utility infrastructure in anticipation of environmental change and increased storm intensity (Coumou & Rahmstorf, 2012; Min et al., 2011). Focusing events are instances of sudden and relatively rare damages that affect a specific geographic area (e.g., natural disasters or industrial accidents; Birkland, 1998). In response to focusing events, media coverage serves as one element among a complex set of factors that influence societal response to storms. The media can influence public policy and personal decision-making in several ways, including through gatekeeping, agenda setting, and framing (Ashlin & Ladle, 2007; Bohensky & Leitch, 2014; Miles & Morse, 2007; Nelson et al., 2015; Spencer & Triche, 1994). As a gatekeeper, the media determines which stories and whose voices are heard (Dispensa & Brulle, 2003; Driedger, 2007). Through agenda setting, the media brings certain issues and events to the attention of the

audience (McCombs & Shaw, 1972; Scheufele, 2000; Scheufele & Tewksbury, 2007). By framing, the media filters information and emphasizes certain aspects of events or issues to highlight those aspects in coverage (McCombs & Shaw, 1972; Scheufele, 2000; Scheufele & Tewksbury, 2007). Through these three roles, media portrayal of environmental focusing events can influence public perceptions and spending priorities for recovery and mitigation efforts (Ashlin & Ladle, 2007; Miles & Morse, 2007; Spencer & Triche, 1994), which may then affect how society experiences future natural hazards (Miles & Morse, 2007). Therefore, understanding media coverage of storm-related power outages could provide context for the societal actions following storms, as well as future experiences of storm-related power outages in the region.

The objective of this study was to evaluate the media coverage of storm-related power outages in the northeastern U.S. in relation to three major storm events of 2011 and 2012 (i.e., Tropical Storm Irene, Storm Alfred, Hurricane Sandy). I assessed three aspects of media coverage, representing the three aforementioned roles of the media: (1) which voices were represented (gatekeeping); (2) what solutions to power outages were mentioned (agenda setting); and, (3) who or what was considered responsible for power outages (framing).

(Q1) Whose voices are included in media coverage of storm-related power outages?

The media acts as a gatekeeper in determining which stakeholders are included in coverage (Dispensa & Brulle, 2003; Driedger, 2007). Previous media analyses have found a range of coverage of different stakeholders' voices and opinions. Sonnett et al. (2006) posited that "official" sources of information, including government, industry, and experts (e.g., scientists, analysts), are included most frequently in media coverage of environmental risks, whereas the general public is often absent from coverage. Past research has found that the general public is typically missing from media coverage except as an implied audience (Cottle,

2000; Hornmoen, 2009). Although one study found experts to be a dominating voice (Jönsson, 2011), elsewhere, coverage of experts is often minimal (Nelson et al., 2015; Morehouse & Sonnett, 2010). Based on these studies, I hypothesized that government and utility officials would be the dominant voices in media coverage of storm-related power outages, followed by experts and members of the general public.

(Q2) What solutions to the problem of power outages are offered by stakeholders represented in coverage?

In agenda setting, media coverage draws certain issues and events to the attention of readers (McCombs & Shaw, 1972; Scheufele, 2000; Scheufele & Tewksbury, 2007). For example, the media presents a range of potential solutions to environmental risks (e.g., power outages), which may then be relevant for decision-makers in the future (Scheufele & Tewksbury, 2007). Nelson et al. (2015) found that discussion of solutions for an environmental hazard was dominated by government and industry officials, and focused on technological and regulatory solutions. In the same study, media coverage of technological solutions largely excluded perspectives of the general public (Nelson et al., 2015). In my case, I hypothesized that government and industry actors featured in media coverage would focus on technological and regulatory solutions to power outages. In contrast, I expected that the general public would focus on individual actions that they could take to protect themselves from future risks of power outages.

(Q3) Who or what is considered responsible for power outages?

By framing events and issues, the media can influence public perceptions by filtering information and selecting preferred attributes for emphasis (Ashlin & Ladle, 2007; Entman,

1993; Jönsson, 2011; Nelson et al., 2015; Putnam & Shoemaker, 2007). Previous research has found prevalent news frames to include conflict, human interest, and attribution of responsibility (Semetko & Valkenburg, 2001). Here, I focused on the attribution of responsibility for power outages by stakeholders, which could influence future policy for addressing storm-related power outages. Policy may be driven by the desire to hold certain parties responsible for past outages by requiring them to manage for future risks (Bohensky & Leitch, 2014). Moreover, responsibility for addressing risks is often placed with those perceived to be in a position of power with regard to the risk (Bohensky & Leitch, 2014). For example, reporters placed responsibility for managing floods on the government in coverage of the 2011 Brisbane flood in Australia (Bohensky & Leitch, 2014). In that study, the government was perceived to be in a position to provide both mitigation for and warnings about the floods (Bohensky & Leitch, 2014). I hypothesized that the general public and government officials would assign responsibility for power outages to the utility companies because utility companies are most directly in a position to address outages. In turn, I expected utility companies to hold other parties (e.g., the government) responsible as a means to reduce their own responsibility.

Methods

Dataset

Past research suggests that print news is preferable to televised news for content analysis because it provides similar content with greater detail (Driedger, 2007). Therefore, I focused my analysis on printed news articles covering storm-related power outages in the northeastern U.S. from August 21, 2010 (one year before the formation of Tropical Storm Irene) to November 2, 2014 (two years after the dissipation of Hurricane Sandy). This time frame allowed me to assess how power outages were covered by the media prior to the major storms in the region, as well as

how the impacts of those major storms were covered following the events. For the purposes of this study, the northeastern U.S. included New York, New Jersey, and the New England states. The *New York Times* (NYT) was selected because of its national and international stature, and because it is based in the region of interest. In 2013, the NYT ranked second in the United States and 18th in the world for newspaper circulation (World Association of Newspapers and News Publishers, 2014).

To evaluate media coverage of storm-related power outages, I used the LexisNexis database of newspaper articles to find articles published in the NYT containing the keywords "power" and "storm*." The asterisk indicates that the search was for all words starting with "storm," allowing articles that referred to "storms" to be included in the search results. To allow comparison of local and national news coverage, a second LexisNexis search was conducted of articles from local newspapers from throughout the northeastern U.S. using the same criteria. A total of 23 newspapers based within the study area emerged in the sample from the LexisNexis database. Articles were removed from the sample if they were not about storms and power outages, or were about regions other than the northeastern U.S. I excluded blogs from the sample to limit the scope to printed news articles.

Content Analysis and Coding

Content analysis was used to extract and interpret meaning from media discourse (Hseih & Shannon, 2005). A coding frame (Hseih & Shannon, 2005) was created for five categories of interest, with key terms derived from the text (Table 1). For coding verification, 20 randomly selected articles were coded independently by Anita Morzillo and me; we then discussed

discrepancies in coding. The coding frame was revised based on these discussions and the consistency check was repeated. I then coded all articles.

The content of each article was evaluated quantitatively to determine the degree of focus on power outages, and which voices, impacts, and proximate causes (i.e., mechanisms by which power outages occurred) of power outages were included in the articles. Articles were coded for frequency of mention of power outages (1 = once, 2 = two or three times, 3 = more than three times). Categories 2 and 3 were included in the analysis presented in this paper. Category 1 was excluded because these articles mentioned power outages only in passing (e.g., "8.5 million people were left without power" is the only reference to power outages in "Hurricane's Downgrade Undercut Warnings, Report Finds," *The New York Times*, 13 February 2013). To determine whose voices were covered in the articles, I coded presence or absence of a quote from each stakeholder group for each article (Table 1). I also coded for the mention of impacts of power outages and downed trees, and the proximate cause of the power outages, if indicated (i.e., flooding, trees, wind, etc.; Table 1). In cases where more than one cause was identified, all causes were recorded. Although frequency is often used as a metric for impact and importance in media content analysis (Nelson et al., 2015), I acknowledge that the assumption of frequency as a direct measure of impact and importance is limited. I used qualitative analysis to identify emergent themes (Neuman, 2006) in how different groups (e.g., the general public, government officials, utility officials) assigned responsibility and identified solutions for power outages and delays in power restoration after storms. In some cases, these themes may relate to the perceived ultimate causes of power outages (e.g., inadequate preparation by government or utility officials) by the different groups. I conducted a coding consistency check and provided quotations to

support identified themes in order to mitigate risk of researcher bias common with such analyses (Matthes & Kohring, 2008).

Results

The initial LexisNexis search of the NYT articles yielded 2518 articles, excluding blogs and articles that were very similar to others included in the sample. After removing articles that did not meet sampling criteria (see methods), 547 articles remained. The companion search of local newspapers generated 258 articles; 120 met sampling criteria. After removing Category 1 articles (see methods) the final sample included 313 articles from the NYT and 116 articles from local newspapers. In the NYT, Hurricane Sandy received the most coverage (65.2% of articles; Table 2). Conversely, local papers covered Tropical Storm Irene more than any other storm (19.8% of articles). More articles in local newspapers were about multiple or unspecified storms (44.8%) than about a single storm.

In both sets of articles, transportation impacts received the greatest coverage (13.1% of NYT articles and 8.6% of local news articles, Figure 1). These impacts included trees or power lines blocking roads or railroad lines, power failures preventing trains and subways from running, and traffic signal failures. The next most frequently mentioned impacts were those related to health and safety (10.9% of NYT articles and 6.0% of local paper articles), including refrigeration and availability of medication, and injury or death resulting from falling trees and power lines. Although the impacts that received the most coverage were mirrored in local and national coverage, impacts of storm-related power outages as a whole received less coverage in local news articles (Figure 1). Impacts mentioned in the NYT but not local newspapers included

school closings, communication issues (e.g., loss of cell phone network and internet access), impacts on voting in the 2012 national elections, and crime.

(Q1) Whose voices are included in media coverage of storm-related power outages?

In the NYT, government officials received the most coverage of any stakeholder group (63.9% of articles) (Figure 2), supporting my first hypothesis. However, contrary to my hypothesis, residents were featured in about half the NYT articles (49.8%), and more frequently than utility officials (35.5%). In local papers, both government officials and utility officials received coverage in the majority of articles (61.2 and 73.3%, respectively), while residents were featured in only 11.2% of local articles. As hypothesized, experts received less coverage than government and utility officials (22.0% of NYT articles; 18.1% of local articles) (Figure 2).

(Q2) What solutions to the problem of power outages are offered by stakeholders represented in coverage?

In support of my second hypothesis, government officials focused on structural solutions to address the impacts of storm-related power outages. For example, officials mentioned the importance of having backup power systems and generators, particularly in nursing homes, hospitals, public housing, and gas stations (n=32; n indicates the number of articles; Table 3). Elevating electrical equipment was also mentioned (n=8), i.e., moving individual building equipment out of basements, and substations and transformers out of flood zones. Government officials, including Governor Cuomo of New York, advocated for implementing a "smart grid" that would allow utility companies to pinpoint outage locations and restore power more quickly (n=6). Also discussed was the possibility of allocating federal funds to bury power lines (n=8). Other options included: more resilient infrastructure, standby contracts to secure equipment like

generators quickly, flood barriers around equipment, system redundancy, micro-grids, micro-generators at critical locations, backup batteries on cell towers, backup power for transit systems, distributed generation and islanding ability at critical locations, and training programs for the National Guard in power restoration. In the local newspapers, particularly in Massachusetts, government officials also discussed laws that would protect electricity consumers by imposing fines on the utility companies when their response to storms was deemed inadequate, with the revenue from those fines returned to the consumers affected by the outages (n=16).

Utility companies also focused on structural solutions as expected. In the NYT articles, the utility companies focused primarily on flood mitigation efforts, including moving transformers and substations out of basements and flood zones or making equipment submersible (i.e., designed to continue operating when inundated with water), and installing or improving flood barriers around critical equipment (n=7). In local newspapers, the focus was on trimming trees, typically with utilities clarifying that tree trimming was adequate in response to accusations to the contrary (n=13).

As hypothesized, residents and business owners focused on potential individual actions to mitigate the impact of future power outages. One common solution in both the NYT (n=18) and local (n=42) newspapers was the installation of generators to provide backup power to homes and businesses. Many businesses, particularly in Manhattan, mentioned intentions to move critical electrical equipment out of basements (n=9). Other possible solutions mentioned by businesses included solar panels, other distributed electricity generation technologies, redundant power systems, submersible transformers, and buried power lines.

Additionally, in the local newspapers, residents and government officials discussed transitioning from stakeholder-owned utility companies to municipal utilities (n=4). It was noted that municipal utilities "outperformed" private utility companies in power restoration following the major storms ("Senate wants strict rules for utilities during power outages," *Lowell Sun*, 14 February 2012).

Comparing the NYT to local newspapers, discussion of moving electrical equipment out of building basements was covered by the NYT (n=9, 4 of which were from the Metropolitan Desk, see discussion) but not local newspapers. Moving substations out of flood zones was also discussed more extensively in the NYT (n=6, 5 of which were from the Metropolitan Desk, see discussion) than local papers (n=2). Conversely, trimming trees around utility lines to minimize the risk of trees and limbs falling on the lines was mentioned in local newspapers (n=13) but not in the NYT.

(Q3) Who or what is considered responsible for power outages?

Consistent with my third hypothesis, both government officials (n=85) and residents (n=31) placed much of the responsibility for power outages on utility companies (Table 4). Utilities were accused of poor communication with local officials and consumers, lack of preparedness for storms, having too few tree crews, and management issues. Government officials also raised concerns over the utilities' lack of long-term preparation for large storms, citing crumbling infrastructure and inadequate protection for critical equipment against storms and flooding.

Utility companies stated that widespread power outages and the delay in power restoration were the result of the unprecedented scale of the storms (Table 4; n=15). Utility

officials claimed that although the utilities were as prepared as possible, it was impossible to completely prepare for these large storms due to the extent of necessary repairs. Utilities also stated that the widespread nature of the storms throughout the northeastern U.S. meant that utilities were competing with other states for contracted tree service crews. Additionally, officials cited the destruction of roads and bridges for causing delays in power restoration, as crews could not get to target locations while routes were impassable. An issue specific to the coastal area following Hurricane Sandy was the damage of household electrical equipment by floodwaters, requiring electrical inspections prior to power restoration. Utility officials stated that the widespread floodwaters slowed this process (Table 4; n=17).

The Long Island Power Authority (LIPA) also placed some of the responsibility for an inadequate response on New York's governor at the time, Andrew Cuomo (n=3). LIPA is a quasi-governmental agency to which the governor of New York is responsible for appointing board members and staff positions. LIPA officials accused the governor of leaving several positions unfilled that were crucial to storm response, and appointing board members that did not have utility experience. This issue was not mentioned in the local newspaper articles analyzed.

Two additional components of assigned responsibility were mentioned in the NYT, but were mentioned either infrequently or not mentioned in local newspapers. First, in NYT articles (n=15), utility companies explained that delays in power restoration were due to the need for household electrical and infrastructural repairs; two local newspaper articles mentioned this issue. Second, complaints from residents and disability advocates about inadequate preparation for power outages in public housing were covered only by the NYT (n=10).

Discussion

Media coverage of environmental focusing events can influence individual and collective actions in response to environmental change (Ashlin & Ladle, 2007; Bohensky & Leitch, 2014; Miles & Morse, 2007; Nelson et al., 2015; Spencer & Triche, 1994). In this study, I evaluated media coverage of storm-related power outages following major storms in 2011 and 2012 (i.e., Tropical Storm Irene, Storm Alfred, Hurricane Sandy) in the northeastern United States. In the wake of the storms, government and utility officials sought solutions to mitigate storm-related impacts. In New York, investigations led to a restructuring of the Long Island Power Authority ("Governor Cuomo's Power Play," *The New York Times,* October 31, 2014), and efforts to implement smart grids ("Money to Rebuild After Sandy," *The New York Times,* November 15, 2012). In Connecticut, the Governor commissioned a Two Storm Panel, which resulted in concerted efforts by two major utility companies to reduce outages and restoration time with a particular focus on vegetation management (McGee et al., 2012). In Massachusetts, new penalties were imposed on utilities for inadequate response to storm-related outages (220 CMR 19.00). These examples demonstrate that the storms have influenced collective actions, as discovered in other contexts (e.g., Ashlin & Ladle, 2007). To guide the discussion, I focused on three findings from the analysis: 1) differences in extent of coverage of the general public between national and local news outlets, 2) the influence of stakeholder coverage on solutions to and impacts of power outages, and 3) the influence of geographic foci of news outlets on the coverage of responsibility and solutions.

Stakeholder coverage by the media primarily focused on government officials, with less focus on experts and, in local newspapers, the general public (i.e., residents and businesses). These findings are consistent with past research (Cottle, 2000; Hornmoen, 2009; Morehouse &

Sonnett, 2010; Nelson et al., 2015). In contrast, in the NYT, I found that residents received coverage in almost half of the articles. Although assessment of factors responsible for this difference in coverage are beyond the scope of the analysis, I suggest two explanations. First, residents may have been more accessible to the NYT press than to local newspapers, particularly after Hurricane Sandy. Hurricane Sandy resulted in gas shortages that led to long lines at gas stations and in the displacement of people from homes to shelters in the New York metropolitan area. In my analysis, many of the quotations from the general public in NYT articles were obtained by reporters interviewing people in such locations. Therefore, displacement during the hurricane may have been an opportunity for the press to access people more easily. Second, local newspapers tend to have limited resources (Caburnay et al., 2003). This may lead local newspapers to rely on syndicated information and government or corporate press releases of information, which may have contributed to greater coverage of news source-related stakeholders and less coverage of the general public. As an example, elsewhere in my study, I found that 33 of the local articles (28%) cited the Associated Press, whereas 17 of the NYT articles (5%) did so (unpublished data). Therefore, these differences in inclusion do seem to have affected coverage of issues associated with storm-related power outages.

Previous studies of framing have focused on how journalists set up a storyline around natural disasters (e.g., Ashlin & Ladle, 2007; Miles & Morse, 2007; Morehouse & Sonnett, 2010; Siemer et al., 2007). However, framing depends not only on the journalists' narrative choices, but also on journalist selection and inclusion of stakeholder voices (Stallings, 1990; Sonnett et al., 2006; Nelson et al., 2015). For example, Stallings (1990) found that public officials and journalists framed the responsibility for a bridge collapse differently, such that journalists tended to seek those "highest" within political hierarchies that could be held responsible (e.g., federal

agencies), whereas public officials defended such agencies and sought to blame the errors of those "lower" in the political hierarchy (e.g., bridge inspectors). Elsewhere, Arizona newspapers quoted policy makers and water managers who expressed surprise about a regional drought, whereas New Mexico newspapers covering the same drought focused on conflict associated with an endangered fish species using quotes from activists and agriculturalists (Sonnett et al., 2006). In my study, I observed similar journalist decisions about stakeholder inclusion. For example, negative impacts received more coverage in the NYT than in local newspapers (Figure 1). Many of these impacts, particularly health and safety, and losses of heat, food, and plumbing, were described through quotations from residents explaining their experiences during and after the storms (Table 3). The greater coverage of residents in the NYT may then have contributed to the greater coverage of such impacts. Additionally, solutions such as moving electrical equipment out of basements and substations out of flood zones, mentioned more frequently in the NYT than in local newspapers, often were highlighted using quotes from business owners, who received more coverage in the NYT.

The coverage of the solutions to and responsibility for storm-related power outages may have been related to discrepancies in geographic foci between the NYT and local newspapers. In my analysis, the main geographic focus of the NYT was New York City (NYC) and surrounding coastal areas (e.g., Long Island). In the NYT, utility officials emphasized delays caused by the need for electricians to check on equipment damaged by flooding. This problem was unique to NYC and the coastal region, where most of the power outages and damage to many homes was attributed to flooding. Coverage of LIPA assigning responsibility to the state government was exclusive to the NYT, possibly because of the geographic focus on Long Island where LIPA operates. Conversely, tree trimming around power lines to reduce incidents of trees and limbs

falling on lines was discussed more frequently in local newspapers than in the NYT. In the broader New England region, the main geographic focus of local coverage, trees or tree limbs falling on power lines were the source of most of the storm-related power outages (McGee et al., 2012).

The position of the NYT as both a local newspaper for New York City and a national and international newspaper is a potentially confounding factor in my analysis. The geographic focus of the NYT on NYC suggests that the NYT may have been acting predominately as a local newspaper. For example, 65% of NYT articles focused on Hurricane Sandy, which had a much greater impact on NYC than the other storms (Table 2). In contrast, only 2.9% of NYT articles focused on the October snowstorm, which had greater impact outside of NYC (Table 2). It is also possible that NYC would be the focus of national coverage of storms regardless because NYC is a major U.S. and globally important city. Quotes from the general public were included in more than half of articles from both the Metropolitan Desk (59%) and the National Desk (54%), suggesting that the dual role of the NYT may have had minimal influence on the results of my analysis. Even so, future research may assess media coverage of the storms from an "outside" perspective (e.g., *Los Angeles Times*) to look for differences in agenda setting and framing. Future research may also consider the complementary role of national or international newspapers versus local newspapers. It is unclear the extent to which the NYT or similar newspapers leave purview of particular events or issues to local newspapers. The point at which a large storm event expands from local to national significance could be of interest.

My findings indicate several additional opportunities for future research. Although I provided potential explanations for why framing varied between different newspapers, it was not possible to assess causality through my methods. Future research might explore differences in

stakeholder coverage and framing between newspapers with varied target readership populations (e.g., socioeconomic status, geography, scale). As an example, Kenix (2005) found no differences in coverage of pollution in newspapers located in different cities and targeted for different socioeconomic groups. Furthermore, observed differences between national and local news coverage in my study suggested that evaluation of exclusively national and international or local and regional newspapers could result in missing important themes in coverage (e.g., solutions regarding floodwater-associated power outages covered by the NYT but not by local newspapers).

My findings demonstrate that the solutions offered in the media coverage of storm-related power outages are reflected in response actions taken by public and utility officials. Still undetermined is whether these collective actions have an impact on future regional events associated with natural hazards and environmental change. Collectively, however, media coverage of extreme weather events can demonstrate the learning process and policy implementation by governments and others to increase community resilience in response to environmental change (Bohensky & Leitch, 2014). The media coverage of power outages enunciates shared responsibility among entities and the need for collective action and clear delineation of roles toward shared solutions. For example, from this analysis, it appears that structural solutions to reduce power infrastructure vulnerability (e.g., smart grid implementation and back-up power systems for critical locations), may depend on government regulation and funding. Alternatively, proactive measures for storm recovery (e.g., tree trimming, staging and movement of tree and electrical crews, and intra-company communication) may depend on utility companies. Communication between utilities and governments and distribution of information to citizens also appear to be important roles for both governments and utilities.

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Tables

Table 1. Coding frame for quantitative content analysis of newspaper articles addressing storm-related power outages in the northeastern U.S. from August 21, 2010 to November 2, 2014.

Category of Interest	Coding Options
Storm of focus	Tropical Storm Irene
	October 2011 Snowstorm (Storm Alfred)
	Hurricane Sandy
	Other hurricanes or thunderstorms
	Other winter storms
	Tornado
	Storm not specified or multiple storms mentioned
Is climate change mentioned?	Yes
	No
Individuals quoted[a]	Resident
	Business (owner or employee in the capacity of the business)
	Government Official (e.g., politicians and agency officials)
	Utility Company
	Regulatory Agency (e.g., the Public Utilities Regulatory Authority)
	First Responders (e.g., police, fire)
	Relief Services (e.g., Red Cross)
	Tree Companies
	National Weather Service
	Scientists (e.g., meteorologists, climatologists, economists, analysts)
	Other (e.g., union officials, school officials, anyone who does not fit in other categories)
Impacts of trees and power outages	Loss of business
	Loss of food
	Loss of plumbing
	Loss of heat
	Home damage
	Recovery costs
	Transportation
	Health and safety
	Crime
	School (e.g., closings)
	Communication (e.g., phone, cable, internet)
	Elections

	Cultural or community events (*e.g.*, Halloween, weddings)
Cause of power outages	Trees
	Flooding
	Wind
	Snow
	Planned shutdown
	Fire
	Unspecified or 'the storm' in general

[a] For individuals that may have fallen into more than one category, the more specific category was used. For example, officials from the Public Utilities Regulatory Authority or the National Weather Service were categorized individually by organization, rather than in the more general category of 'government official.'

Table 2. Percentage of articles covering different storms in the New York Times and local newspaper articles related to storm-related power outages in the northeastern U.S. from August 21, 2010 to November 2, 2014 (n=313 and 116, NYT and local sources, respectively).

	Percent of Articles	
Storm	**New York Times**	**Local Newspapers**
Tropical Storm Irene	9.6	19.8
October Snowstorm	2.9	4.3
Hurricane Sandy	65.2	9.5
Other Hurricanes/Thunderstorms	2.2	8.6
Other Winter Storms	5.8	12.1
Tornado	1.0	0.9
Unspecified or Multiple Storms	13.4	44.8

Table 3. Representative quotes for solutions identified by different stakeholders in print news media coverage of storm-related power outages in the northeastern United States. Where possible, names have been removed for anonymity.

Stakeholder	Theme	Representative Quote
Government Officials	Government officials suggest having backup power (*e.g.*, generators) at critical locations like hospitals, gas stations, and public housing. (NYT n=29; local n=3)	Mayor de Blasio announced that the Federal Emergency Management Agency had given the city $108 million to install backup generators, elevated boilers and new flood-barrier systems at the Coney Island Houses, a five-building public housing project that was inundated during the storm, leaving its 1,400 residents without heat or power for 22 days. – 'Building for the Next Big Storm,' *The New York Times*, 26 October 2014
	Government officials suggest elevating equipment out of flood zones and basements. (NYT n=6; local n=2)	Officials said they were also working on long-term protections like raising or waterproofing heating and electrical equipment in the affected [public housing] developments. – 'Public Housing Residents Rely on Agency Still Recovering From Hurricane,' *The New York Times*, 30 October 2013
	Government officials suggest implementing a smart grid, micro-grids, or distributed generation and islanding. (NYT n=6; local n=0)	Mr. Cuomo also said he wanted federal money to build new oil and gas pipelines to guard against fuel shortages, and to replace the aging power grid with a so-called smart grid that would reduce energy costs and allow power companies to find and repair damages more quickly. – 'Money to Rebuild After Sandy,' *The New York Times*, 15 November 2012
	Government officials suggest burying power lines underground. (NYT n=4, local n=4)	'It seems to me that burying the wires is something that could qualify [for Hurricane Sandy recovery funds],' [the supervisor of the Town of North Hempstead] said, 'and we plan to make a strong case for that.' – 'Poles Generate Residents' Heat on Long Island,' *The New York Times*, 22 April 2014 'Should all the lines be buried underground? I love the idea,' Patrick said. 'Apparently, that's a $1 trillion project across the whole of the commonwealth. And the cost of that, how to pay for it,

		no one has answered yet.' – 'As Coakley Investigates Complaints, Patrick Says Utilities Doing Great Job,' *Lowell Sun*, 1 November 2011
	Government officials recommend imposing penalties on utilities for inadequate storm response. (NYT n=0; local n=16)	Outrage over the storm response by the major utilities has sparked a flurry of legislative proposals on Beacon Hill. The Senate this past week passed a bill that would require the major power companies to be more responsive to customers during storms, while also distributing state penalties for poor performance back to ratepayers in the form of credits. – 'You Could End Up Footing the Bill for Power Outages,' *The Berkshire Eagle*, 18 February 2012
Government Officials and Residents	Government officials and residents suggest implementing municipal utilities. (NYT n=1; local n=3)	State lawmakers are once again pushing a bill to give cities and towns the tools to form their own utilities. For nearly a century, utility companies have been given veto power over municipalities' efforts to purchase poles and wires from the existing utility and establish their own light authority. This bill would remove that veto power. 'If they have the wherewithal, let the community be the one that makes that decision,' said state Rep. _____, a Fitchburg Democrat who is sponsoring the bill. 'These investor-owned utilities are a monopoly.' – '5 Years After Ice Storm, Bitterness Hasn't thawed; Utilities Say They're Prepared,' *Lowell Sun*, 12 December 2013 Protesters even showed up last month to mark the second anniversary of the ice storm and call for the Legislature to pass a bill making it easier for communities to create their own municipal light companies. – 'Unitil Works Beyond its PR; Disaster is Ultimate Test of Confidence in Utility,' *Sunday Telegram*, 9 January 2011
Utility Officials	Utility officials suggest moving substations out of flood zones or flood-proofing critical equipment.	Consolidated Edison wants to move building transformers or make them submersible. – 'City Learns Lessons From the Storm, Many of Them the Hard Way,' *The New York Times*, 5 September 2011

	(NYT n=7; local n=0)	Most of that money [from rate increases] - $800 million - would go toward making parts of the electricity-distribution system more water-resistant: raising some equipment off the ground or surrounding it with higher floodgates and burying some overhead wires, [Consolidated Edison] said. – 'Con Edison is Seeking Higher Rates,' *The New York Times*, 26 January 2013
	Utility officials mention the importance of tree trimming, which they already engage in. (NYT n=0; local n=13)	In an interview at the Telegram & Gazette yesterday, National Grid executives said the severe damage from the storm does not represent a lack of maintenance on their part. They said the company spent $28 million on tree trimming in Massachusetts this fiscal year, an amount that has been steady for the last five years. – 'Going on the Offensive; Utility Explains Its Handling of the October Storm,' *Telegram & Gazette*, 10 November 2011
Residents and Business Owners	Residents and businesses discuss purchasing generators or already having them. (NYT n=18; local n=42)	People trudging through stores in search of sold-out supplies had little time to meditate on climate change. They talked more about how recent storms – the ice storm of 2008 in New Hampshire and Tropical Storm Irene in New Jersey – had prompted them to buy generators and left them better prepared. – 'Cleaning Up After Nature Plays a Trick,' *The New York Times*, 31 October 2011
Business Owners	Business owners, particularly restaurant owners, discuss moving equipment out of basements. (NYT n=9; local n=0)	'[Restaurant] owners are re-examining their buildings' infrastructure and architecture. They are questioning their industry's tradition of placing kitchens and refrigerators in basements. For the first time, many are realizing a need to set up backup power, communication systems and transportation networks.' – 'Sandy Offers Lessons to Restaurateurs,' *The New York Times*, 7 November 2012

Table 4. Representative quotes for themes of assignment of responsibility identified in print news media coverage of storm-related power outages in the northeastern United States. Where possible, names have been removed for anonymity.

Stakeholders	Theme	Representative Quote
Government Officials	Government officials hold utilities responsible for poor preparation, inadequate response, and/or lack of communication. (NYT n=35; local n=50)	'CL&P's preparation for major storms was unreasonably inadequate,' [CT Attorney General] said at a news conference. 'Its emergency response plan was beyond inadequate.'– 'Conn. AG raps utilities over Oct. storm response,' *Brattleboro Reformer*, 12 June 2012 Worcester city councilors called the response unacceptable. Sturbridge selectmen said they were disgusted. State Sen. _____, D-Barre, said he was outraged. Municipal officials complained that the utility failed to prepare for the store. – 'Going on the offensive; Utility explains its handling of October storm,' *Telegram & Gazette,* 10 November 2011 The town of _____ alleges that National Grid failed to 'maintain basic levels of responsible communication with municipal officials and emergency-management and safety offices,' said _____ [Massachusetts Attorney General].... 'We understand a lot of Mother Nature can't be totally predicted and certainly can't be controlled, but in this day and age shouldn't a utility be able to take advantage of the most advanced software that can predict the severity and location of a storm, so that they can dispatch their crews where they need to?' _____asked. – 'AG wants National Grid to pay $16M,' *Sentinel & Enterprise,* 27 July 2012 'The upper management couldn't communicate with the middle management,' he said. 'The middle management couldn't communicate with the crews. And finally, when we had sufficient crews coming in – resources that should have been arranged before – they came in and had very little direction and they were flabbergasted at the condition of the infrastructure, the wiring, the entire system.' – 'Suffering on LI As Power Agency Shows Its Flaws,' *The New York Times,* 14 November 2012

Residents	Residents assign responsibility for widespread power outages to utility companies. (NYT n=20; local n=11)	'I would say PSE&G's response would have to be an order of magnitude better before they would rise to the level of abysmal,' said _____, 64, who complained of living 'in a third-world country called Teaneck, New Jersey.' – 'Power, Freshly Restored, Goes Back Out for Some,' *The New York Times,* 9 November 2012 It's been six days since _____ could flush her toilet without first walking over to a neighbor's house to get a couple of gallons of water. She's already dumped out every scrap of food in her fridge, and she's grown tired of hearing utility workers telling her that her street in Hanson is a 'priority' for the company. – 'IRENE AFTERMATH; Thousands Still Struggle with Loss of Electricity,' *The Patriot Ledger,* 3 September 2011
Utility Companies	Utility companies discuss that power outages were due to scope of storm. (NYT n=7; local n=8)	National Grid was also singled out by DPU for not securing enough crews in advance of the storms. In the case of Irene, the company noted that importing out-of-state crews was difficult because the storm wreaked havoc across much of the eastern United States. – 'Utilities Appeal Millions in Fines for 2011 Storms,' *Brattleboro Reformer,* 7 April 2014 'The amount of devastation our system sustained last fall cannot be understated – with an estimated 80 percent of our overhead circuits damaged after Irene alone,' Nstar President _____ said in a statement released by the company. 'We were essentially rebuilding the electric system as we restored power, and the penalties assessed today are simply not in line with the realities of getting the job done.' – 'Hefty Fines for Mass. Utilities for Storm Response,' *Cape Cod Times,* 11 December 2012 Consolidated Edison responded by saying that the company had already restored four times as many customers as it has ever had to restore after a storm. 'The 800,000 or so we've restored is equivalent to four Hurricane Irenes,' said _____, senior vice president for electric operations at Con Edison. – 'Schools Reopen to Snarls; Transit Headaches Persist,' *The New York Times,* 6 November 2012
	Utility companies explain that the need for home or infrastructural repairs delayed power restoration.	'_____, president of National Grid, said failures could last several days because repairs would not begin until the storm ended and would require unearthing power lines

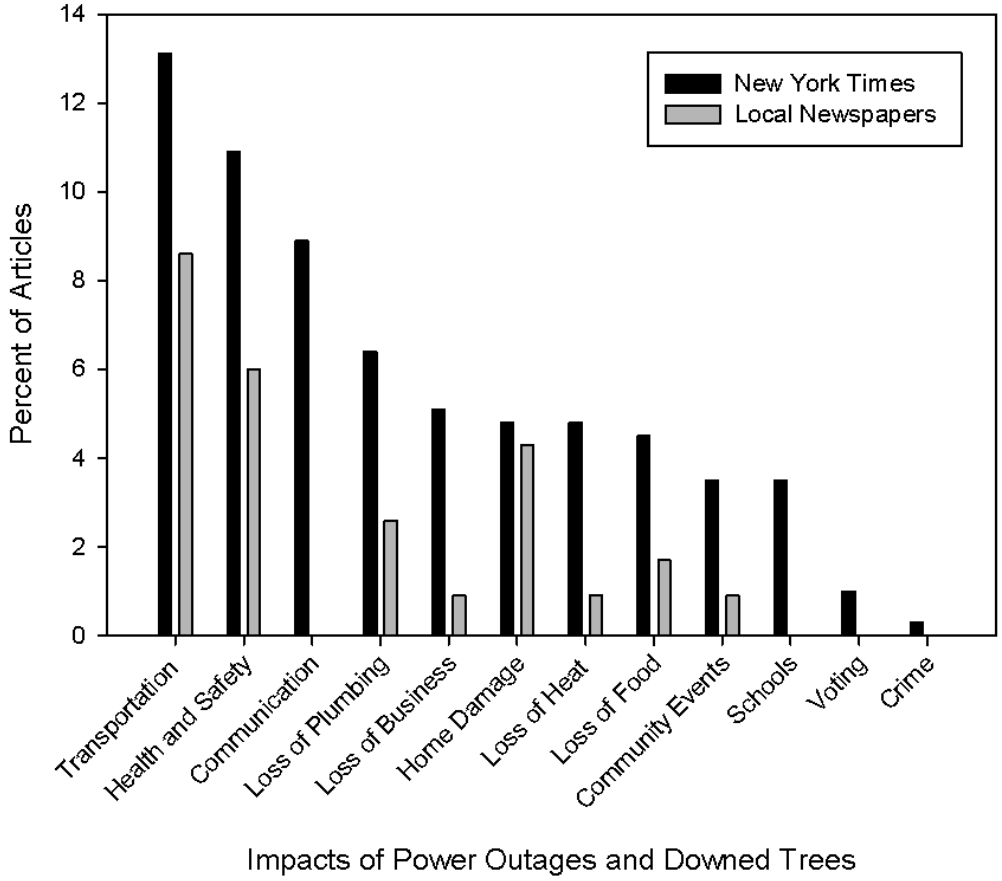
	(NYT n=15; local n=2)	buried under mounds of snow.' – 'Heavy Snow and High Wind Sweep Into the Northeast' *The New York Times*, 9 February 2013 'The utility said it could not return power to about 35,000 customers in flood-damaged areas like Howard Beach in Queens and Red Hook and Sheepshead Bay in Brooklyn until electricians certified their homes as safe.' – 'New York City,' *The New York Times,* 10 November 2012
Long Island Power Authority (LIPA)	LIPA shifts responsibility to the New York State government, and Governor Cuomo for inadequate staffing. (NYT n=3; local n=0)	'There are many, many people who have been placed at LIPA during my tenure here who have no utility experience or training in the job that they have been placed in,' said _____, the authority's director of community relations. – 'Suffering on LI As Power Agency Shows Its Flaws,' *The New York Times,* 14 November 2012 After Hurricane Sandy, _____, who was the authority's chairman, said that the trustees devoted so little time to discussing the pending storm because they were confident that a plan was in place. He noted that the trustees were not utility professionals, but rather 'an oversight board of citizens.' – 'After Storm, Businesses Try to Keep Moving,' *The New York Times,* 31 October 2012
Residents, Disability Advocates, Judge	Residents, disability advocates, and a judge assign responsibility to the NYC Housing Authority and other city agencies for not being prepared for outages in public housing, and particularly for the impacts of the outages on disabled residents. (NYT n=10; local n=0)	'I have to say that the Bloomberg administration was unfortunately resistant to working cooperatively on the issue, and we look forward with the new administration to doing something constructive because that's what's necessary for this very vulnerable population,' _____ said. – 'U.S. Judge Says City Neglected Disabled,' *The New York Times*, 8 November 2013 Yet _____of the Legal Aid Society estimated on Thursday that more than 15,000 units of public housing closest to the city's shoreline -- mostly in the Rockaways, Coney Island and Red Hook -- were still without heat and hot water or electricity. 'We're into the second week of this,' he said, 'and there is no real urgency to get it fixed. ...No can-do New York attitude here.' – 'Where Hurricane Sandy Still Hurts,' *The New York Times*, 9 November 2012

Figure Legends

Figure 1. Impacts of power outages and downed trees mentioned in New York Times and local newspaper articles covering storm-related power outages in the northeastern United States from August 21, 2010 to November 2, 2014

Figure 2. Stakeholders quoted in New York Times and local newspaper articles covering storm-related power outages in the northeastern United States from August 21, 2010 to November 2, 2014

Figure 1.


New York Times
Local Newspapers
Percent of Articles
0
2
4
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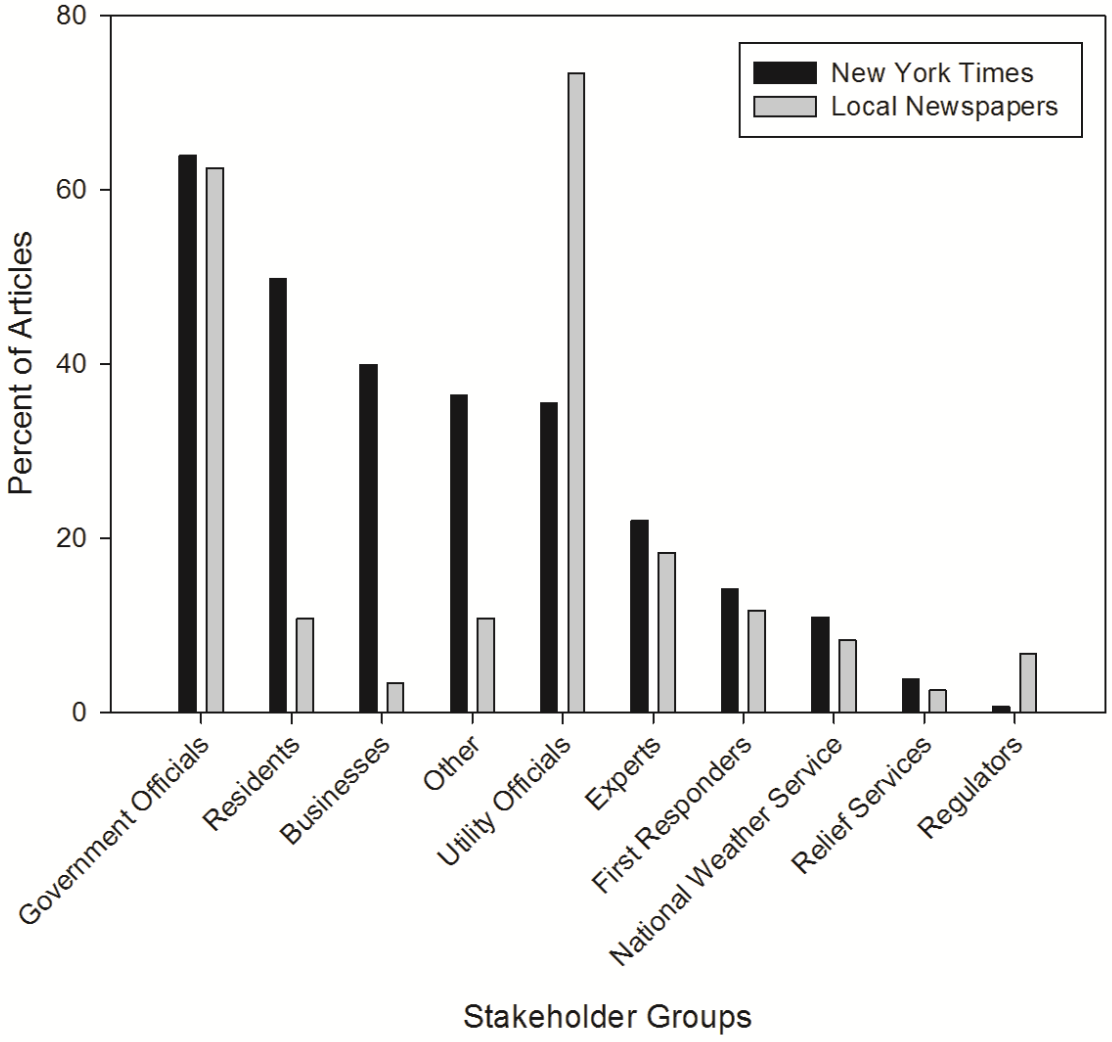
Transportation
Health and Safety
Communication
Loss of Plumbing
Loss of Business
Home Damage
Loss of Heat
Loss of Food
Community Events
Schools
Voting
Crime
Impacts of Power Outages and Downed Trees

Figure 2.


80
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Experts
First Responders
National Weather Service
Relief Services
Regulators
Stakeholder Groups

CHAPTER TWO: TREE CREW PERSPECTIVES ON WOOD PRODUCT RECOVERY FROM UTILITY VEGETATION MANAGEMENT

Abstract

Utility vegetation management generates large quantities of wood that require disposal. To explore opportunities to reduce wood waste and promote wood recovery, I evaluated the perceptions and experiences of utility-contracted tree crews regarding a wood recovery program. I conducted interviews with tree crew members both involved (n=24) and not involved (n=58) with the pilot program. Interview questions focused on workflow, interactions with homeowners and the public, and opportunities for implementation of a wood recovery program from the crewmember perspective. Participants generally had positive attitudes toward a wood recovery program, wanting to provide benefits for communities through revenue from log sales and to reduce wood waste. Potential challenges associated with such a program included: (1) increased time required for tree removal, (2) safety concerns for removing larger logs, (3) physical obstacles such as mailboxes and stone walls, (4) homeowners wanting to keep the wood, and (5) low quality wood (i.e., containing rot or metal). The protocol was modified to address such concerns. With the input of tree crew members, my findings suggest that a wood recovery program has the potential to be successful in reducing wood waste from utility vegetation management and generating benefits for communities, particularly in urban environments.

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Introduction

Trees in the urban forest and residential environment are generally considered amenities or assets to the community, providing numerous benefits including aesthetics, strengthened community ties, stress relief, and improved property values (Ulrich, 1979; Kweon et al., 1998; McPherson et al., 2005; Nowak & Dwyer, 2007; Donovan & Butry, 2010; van den Berg et al., 2010). However, if trees are removed due to death, disease, construction, or utility line clearance and risk management, they are considered a liability requiring disposal rather than an asset (Bratkovitch, 2001; Bratkovitch, 2014). Alternatively, trees removed from a community could continue to provide benefits in the form of wood products (Bratkovitch, 2001; Bratkovitch, 2014).

Several programs and companies have pursued opportunities to use wood products from urban trees. For example, the Sustainable Wood Recovery Initiative at Michigan State University is a campus-wide program for trees removed due to poor health, damage, safety issues, or construction. The wood is milled, dried, and provided to artisans for use in marketable products (http://www.canr.msu.edu/for/programs/swri). City Bench, based in New Haven, Connecticut, converts trees removed from urban centers and college campuses into high-value furniture (http://www.city-bench.com). Other programs facilitate information exchange or markets for reclaimed urban wood. One example is the Urbanwood Project, a wood marketplace that originated from efforts to encourage utilization of emerald ash borer-infected trees killed in southeast Michigan (http://urbanwood.org/about/). Elsewhere, the Southeast Urban Wood Exchange provides resources for municipalities and arborists to connect with potential end-users, encouraging the highest and best use of urban wood (http://www.urbanwoodexchange.org/about.php).

One driver of tree removal in urban and residential environments is utility vegetation management, which produces large quantities of wood that require disposal or utilization. In the northeastern United States (US), utility companies are tasked with managing trees that could threaten utility infrastructure (i.e., trees within a certain distance of transmission and distribution lines; Hansen, 2011). In Connecticut, the focus of this study, recent major storms resulted in widespread power outages from trees or tree limbs falling on the power lines; in response, utility companies have engaged in more-intensive tree pruning and removal to reduce the risk of future outages (McGee et al., 2012; State Vegetation Management Task Force, 2012). Some of the wood from pruned or removed trees is used as firewood and mulch by property owners and other end-users. However, utility companies and arborist contractors assume responsibility for disposal of remaining wood waste, representing a significant cost (Fratanduono et al., 2013). Therefore, there is interest on behalf of utilities and municipalities in Connecticut to minimize the costs of waste wood disposal, while also realizing an opportunity to generate benefits for communities through wood product recovery (Donnelly & Doria, 2014).

To explore the potential for wood recovery in a utility vegetation management context, a wood product recovery pilot program was initiated in the Town of North Haven in southwestern Connecticut in 2015. The program was a collaboration with The United Illuminating Company (UI), one of the two main electrical utilities in the state. Trees were selected for removal based on UI's ongoing utility vegetation management program protocol. To implement the pilot program, utility-contracted tree crews were trained to remove trees using a modified protocol that allowed recovered logs to be sold as wood products (e.g., saw logs, tie logs; Figure 1a) and ensured marketability of wood chips generated (i.e., by keeping trash and debris out of chips). For trees located on private property, property owners were asked if they wanted to donate their

tree(s) to the program. Accumulated logs and chips were stored on town property until sale to a local wood products company. Revenue from the sale of wood products was returned to the town for tree planting programs or other community initiatives.

My objective was to evaluate the perceptions and experiences of utility-contracted tree crews regarding a wood recovery program, including the perspectives of crews involved in the pilot program and crews not currently engaging in wood recovery. Past research suggests that possible challenges in wood recovery include lack of necessary equipment and local processors (Endahl, 2015), the need for educational seminars for operators who had not previously engaged in wood utilization (Endahl, 2015), ability to access trees around obstacles (MacFarlane, 2007), safety concerns due to proximity to hazards (MacFarlane, 2007), and perceived low wood quality due to suboptimal growing conditions and potential presence of contaminants in the wood (e.g., nails, concrete; MacFarlane, 2007). I hypothesized that similar concerns would arise in this study. Additionally, I expected that the utility vegetation management context would pose challenges, including proximity to electrical hazards and physical obstacles (i.e., utility poles and wires, fencing, driveways, roads), which might preclude the crews' abilities to remove longer lengths of wood. Therefore, I hypothesized that tree crew members would express concerns about such obstacles and challenges in relation to participating in a wood product recovery program from utility tree removals.

Methods

To assess potential opportunities or barriers associated with the pilot program, I conducted semi-structured qualitative interviews with tree crews (Neuman, 2006, pgs. 304-313). In this context, the advantages of qualitative data collection are threefold. First, qualitative methods can supplement data collected through quantitative methods, deepening and enriching

understanding of relationships between the urban forest and its stakeholders (Elmendorf & Luloff, 2001; McLean et al., 2007; Gundersen & Frivold, 2008; Ostoic & van den Bosch, 2015). Second, qualitative data collection has the potential to reduce conflict and promote collaboration between stakeholders by gathering rich and localized information to consider for program development and implementation (Elmendorf & Luloff, 2001; Brody et al., 2003; Elmendorf & Luloff, 2006). Finally, open-ended (qualitative) questions have been shown to provide different data than close-ended (quantitative) questions about values related to forests (Bengston et al., 2011). Limitations of qualitative interviewing include a lack of precise, quantitative measurements for distinct variables and lack of statistics to test hypotheses (Neuman, 2006, pg. 157). However, for my purposes, I determined that qualitative interviews were appropriate for assessing tree crew perceptions of wood recovery despite these limitations. Topics addressed in the interviews for this study included work areas and procedures, current destination of wood from tree pruning and removals, interaction with homeowners or other community members, perceptions of or experience with wood recovery, and anticipated or actual barriers and challenges to wood recovery (see Appendix A for specific interview questions).

I worked with two utility companies for recruiting tree crews to interview – Eversource Energy (Eversource) and the United Illuminating Company (UI). The study included two types of interviews to investigate tree crew perceptions and experiences with wood recovery. The first type, pre-implementation interviews, were conducted with crews who had not been involved in the pilot program. The goal of pre-implementation interviews was to assess crews' current workflow and their perceptions of wood recovery in the utility context. Both Eversource-contracted and UI-contracted crews were included in pre-implementation interviews. The second type, post-implementation interviews, were conducted with UI-contracted tree crews who had

been involved in the North Haven pilot program, and were conducted in two phases. The first phase was completed shortly after pilot program implementation (September and October 2015); the second phase was conducted a year later (September 2016). Post-implementation interviews addressed the same goals as the pre-implementation interviews and, in addition, assessed the actual challenges and opportunities that tree crews experienced in implementing the pilot program.

The initial protocol for the pilot program called for tree crews to identify potentially valuable logs from all parts of the tree, including the butt log (i.e., bottom log closest to the ground), the trunk, and branches of sufficient diameter (Figure 1a). However, initial feedback from the first round of post-implementation interviews indicated that this protocol was prohibitively complex and posed potential safety hazards when trying to recover logs from above the power lines. Therefore, the protocol was modified to focus on preserving the butt log of the tree when feasible (Figure 1b), rather than all parts of the tree. Pre-implementation interviews and the second round of post-implementation interviews solicited feedback on this modified protocol.

For pre-implementation interviews with Eversource-contracted crews, I interviewed crew members from three tree crews in each of the seven geographic work areas defined by Eversource. Tree crews typically included two or three individuals, but sometimes included up to six individuals when multiple trucks were working together. A comprehensive list of the work locations for crews in each region was sent to the interviewer on the scheduled morning of interviews. The three crews to be interviewed within each work area were randomly selected. If one of the selected crews could not be located, a replacement crew was randomly selected. For interviews with UI-contracted crews (both pre- and post-implementation), a comprehensive list

of all applicable crews and work locations was supplied to the interviewer on the day of interviews. I randomly selected crews from that list. Interviews were concluded once researchers determined that information saturation had been reached at each phase. Information saturation occurs when the range of ideas relevant to the research questions has been addressed in the interviews, and no new information is gained through additional interviews (Kreuger & Casey, 2009).

When I arrived at a work location, the crew ceased operations. Crew members were provided with an information sheet describing the interview process and given the opportunity to ask questions and determine whether they wanted to participate. Because a translator was not available, only individuals who were comfortable completing the interview in English were included in the study. Interviews were completed on-site and conducted out of earshot of other crew members to ensure privacy. The human subjects research protocol was approved by the University of Connecticut Institutional Review Board (#H15-175 and #H16-007). Interviews were transcribed for analysis, and open coding was used to identify recurring themes in the data (Neuman, 2006, pgs. 461-464).

Results

I conducted 58 pre-implementation interviews and 24 post-implementation interviews. Pre-implementation interviews exceeded post-implementation because I aimed to include tree crews from both utility companies and crews working in different parts of the state. Post-implementation interviews could only be completed with crews working in the town where the pilot program existed. Four individuals participated in both 2015 (post-implementation 1) and 2016 (post-implementation 2) interviews, for a total of 82 interviews with 78 participants (Table 1). As follows, values of *n* indicate the number of participants who provided each response.

These *n* values are only included in instances when ten or more participants gave the same response, in order to focus on responses that were most prevalent.

Work Flow (Pre-implementation Interviews)

Work Settings

Most participants (*n*=52) indicated that they worked in a variety of settings ranging from urban to rural. The remaining participants indicated that they worked only on back roads, or primarily in rural, suburban, or urban areas.

Tree Removal Process

Many participants indicated that they removed one to three trees per day (*n*=33). Several participants stated that the number of trees pruned per day was 20-30 trees, but responses ranged from five trees to seven spans (i.e., areas between utility poles). Participants indicated that variation in the number of trees pruned or removed was most often due to the size or diameter of the trees (*n*=21), because larger trees took more time.

Safety was a prominent concern for participants. Seventeen participants discussed safety procedures as an important component of the tree removal process. Participants emphasized that each job site presented a different set of conditions that may affect their workflow:

> *"...[W]hen we pull up to a job site, we'll do what's called a pre-job. We assess the surroundings, you know, are we working on the hillside or is it sloped down? Are there guardrails? ...Is it a busy street or a nice quiet street? You take all these things into consideration."*

Participants described two means of removing a tree. Most participants (*n*=39) explained the process of removing a tree as follows: start at the bottom of the tree removing branches, work up to the top of the tree to clear out all of the branches, and then "chunk" the tree down. The

process referred to as “chunking” involves cutting the trunk into smaller lengths of wood, which are either dropped or lowered with ropes (“rigged”) to the ground. The branches are removed from bottom to top for safety reasons. Removal of obstacles around the bottom of the tree reduces the risk of branches cut from the top becoming caught or bouncing off of other branches while falling. Once all of the branches are removed, and the height of the tree trunk is below the height of the utility lines, the butt log (i.e., the bottom log of a tree; below the branches and above the roots or stump) is felled whole if possible. Alternatively, some participants described a tree removal process in which the tree is felled whole, but this description of tree removal was rare among those interviewed.

Participants were asked about the length of the wood removed when “chunking” a tree down. Lengths discussed ranged from several inches to 20 feet, with most in the range of three to six feet. Participants expressed that lengths vary based on tree diameter (*n*=13), proximity to utility wires, whether the crew was dropping or rigging the logs to the ground, and the preferences of the crew foreman.

Participants also gave a range of responses for the diameter of material that could be chipped. The most common responses were four to six inches (*n*=19) and eight to twelve inches (*n*=22). Participants indicated that newer chippers were able to handle larger diameters. If homeowners requested small diameter wood for firewood, that wood was not chipped.

Interactions with Homeowners and Other Members of the Public

Most participants (*n*=53) stated that they have interacted with homeowners in the course of their work:

> *“...[S]ome people want to stick around and watch every part of it...then some people just, they sign off the work and that’s it, they don’t want to know about it again.”*

Many tree crew members had been asked what they were doing by homeowners (*n*=26). Several participants stated that homeowners have expressed concerns about potential disturbance to other trees or their property (e.g., asked the crews to stay out of gardens or be cautious around fences) (*n*=11). Some participants indicated that homeowners have asked them either to not conduct the pruning or removal, or to prune less than planned (*n*=10). Participants also indicated that homeowners have asked them questions about the wood from tree removals: what would happen with the resulting wood, whether homeowners could keep the wood, and when the wood would be removed from the property by the company's log truck.

Participants stated that they interact with the general public primarily through managing vehicular and pedestrian traffic around the work site. Other interactions include questions about what the crews were doing and why, inquiries about taking the wood or wood chips, and complaints about tree removals.

Current Destination of Wood from Utility Tree Removals

Participants (*n*=27) expressed that they delivered the wood chips to a town-owned property or a general dumpsite, but they did not know where the chips went after delivery to these locations. Wood chips were sometimes taken to customers who sought the chips for use in yards and gardens (*n*=25). Alternatively, chips were recycled at mulch producers or landscaping facilities (*n*=18). Participants commented that it was more difficult to find a location to deposit wood chips when working in urban areas.

Many participants (*n*=25) stated that a log truck picked up the logs, but were unsure where the logs were delivered. Some participants (*n*=17) stated that the wood stayed on the property where the tree was felled, and the homeowner had to request removal if they did not want to keep the wood. Other destinations for removed wood that were mentioned by

participants included wood processing plants, recycling centers, private houses, and woodlots. In the UI territory, many participants expressed that the logs were taken to a processing plant to be ground into mulch (*n*=11).

Participants were asked how often homeowners kept the wood generated by utility tree removals, and how often people looking for firewood took the wood when homeowners chose not to keep it. Crew members found it difficult to provide specific estimates of frequency since homeowners' desires for wood included several factors. For example, homeowners were more likely to keep hardwood than softwood because hardwood was more desirable for firewood:

"You want like a hardwood for…firewood, like hickory, oak, things of that nature."

Homeowners in rural areas were more likely than those in urban areas to keep the wood or give the wood to neighbors, friends, or family. In response to being asked about how often homeowners chose to keep the wood from utility removals, one participant responded:

"A lot, if it's out of the urban – like the city area – then most, pretty much all the time. But if we're in like a downtown area, or in a more like suburban area or whatever...we'll take the wood. But people in the woods want the wood."

In addition, homeowners were more likely to keep the wood as winter approaches than during the summer. However, homeowners were less likely to keep larger pieces of wood that may be too difficult to manage with available tools:

"You'll have customers come out and say, 'Can you leave the small pieces?' …they usually don't want the big pieces."

According to participants, homeowners in wealthier areas were less likely to keep the wood than those in less wealthy areas. Additionally, the wood was less likely to be picked up by other people in wealthier areas, according to participants.

Program Perceptions (Pre-Implementation)

Positive Impressions of a Wood Recovery Program

The participants who were not involved in the pilot program were asked about their general impressions of a potential wood recovery program (Figure 1b). Many of the participants expressed that they had no concerns about wood recovery taking more time than their usual workflow (*n*=22), or no safety concerns (*n*=24). Several participants believed that the new process might be faster and easier than their current removal process, as it would require fewer chainsaw cuts to remove a tree:

> *"It might even make it easier because we normally cut that in half, four feet."*
>
> *"Yeah, I can't see why leaving it in ten foot lengths is any different, once it's down to here, versus cutting it into three or four, six foot lengths. I don't see the difference."*

Many participants stated that they already tried to preserve the butt log at a longer length when possible, as this saved time and generated fewer pieces for the log truck to pick up (*n*=23). Participants also expressed interest in the benefits of the program to society, particularly generating funds for the community and reducing wood waste going to landfills:

> *"If it's a possibility for everybody to benefit from that process then I would be all for that."*
>
> *"That would be a really good idea, especially if it involves planting trees that we're taking out."*
>
> *"I'm all for recycling and everything, just trying to make the most of things, 'cause we just, you know, a lot of the stuff just goes to waste."*

Concerns about the Program

Some participants expressed concerns that it may take them longer to remove longer logs. Measuring the correct length of the log and using more caution when felling logs were expected to take more time. Thirteen participants (*n*=13) stated that the new protocol had the potential to cause safety issues because of proximity to electric and communication wires. Some expressed concern about the larger fall radius of a longer log, or the need to rig down larger pieces of wood with the potential for injury:

> *"That's a great idea and it depends though, the height of the wire and stuff, 'cause sometimes that's not practical to leave [the butt log] that tall… if it's up on a hill, if it's like in a dangerous spot."*

Besides time and safety issues, there were two other main concerns expressed about potential implementation of a wood recovery program. First, some participants were concerned that homeowners would be unwilling to donate logs to the program. This was particularly a concern in more rural areas, where homeowners often kept the wood or gave it to a friend or neighbor:

> *"Um, to be honest with you, around here it* [a barrier to the program] *would probably be more the homeowners than anything else because they may not want to give it* [the wood] *up. They may want to keep it."*

The second main concern was about the low quality of the wood from utility tree removals. Some participants stated that sawmills would not be interested in logs from roadside tree removals because these logs might contain metal:

> *"People nail up signs for yard sales, so that wood technically is junk. You can't do anything. No mill will put a saw into it."*

Others stated that trees were often targeted for removal because they were dead or rotting, so the wood would not be marketable.

Other Comments on the Program

Participants provided other insights into how the program could be made more feasible or acceptable for the tree crews. Thorough instruction prior to implementation was considered important for program success, as tree crew members did not always have prior experience in the logging industry. The crew members also mentioned the need for additional equipment, such as larger chainsaws or wedges, to aid wood recovery.

Program Evaluation (Post-Implementation)

Participants working within the pilot program area in North Haven indicated a range of comprehension and communication about the program. Three of the 13 participants in the first round of interviews (UI post-implementation 1) could not recall receiving any information about the program. Of those that had received information from either the utility company or their general foreman, four were aware that the revenue from the logs would go back to the town from which the trees were removed. When asked whether they would support or oppose continuing the wood recovery program at all of their tree removal sites (i.e., including outside of North Haven), seven supported continuing wood recovery, while others were unsure or indicated that it would depend on the specific site. None of the respondents indicated opposition to continuing the program. Concerns included personal safety (n=4) and time (n=6), with participants estimating that it took 15-30 minutes longer to remove a tree with the wood product recovery protocol:

> *"Every scenario is different...if we have the space and we can just drop larger sections you know it actually saves us time because we're making less cuts and we can get it on*

the ground faster, but you know then there's other times when we have to really think about whether we can do it safely. So it's just all logistically, you know, it's just a tree by tree basis."

"It is a little bit more of a safety issue because, of course, you know, we're doing our job, which is dangerous as it is and then we have to do extra work on top of that, so that kind of makes, you know, added time pressure, which leads to more accidents."

In the second round of interviews (UI post-implementation 2), seven of the 11 tree crew members interviewed indicated that they had worked on the pilot program in North Haven. The remainder had either not worked in North Haven or had recently started working on the crew. Of the seven that had worked on the program, three indicated that they had not encountered any issues with implementing the new tree removal process, but four indicated that the new process took more time. Six of the interviewees supported continuing the wood recovery program at tree removal sites outside of North Haven; another indicated that their support would depend on the specific location.

Discussion

The objective of this study was to assess the perceptions and experiences of utility-contracted tree crews with regard to a wood recovery program. At the time of writing, the pilot program in North Haven, CT has generated about $5,800 in revenue for the town (E. McConnell, personal communication); there has been no estimate of utility implementation costs. For a similar concurrent pilot program in Haddam, CT, utility costs were estimated to be $12,000, with $6,000 in revenue for the town (S. Stotts, personal communication); the utility company identified opportunities for improving efficiencies and reducing costs in the future. To guide the discussion, I focused on three findings from the analysis: (1) the generally positive attitudes of tree crews toward a wood product recovery program in the utility context, (2) the potential

barriers to such a program identified by tree crews, and (3) the utility of qualitative interviews with practitioners in assessing urban forestry and arboricultural programs.

First, contrary to my hypothesis, I found that participants were generally supportive of wood recovery from utility vegetation management. Through the interviews, I learned that participants were particularly motivated by the opportunity to reduce wood waste and to provide benefits to the communities in which they worked. Many participants also expressed that the modified protocol (Figure 1b) was very similar to their current workflow, making the program relatively simple to implement. This enthusiasm is consistent with findings from Endahl (2015), who found that a majority of respondents (municipalities and arborists in Virginia, US) considered urban forest waste utilization a major issue for the urban forestry industry currently and in the future.

Participants were able to provide insight into where such a program might be most successful. Since homeowners in urban areas are less likely to keep the wood from removals for personal use than homeowners in rural areas, a wood recovery program might be more successful in urban areas. Participants indicated that urban areas generally pose a challenge in finding places to dispose of the wood. Therefore, in urban settings, a wood recovery program might save time if crews are provided a consistent location for log and chip drop-off. Previous research has highlighted urban environments for potential wood recovery due to the high density of tree removals and close proximity of potential end-users (MacFarlane, 2007). Endahl (2015) found that private arborists often cited the need for local facilities available to receive and stockpile urban forest waste. In the pilot program for this study, the town provided property at which wood could be dropped off, sorted, and stored until pick-up by the end-user.

Second, the potential challenges that participants perceived for implementing a wood recovery program were consistent with those hypothesized. These included: (1) increased time required to remove a tree according to the new protocol, (2) safety concerns for removing larger logs, (3) physical obstacles to removing logs (i.e., mailboxes and stone walls), (4) homeowners who want to keep the wood, and (5) low quality wood (i.e., containing rot or metal). In modifying the protocol for the program (adjustment from Figure 1a to Figure 1b), we were able to take into account the feedback provided during the first round of post-implementation interviews. The new protocol aligned more closely with the current workflow of tree crews, and addressed some of the time and safety concerns that were expressed. By focusing on the butt log of the tree for recovery, rather than assessing the entire tree for potential wood products (Figure 1), the modified protocol ensured that crews worked below the height of the power lines when recovering logs. This modification was intended to reduce the risk of contact with the power lines and minimize disruption to workflow. However, participant feedback indicated that even the modified protocol could pose challenges at some work sites. Therefore, program success might be enhanced if supervisors are aware of such challenges and emphasize the importance of only recovering logs when it is safe and practical to do so.

To address concerns about the time required, asking homeowners whether they plan to keep the wood concurrently with obtaining permission for tree pruning or removal would allow crews to focus the wood recovery program on properties willing to donate their trees. Additionally, a protocol for wood recovery might emphasize recovering only logs that are not obviously damaged or decaying. While low quality logs may be an issue in some cases, the revenue generated thus far by the program in the study area indicates that high quality logs are available from utility removals. Despite identifying low-quality wood as a potential barrier for

urban wood utilization, a previous study found that quality of urban-grown hardwoods was comparable to that of nearby forest-grown hardwoods in southeastern Michigan (MacFarlane, 2007). As I observed, collaboration among the municipality, utility company, and a local wood products company in the pilot program in this study implies willingness of some sawmills to engage with urban wood waste recovery.

Finally, I found that qualitative interviews with practitioners (in this case, tree crews) provided valuable insight into the potential opportunities and challenges in implementing a wood recovery program. Elmendorf and Luloff (2001; 2006) suggested that qualitative data collection methods, particularly key informant interviews, facilitate stakeholder collaboration in urban forestry programs because participants can provide localized and in-depth information that can be considered for program development. In this study, interviews provided tree crew members with the opportunity to have a conversation about their work process. Tree crew perspectives and experiences made a tangible difference in the program by giving feedback that resulted in a modified protocol (i.e., the transition in protocol from Figure 1a to 1b), supporting previous research suggesting that key informant interviews can improve planning processes (Brody et al., 2003). Another benefit of the qualitative methods used in this study was that participants were able to provide additional context for quantitative data. For example, participants were able to not only state the diameter of material chipped, but also explain their response, including the range of possible diameters chipped, why larger diameters might not be chipped, and how different equipment impacted chipping. In-field interviews also allowed for reference to specific equipment, trees, settings, and conditions (Lowery & Morse, 2013; Conway, 2016). During the interviews, participants referred to specific trees and equipment at the work site to facilitate their

description of tree removals, as well as potential obstacles that might pose a problem around power lines.

The results of this study indicate potential for developing wood recovery programs for utility vegetation management, particularly in urban areas. My study focused on one of the stakeholders most directly involved with implementation: the tree crews. Future research may include other key informants, including municipal officials, homeowners, utility work planners and arborists, and wood product buyers.

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Tables

Table 1. Summary of interviews conducted with tree crews in relation to a wood recovery program for utility tree removals.

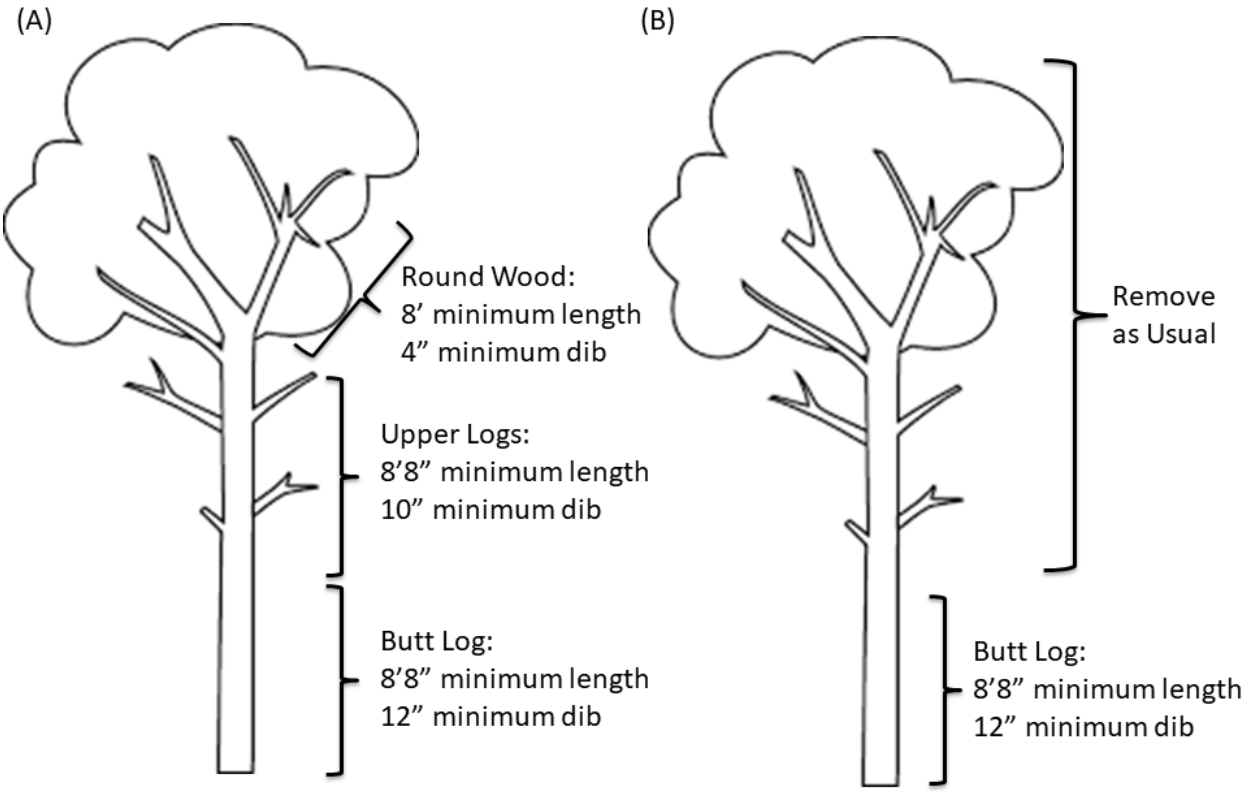
	Timeline	**Number of Individuals Interviewed**	**Prior Exposure to Pilot Program?**
Eversource pre-implementation	July-August 2016	42	No
UI pre-implementation	April 2017	16	No
UI post-implementation 1	September-October 2015	13	Yes
UI post-implementation 2	September 2016	11	Yes

Figure Legends

Figure 1. Protocol for tree crews in the wood recovery pilot program. (A) shows the initial protocol, in which crews were asked to identify and recover, if possible, marketable logs from all parts of the tree. Numbers indicate acceptable lengths and diameters (inside bark diameter; dib) for marketable logs. (B) indicates the modified protocol, based on initial tree crew feedback, which called for crews to focus on recovering only the butt log of the tree.

Figures

Figure 1



Appendix A: Interview Questions

Pre-Implementation Interview Questions

Prior to Interview (UI only): Have you been interviewed by researchers from UConn in the past year? Have you been trained to remove trees in a way that produces logs that can be sold?

Initial Questions:

(1) Do you work primarily in urban, suburban, or rural areas, or do you work in all of these settings?

(2) About how many trees do you remove or trim in a typical day?

(3) Can you walk me through how you go about removing the tree?

(a) In what order are parts of the tree removed?

(b) What parts are chipped or cut up? *Prompt:* Approximately what diameter material is chipped?

(c) How large are pieces cut for those parts of the tree that are not chipped?

(4) Where does the wood from tree removals and trimming go after you leave the site for the day?

(a) In your experience, where do the chips go?

(b) Where does the rest of the wood go?

(c) How often do homeowners ask to keep the wood? *Prompt:* About what percentage of the time would you estimate that this happens?

(d) When they ask to keep the wood, do you cut it differently?

(e) If homeowners do not keep the wood, how often is it picked up by other people in your experience? *Prompt:* About what percentage of the time would you estimate that this happens?

(f) How often does it need to be picked up your company for disposal? *Prompt:* About what percentage of the time would you estimate that this happens?

(5) When you're removing trees, do you have any interaction with the homeowners?

(a) If yes, what does that usually involve?

(b) Do you have any interaction with other people passing by?

Program Explanation:

[UI/Eversource] is considering a new process for removing trees that will result in logs that can be sold. The revenue from these logs would be given to the town from which the trees were removed to fund tree-planting programs. This process would involve cutting branches closer to the truck, identifying logs that are of high enough quality for sale, and cutting the butt log of the tree to a length of 8'8" or more whenever it is safe and practical to do so. [Participants were shown a diagram similar to Figure 1 to clarify the explanation.] We are interested in your opinions about this new program.

(1) Does this explanation make sense to you or do you have any questions about the process?

(2) Do you have any experience working with this process?

(3) If you were asked to implement this new process, what barriers or challenges might you anticipate? Do you have any concerns about the new process? *Prompts:* Concerns about time, safety, costs?

UI Post-Implementation Interviews (1)

(1) Have you recently received direction from UI to make some changes in how the wood is cut during tree removals?

(a) If yes, proceed to Question 2.

(b) If no, prompt: Have you been asked by your foreman or anyone from UI to cut longer logs when removing trees?

(c) If yes, proceed to Question 2.

(d) If no, proceed to Question 4.

(2) Who did you receive the directions from? [i.e., foreman, directly from UI]

(3) Did UI provide information about why these changes were made?

(a) If yes, proceed to Question 5.

(b) If no, proceed to Question 4.

(4) Have you heard of the biomass recovery program initiated by UI?

(a) If yes, process to Question 5.

(b) If no, prompt: UI is requesting that the logs be left long (greater than 8 feet) whenever possible so that they can be collected and sold to log buyers. The money from these sales will be given to the town of North Haven (or other towns as appropriate) for a tree planting program. Does this sound familiar?

(c) If yes, proceed to Question 6.

(d) If no, proceed to Question 9.

(5) What information did you receive about why the changes were made?

(6) Can you briefly explain the protocol you are following for the biomass recovery protocol?

(7) Have you encountered any issues in the process? (i.e., clarity of communication with the process, personal safety issues, etc.)

(8) Have you had any interaction with a UI representative to receive feedback about the harvesting process? If so, what did that feedback include? Have you received any feedback from your foreman or another supervisor?

(9) Do you have any interaction with homeowners when you are removing trees? If so, what does that interaction usually involve?

(10) Have you encountered individuals who have asked you about removing downed wood after it has been cut?

(11) Would you support or oppose continuing wood recovery at all of your tree removal sites? Why or why not?

(12) Do you think that wood recovery adds to the time required to remove a tree?

(a) If yes, how much more time does it add? What is more time consuming?

(b) If no, does this system reduce the time to remove a tree or does the time required remain the same? Why?

(13) Is there anything else you would like to add?

UI Post-Implementation Interviews (2)

Initial Questions:

[See Initial Questions from UI/Eversource Pre-Implementation Interviews.]

Biomass Recovery Program Questions:

(1) Have you been asked to remove trees in a way that produces logs that can be sold?

(a) If yes, proceed to Question 3.

(b) If no, proceed to Question 2.

(2) Have you been asked by your foreman or anyone from UI to cut longer logs when removing trees?

(a) If yes, proceed to Question 3.

(b) If no, end of interview.

(3) Were you interviewed last year about this program?

(4) Who did you receive the directions from?

(5) Did UI provide information about why you are asked to remove trees this way?

(6) What information was provided about the program?

(7) Can you briefly explain the protocol you are following for the biomass recovery program?

(8) Have you encountered any issues in the process? (i.e., clarity of communication about the process, personal safety issues, etc.)

(9) Have you had any interaction with a UI representative to receive feedback about the harvesting process? Is so, what did that feedback include? Have you received any feedback from your foreman or another supervisor?

(10) Do you have any interaction with the homeowners when you are removing trees? If so, what does that interaction usually involve?

(11) Have you encountered individuals who have asked you about removing downed wood after it has been cut?

(12) Would you support or oppose continuing wood recovery at all of your tree removal sites? Why or why not?

(13) Do you think wood recovery adds to the time required to remove a tree?

CHAPTER THREE: AMENITIES, DISAMENITIES, AND DECISION-MAKING IN THE RESIDENTIAL FOREST

Abstract

The residential forest provides many amenities to communities, including stress relief, air quality improvement, and higher property values. However, the residential forest may also contribute human-perceived problems or disamenities including allergens, leaf debris, infrastructure damage, and maintenance costs. Vegetation management by utility companies along power lines is one process shaping the residential forest. Property owners' decisions to consent or object to utility vegetation management may be influenced by perceived amenities and disamenities of the forest. To explore this decision-making process, I conducted 32 one-on-one qualitative interviews with resident-homeowners who have consented or objected to a utility company tree removal on their property between 2014 and 2017. The study area included several towns in eastern Connecticut, USA, representing urban, suburban, and exurban residential areas. I applied the Means-End Chain Theory as a theoretical framework, and used laddering interviews to explore the tree amenities and disamenities that residents identified and values associated with trees. Residents identified attractiveness, shade, and privacy most frequently as amenities provided by trees; risk to power lines, trees being dead or diseased, and risk to people were most frequently identified as disamenities. Amenities and disamenities were connected to values such as happiness and enjoyment, closeness to nature, comfort, pride in one's home, aesthetics, life, avoiding harm to others, and time or money for other priorities. Participants who objected to utility tree removals expressed amenities of trees as reasons for the objection, whereas participants who consented focused more on disamenities in explaining their decision. My findings may guide communication and outreach to residents by both public and private land

management professionals, particularly in residential forests and the utility vegetation management context.

Introduction

Humans have long interacted with forests as sources of aesthetic, cultural, spiritual, provisional, and other services (Nature Communications, 2018). The presence of the residential forest, i.e., trees and woods in and around where people live (Kendra & Hull, 2005), has been associated with lower stress levels (Ulrich, 1979; van den Berg et al., 2010), strengthened neighborhood ties (Kweon et al., 1998; Kuo et al., 2003), air quality improvement (Nowak & Dwyer, 2007), improved public health (Dwyer et al., 1992), attractive aesthetics (Thompson et al., 1999), and increased property values (Donovan & Butry, 2010). More recently, attention also has been given to potential disamenities that trees may contribute to communities (Kitchen, 2013). Disamenities are the structures and functions of ecosystems that people perceive as negative to their well-being (Lyytimäki & Sipilä, 2009). For trees in the residential forest, disamenities include pollen allergens, leaf debris, damage to infrastructure (such as to utility power lines), maintenance costs, and excessive water use (Lyytimäki & Sipilä, 2009; Escobedo et al., 2011; Pincetl et al., 2012; Kirkpatrick et al., 2013; Kitchen, 2013; Dobbs et al., 2014; Delshammar et al., 2015; Lyytimäki, 2015; Conway & Yip, 2016).

Residential landscapes provide ecosystem services for communities and are important sites for human-environment interactions (Kuo, 2003; Cook et al., 2012). In residential areas, people exert control over their surrounding environment as they make changes to vegetation on their property, including planting and removing trees (Pickett et al., 1997; Cook et al., 2012). Such decisions are driven by many factors, including residents' landscape preferences and attitudes toward lawn management practices, property attributes (e.g., yard size and housing age), socioeconomic status, neighborhood norms, appearance of neighbor's yards, and institutional constraints (e.g., homeowner associations or local government regulations) (e.g.,

Martin et al., 2003; Nassauer et al., 2009; Cook et al., 2012). Previous research on the residential forest has focused largely on the benefits or amenities provided by trees and how the amenities affect residents' decisions to plant or maintain trees (e.g., Summit & McPherson, 1998; Jones et al., 2012; Kirkpatrick et al., 2013; Conway & Yip, 2016; Conway, 2016). However, disamenities also play a role in residents' perceptions of trees and residents' decisions about trees on their property (Kirkpatrick et al., 2013; Conway & Yip, 2016; Conway, 2016).

One process shaping the residential forest is vegetation management by utility companies along roadsides and power lines, which is driven by the need to mitigate potential storm damage to trees and power lines to maintain a reliable power supply for consumers (Kempter, 2004; Eversource, 2019). This management is largely mediated by property owners, who may consent or object to a utility company's request to prune or remove trees. Utility tree management is conducted at no direct cost to the property owner, providing homeowners with the autonomy to make tree management decisions for the trees on their property that have been identified as potential hazards by the utility company, regardless of financial considerations that might otherwise constrain decision-making about tree removals (Perkins, 2011). For example, Conway (2016) found that one of the most common reasons for participants to retain unwanted trees was that removals were too expensive.

In order to understand how residents make decisions about utility vegetation management, I addressed three questions: (1) What amenities and disamenities of front yard roadside trees do homeowners identify as important?; (2) What relationships exist between the amenities and disamenities of trees and homeowners' underlying values?; and, (3) How do amenities, disamenities, and values influence homeowner decision-making about tree removals? To explore these topics, I interviewed homeowners in central Connecticut, USA, who had been

approached by their utility company about the removal of a power line-adjacent tree on their property.

Background and Theoretical Framework

Amenities and Disamenities of Trees

Past research has suggested that shade is often identified as the most important amenity provided by trees in the residential forest (Summit & McPherson, 1998; Lohr et al., 2004; Camacho-Cervantes et al., 2014; Conway & Yip, 2016). Other amenities that residents considered important have included attractiveness or aesthetics (Smardon, 1988; Summit & McPherson, 1998; Camacho-Cervantes et al., 2014; Conway & Yip, 2016), calm feelings (Lohr et al., 2004), improved air quality (Lohr et al., 2004), oxygen provision (Camacho-Cervantes et al., 2014; Conway & Yip, 2016), attraction of wildlife (Lohr et al., 2004; Kirkpatrick et al., 2013), and environmental quality improvement (Camacho-Cervantes et al., 2014). Based on previous studies, I hypothesized that participants would more frequently mention amenities that directly affected or benefited the participants and their households (e.g., aesthetics and shade) than those that affected or benefited the environment or their communities (e.g., air quality, stormwater reduction, wildlife habitat).

Previous work has also explored residents' perceptions of the disamenities that trees contribute to the residential landscape. For example, trees can be sources of perceived risk in residential areas, both as potential refuges for criminals (Lohr et al., 2004; Perkins, 2011; Conway & Yip, 2016) and as potential hazards to personal safety and property (Mortimer & Kane, 2004; Lyytimäki & Sipilä, 2009; Kirkpatrick et al., 2013; Camacho-Cervantes et al., 2014; Conway & Yip, 2016). In addition, trees may act as a fire hazard, cause root damage to

sidewalks, or threaten infrastructure like utility lines (Summit & McPherson, 1998; Lohr et al., 2004; Jones et al., 2012; Kirkpatrick et al., 2013; Camacho-Cervantes et al., 2014; Dobbs et al., 2014; Conway & Yip, 2016). Other disamenities described in past research included cost (Kirkpatrick et al., 2013; Conway & Yip, 2016), weeds (Kirkpatrick et al., 2013), attraction of pests (Summit & McPherson, 1998; Kirkpatrick et al., 2013; Conway & Yip, 2016), unwanted shade in the yard or garden (Conway & Yip, 2016), messy leaves and flowers (Summit & McPherson, 1998; Camacho-Cervantes et al., 2014; Conway & Yip, 2016), allergens (Lohr et al., 2004; Dobbs et al., 2014), and blocked views (Kirkpatrick et al., 2013). Like my hypothesis for amenities, I expected that participants would more frequently mention self- and household-focused disamenities (e.g., leaf debris, infrastructure damage) than environment- and community-focused disamenities (e.g., invasive species, volatile organic compound emissions).

Values Associated with Trees

Values have been shown to influence beliefs and attitudes and, in turn, affect decision-making in residential landscapes (Cook et al., 2012). Past research has suggested association between trees and many human-based values, including emotional connection (Hull, 1992; Coles et al., 2013; Conway, 2016), community image and aesthetics (Hull, 1992; Coles et al., 2013; Conway, 2016), environmental protection (Hull, 1992; Conway, 2016), and connection to nature (Coles et al., 2013). However, to my knowledge, values (from a cognitive psychological perspective) that residents associate with the disamenities of trees have not been previously studied. As in previous studies, I expected that the participants would associate trees with human values like closeness to nature, positive emotions, stress relief, and quality of life. Based on the hypothesized disamenities (see above), such as leaf debris (which would require time or money for clean-up) and infrastructure damage (which would also impose a cost), I hypothesized that

residents might connect disamenities to taking away time and money from other priorities (Lopez-Mosquera & Sanchez, 2012; Arsil et al., 2016). Additionally, trees on private properties have been associated with lower sales prices, possibly related to imposed disamenities such as leaf debris, blocked views, and risk to infrastructure (Donovan & Butry, 2010; Pandit et al., 2013). In other studies, available time and money for other priorities because of time and monetary savings were connected to such values as a sense of accomplishment, life satisfaction, fun and enjoyment, and general well-being (Lopez-Mosquera & Sanchez, 2012; Arsil et al., 2016).

Decision-Making for Utility Vegetation Management

Previous work has assessed reasons that homeowners provide for planting, maintaining, or removing trees. Aesthetics, familiarity, safety, health, and pride in one's yard have been identified as drivers of landscaping preferences and management choices (Spinti et al., 2004; Nielson & Smith, 2005; Hirsch & Baxter, 2009; Larson et al., 2009; Cook et al., 2012). Kirkpatrick et al. (2013) found that the most common reasons for tree removal were disease or advanced age, root damage to infrastructure, and fallen limbs or trees. Similarly, Conway (2016) found that concern about tree health was also the most common reason for removing trees or planning to do so soon, followed by property damage concerns (both actual damage and perceived risk). Conversely, while reasons for objecting to a tree removal have not been explored, people may object to removals for reasons similar to those that they provide for planting trees. As an example, aesthetics are commonly identified as a reason for planting trees (Summit & McPherson, 1998; Conway, 2016), and an anticipated resulting change in aesthetics may influence homeowners' decisions to object to tree removal. Other reasons for planting trees include privacy, creating shade, replacing another tree, emotional connection, obtaining fruit, and

anticipated improvement to property values (Summit & McPherson; Conway, 2016). Therefore, I hypothesized that the amenities and disamenities that participants considered important, as well as the values connected to those attributes, would contribute to resident decision-making about tree removals.

Theoretical Framework: Means-End Chain Theory

I used the Means-End Chain (MEC) Theory (Gutman & Reynolds, 1979) as a theoretical framework to structure my analysis. MEC theory describes how consumers identify attributes of products and connect those attributes to their own personal values or goals (Gutman & Reynolds, 1979; Reynolds & Gutman, 1988; Walker & Crittenden, 2012). Originating in marketing, the MEC theory posits that product attributes and personal underlying values contribute to consumer decisions to purchase a product or engage in a behavior. Broadly related to my study, MEC theory has been applied to several environmental topics. For example, Ramirez et al. (2015) used MEC analysis to explore consumers' personal goals associated with consuming sustainable products; goals included reducing environmental toxins, expanding energy conservation, promoting coexistence with nature, and improving self-esteem. Bagozzi and Dabholkar (1994) found that values associated with recycling included health, providing for future generations, and sustaining life for long-term survival. Lopez-Mosquera and Sanchez (2011) applied MEC analysis and contingent valuation to estimate consumers' willingness-to-pay for peri-urban green spaces. Values associated with these green spaces included mental and physical well-being, enjoyment of landscape beauty, quality of life, and respect for others (Lopez-Mosquera & Sanchez, 2011). To my knowledge, this study is the first to apply MEC analysis to decision-making about trees.

The MEC theory posits three levels of abstraction related to a product or behavior (Gutman & Reynolds, 1979; Reynolds & Gutman, 1988; Walker & Crittenden, 2012; Figure 1). The most concrete constructs are the product attributes, which are the features of the product that consumers identify as important. For example, Lopez-Mosquera and Sanchez (2011) identified "landscape beauty" as an attribute of natural areas visitation. Second, consequences are intermediate constructs that are generally the effects or results of attributes. In Lopez-Mosquera and Sanchez (2011), "mental well-being" was identified as a consequence of "landscape beauty." Finally, the most abstract constructs are values – closely held constructs of importance (Gutman & Reynolds, 1979; Reynolds & Gutman, 1988; Walker & Crittenden, 2012). For example, "better relationships with others" was identified as a value associated with "mental well-being" (Lopez-Mosquera & Sanchez, 2011). While the MEC theory focuses on the positive attributes (i.e., amenities) that drive decision-making, I extend application of theory in this study by also considering negative attributes (i.e., disamenities) of trees.

Methods

Data Collection

Widespread power outages from several major storms in the northeastern US in 2011 and 2012 (i.e., Storm Alfred, also called the October Snowstorm, Hurricane Sandy, and Tropical Storm Irene) may have influenced homeowner perceptions of the risks of trees (McGee et al., 2012). To mitigate the risk of future outages caused by trees and tree limbs, Connecticut's main utility company, Eversource Energy (hereafter Eversource), began widespread enhanced tree trimming (ETT) practices, which involves the clearance of trees or limbs within eight feet of either side of utility lines from ground to sky (Eversource, 2019). The study area included several towns in eastern Connecticut that had recently experienced ETT (Andover, Bolton,

Coventry, Manchester, and Mansfield), which spanned a spectrum of urban to exurban residential development. Stakeholder interviews associated with a larger study identified the selected towns as relevant based on history of power outages and variable town-level support for utility tree pruning and removal. Maps of utility distribution lines that had undergone ETT from 2014 to 2017 were provided by Eversource. The time period of 2014-2017 was selected to correspond to years after the major storms, and storm-related implementation of ETT in 2013. These years (i.e., 2014-2017, rather than 2011-2013) were selected to maximize homeowner recall of their decision-making around consenting or objecting to vegetation management (Groves et al., 2009). Using ArcGIS (ESRI, 2018), I intersected the polygon maps of ETT provided by Eversource with tax parcel maps from the Capitol Region Council of Governments (CRCOG, 2017) to identify individual parcels at which ETT may have taken place.

Next, from the identified parcels, I used the CRCOG (2017) tax parcel information to select parcels where the address of the property owner matched the parcel address (i.e., parcels with a resident-homeowner). Then, I used the CRCOG database to determine the assessed property value for each eligible parcel. I limited participation to resident-homeowners because residents directly interact with their trees on a daily basis (i.e., as opposed to absentee homeowners), and homeowners are the property-level decision-makers for utility vegetation management. Parcels were stratified based on assessed property values to ensure that a range of property values were sampled. Two strata were created, and identified as properties: (1) above, and (2) below the median assessed property value for all eligible parcels. Within each stratum, simple random sampling was used to select 300 sample parcels, for a total of 600 households. Potential participants were first contacted by mail using a letter that explained the study, defined qualification for participation, and provided the researcher's contact information. Participants

were asked to contact the researchers if they wished to participate. After two weeks, a reminder postcard was sent. Mailings were completed in three waves (200 addresses per wave) from June 2018 to September 2018. Additionally, in-person canvassing was used at previously contacted addresses to encourage participation, starting after the second mailing in August 2018. The University of Connecticut Institutional Review Board provided approval for use of human subjects (#H16-007).

Interviews were conducted at the participant's residence, which allowed participants to refer directly to trees in their yard during the interview (Lowery & Morse, 2013). Laddering interviews (one-on-one, semi-structured interviews; Hinkle, 1965; Lopez-Mosquera & Sanchez, 2012) were used to elicit the attributes, consequences, and values that residents associated with their trees. The laddering technique can be either "hard" or "soft" (Russell et al., 2004). Hard laddering uses predefined attributes, consequences, and values from the literature, whereas soft laddering is an open-ended process in which interviewees identify for themselves the attributes of an item or behavior they consider important and the consequences and values they associate with those attributes (Russell et al., 2004; Lopez-Mosquera & Sanchez, 2012; Walker & Crittenden, 2012; Arsil et al., 2016). In my case, I used soft laddering, which is considered more appropriate than hard laddering for small sample sizes (fewer than 50 participants; Russell et al., 2004).

Each interview consisted of three main segments. First, I began by asking the participant to identify a tree for which the utility company requested consent to remove, and to provide some details about the tree (e.g., species, size, location, tree health at the time of removal). Second, to identify the positive attributes of the tree, participants were asked, "For that particular tree, can you identify some positive attributes of the tree? In other words, what benefits did/does

the tree provide to you, your family, your community, or the environment as a whole? What did/do you like about the tree?" To elicit consequences and values, participants were then asked to explain why each attribute mattered: "You indicated that ____ was a positive attribute of the tree. Why is that attribute important to you?" For each element listed, the participant was asked: "Why is that important to you?" until a point of abstractness was reached from which they could go no further. This question sequence was then repeated for negative attributes of the tree. For example, I elicited negative attributes by asking, "Thinking again of the specific tree you identified, can you identify some negative attributes of the tree? In other words, what costs and risks did/does the tree impose on you, your family, your community, or the environment as a whole? What did/do you not like about the tree?" I then elicited consequences and values by asking, "You indicated that ____ was a negative attribute of the tree. Why is that attribute important to you?" and iteratively continued until participants had no more comments. To provide additional context for responses, participants were also asked about their experience with the utility company, other tree management activities they had recently conducted on their property, and their ideal front yard.

I piloted the interview guide with the first five participants to identify any potential issues with question wording or clarity. At the end of the interviews with these five participants, I asked the participant if any questions were unclear or if any of the question wording was confusing. All five participants indicated that the questions were clear and had no concerns about wording. Because no changes were made to the instrument following the pilot, data from the pilot interviews were included among collective data reported. Interviews were manually transcribed and reviewed for accuracy. A total of 32 interviews were conducted, at which point I determined that information saturation had been reached (Neuman, 2006; Kreuger & Casey, 2009).

Data Analysis

The interviews were first open-coded to identify attributes described by respondents and to synthesize similar concepts where appropriate (Reynolds & Gutman, 1988; Neuman, 2006; Tey et al., 2015). Attributes were determined to be either self- and household-focused or community- and environment-focused based on how respondents described the amenity or disamenity. If one respondent framed an amenity or disamenity as both self- and household-focused and community- and environment-focused, or if both frames were used by different respondents, both foci were recorded (Table 1). Then, interviews were re-coded for relationships among attributes, consequences, and values identified by respondents (Reynolds & Gutman, 1988; Arsil et al., 2016). Using LadderUX software (2019), I created hierarchical value maps (HVMs) to visualize attribute-consequence-value relationships described by participants. These maps consist of boxes that represent attributes, consequences, and values coded from the interviews, and arrows between boxes that represent relationships identified by participants. A cut-off value of two was used, meaning that each relationship (between an attribute and consequence, or consequence and value) included in the HVM was mentioned by at least two participants (Reynolds & Gutman, 1998; Lopez-Mosquera & Sanchez, 2011). This cut-off value was chosen to maximize the amount of information in the HVM without hindering interpretation (Reynolds & Gutman, 1998; Lopez-Mosquera & Sanchez, 2011).

Results

Amenities, Disamenities, and Values

Participants identified a wide range of amenities and disamenities as important attributes of their yard trees (Table 1). The most commonly mentioned amenities of trees were

attractiveness or beauty (n=22) and shade (n=19). Most of the amenities identified were self- and household-focused (i.e., attractiveness, shade, privacy, sound barrier, improve property values), but there were some exceptions. Community- and environment-focused amenities included providing oxygen (n=8) and providing wildlife habitat (n=10). Wildlife habitat was generally discussed in terms of bringing enjoyment to the participant as a result of watching wildlife in their yard. The most commonly mentioned disamenities of trees were risk to power lines (n=16) and the tree being dead or diseased (n=10; Table 1). Risk associated with the power lines was framed as both self- and household-focused (e.g., not wanting to deal with the consequences of power loss) and community- and environment-focused (e.g., not wanting neighbors to lose power, concern about impacts on emergency crews). Concerns about danger to people, roadways, and other property were similarly framed as both self- and household-focused and environment- and community-focused.

Participants connected the amenities of trees to several values, including closeness to nature, happiness and enjoyment, comfort, pride in one's home, aesthetics, and life (Figure 2). Attributes like the provision of wildlife habitat and attractiveness of trees were related to closeness to nature and happiness and enjoyment. Attractiveness was also connected to pride in one's home. Shade provided temperature regulation, which was related to comfort. Trees providing a visual barrier from the road was associated with preventing others from looking into the home and improving aesthetics. Finally, the provision of oxygen was connected to life.

The most commonly identified values in connection with the disamenities of trees were avoiding harm to others, and available time and money for other priorities (e.g., other home-improvement projects; Figure 3). Property damage and non-leaf debris (e.g., falling limbs) were connected to avoiding harm to others. Participants did not wish for their trees to cause property

damage or endanger the safety of others. Both leaves and non-leaf debris were connected to the consequence of requiring cleanup, which in turn connected to taking time away from other priorities. Some participants hoped to reduce the need for cleanup by removing trees, thus allowing them more leisure time. Similarly, concern about taking money away from other priorities was associated with the cost of removal.

Decision-Making about Utility Vegetation Management

Of the 32 participants, 23 consented to utility tree removal, five objected, one consented to several removals but also objected to one additional removal, and three had contacted the utility company seeking removals from their property. One participant who had consented to a removal also contacted the utility company about an additional removal. When asked how they arrived at the decision to consent or object to utility management, participants had a wide variety of reasons.

Among those who consented, three participants did so in order to avoid loss of power to the whole community.

> *"I just thought it was good for the whole community and that we don't run, you know, without electricity."*
>
> *"It would knock electricity out to the whole street, multiple streets for that matter."*
>
> *"I understand the importance of you know, the electrical wires, I don't want to be responsible for, you know, one of my trees hurting my neighbor's power."*

Others were also concerned about the threat to the power lines because they did not want to lose their own power.

> *"I think they gave us an opportunity to call if we wanted to, if we had some objections, but we didn't. We're in an area that loses power frequently…so our concern would be not*

to lose power, so if they felt like they had to trim to keep our power going, then we're fine with that."

Three participants indicated that they trusted the judgment of the utility company, or contracted tree crews to judge whether a tree needed to be removed.

"We figured that they're tree experts, so they know what they're doing. So, you know, we have confidence and trust in them."

"If they felt it was too close to the road for the wires, then we deferred to their expertise."

"Well, uh, they recommended it very strongly, especially after the two big storms we had in 2011 and 2012, Superstorm Sandy where we lost 9 days of power in this neighborhood. We were out of power for nine days. So any time the utility companies, power lines, come down and say, we need to trim these trees back, with your permission, it's very important to keep the power going here. We always agreed."

Similarly, some felt it was "common sense" for the trees to be removed, either because they were dead or dying or because of proximity to the power lines.

"It just wasn't even a rational thing to say no, no, no, no."

"Taking the branches down was a no-brainer [i.e., no further contemplation needed to make a decision] *because, you know, as you remove the number of branches [near] the wires, it's gotta cut down on the power outages."*

"Well it's always been kind of obvious what was leaning over and was gonna be a problem."

Conversely, some participants felt they made the decision to consent with incomplete information. For example, one participant stated that they were not informed about which trees would be taken down.

> *"But when they asked for my permission, they didn't say what trees, so I was not happy that it wasn't identified for me."*

Another participant felt it was unclear what would happen if she were to object to the removals.

> *"I mean, yeah, there was probably a box to check [to object], but I don't know where that would've gotten me. I don't even know if I would've then been liable for the whole trees if I had refused our little tiny trees that were healthy."*

The most common reason for participants to object to a tree removal was uncertainty about the need for removal. These participants felt that their trees did not actually pose a threat to the power lines.

> *"I went out and I stood where the power lines are on the road and I looked down the power lines and I looked at the tree in relation to where the power lines were and the tree was nowhere near the power lines."*

> *"Um, he [my husband] just didn't think it was a threat. If a branch fell, it wasn't going to fall on the power lines. It was a healthy tree, so. We just want to keep our trees."*

Participants also expressed apprehension about the contractors carrying out pruning and removals. There was concern about what a tree or the forest would look like after management, particularly when a tree was scheduled for pruning rather than removal.

> *"They were being particularly harsh to the trees, I think, making them one-sided."*

"Whoever's doing the trimming is oftentimes, not only with the trimming trees, but with the brush alongside, it's just a pure hack job … Afterwards, it looks like a war zone, everything is just hacked to bits."

In one case, a participant consented to the pruning of a tree on her property, then removed the tree completely based on its appearance after pruning.

"And actually what they did was they removed half of it that was hanging over and then when I got home from work, I said that looks stupid, I said the whole half of the tree is gone, so then my husband had to end up dropping the other – the tree itself."

Discussion

The objective of this study was to identify the amenities and disamenities that homeowners consider important for their yard trees and how those amenities and disamenities connected to homeowners' underlying values. I also explored how amenities, disamenities, and values influenced resident decision-making about utility vegetation management on their property. To guide the discussion, I focused on three aspects of the findings: (1) the amenities and disamenities identified by participants; (2) participants' decision-making process in consenting or objecting to tree removals and associated relationships with attributes and values; and (3) the role of trust or distrust in the utility company in participants' decision-making about tree removals on their property.

Many of the amenities and disamenities mentioned by participants were consistent with those found elsewhere in the literature, and consistent with my hypotheses. As I hypothesized, the most frequently mentioned amenities and almost all of the identified disamenities were self- and household-focused. Attractiveness and shade were the amenities identified most frequently in my study, which corresponded to the findings of several other studies that also found shade

and aesthetics among the most important benefits of trees or reasons for planting or having trees (Summit & McPherson, 1998; Lohr et al., 2004, Camacho-Cervantes et al., 2014; Conway & Yip, 2016). Disamenities frequently identified in my study were hazards to personal safety and property, and threats to infrastructure (including power lines), and paralleled findings of others (Summit & McPherson, 1998; Lohr et al., 2004; Lyytimäki & Sipilä, 2009; Jones et al., 2012; Kirkpatrick et al., 2013; Camacho-Cervantes et al., 2014; Conway & Yip, 2016). For example, Lohr et al. (2004) found that infrastructure damage and the threat of trees to power lines were among the problems that respondents identified with trees in cities. Conversely, other amenities and disamenities frequently noted or identified as important elsewhere were among those infrequently or not mentioned during my interviews. Climate change mitigation was only mentioned by two participants in my study but was identified as an important benefit of urban trees by 30% of participants in Conway and Yip (2016). Air quality improvement was identified by only one of my participants yet ranked as the third most important benefit in Lohr et al. (2004). Although oxygen provision was mentioned by only eight participants in my study, oxygen supply was considered an important benefit by a majority of respondents in both Camacho-Cervantes et al. (2014) and Conway and Yip (2016). While feelings of calm were not mentioned by any of my participants, Lohr et al. (2004) found that the second most important reason to have trees was for a calm feeling, and 21% of participants in Conway and Yip (2016) ranked calm feelings as an important benefit.

Although concern about the threat to power lines was the disamenity most frequently mentioned by my participants, I cannot conclude that it was the overall most important disamenity. The context of the study was utility company vegetation management. Therefore, tree pruning and removal to mitigate the risk of power outages was mentioned as the reason for

contacting participants and in the introduction to the interview, and may have influenced the prominence of powerlines as a topic during the interviews. Risk to power lines as a disamenity has been identified in previous work (Conway & Yip, 2016; Camacho-Cervantes et al., 2014). Problems with utility wires was one of the most important risks identified by participants in Conway and Yip (2016) but was only mentioned by 10% of participants in Camacho-Cervantes et al. (2014).

The values connected to amenities and disamenities were also consistent with previous literature and my hypothesis. I hypothesized that participants would associate tree amenities with values like closeness to nature, positive emotions, stress relief, and quality of life. Connection to nature and happiness, fun, and enjoyment were commonly identified. In addition, participants connected amenities to comfort, pride in one's home, aesthetics, and life. Consistent with my hypothesis, participants associated disamenities with the values of avoiding harm to others, time and money for other things, and leisure time.

Although I hypothesized that amenities, disamenities, and values would contribute to resident decision-making about tree removals, the results were mixed. I found that decisions to consent to tree removal were made largely separate from the consideration of amenities. Participants that consented to removal considered the disamenities: the threat to power lines, the risk of dead or dying trees, and the risk to people and property, as well as the desire to avoid harming others. This is consistent with previous findings of diseased trees, damage or risk to infrastructure, and the risks of fallen limbs or trees being among the most common reasons that residents would remove a tree from their property (Kirkpatrick et al., 2013). Just the opposite, objections to tree removal often included a consideration of the amenities of the tree. If a tree was important to a participant (e.g., because it was a rare species or otherwise unique), the need

for removal was more often scrutinized. Additional factors such as the role of trees in visually screening road traffic played a role in at least one other objection. Disamenities were occasionally considered in respondent decisions to object to tree removal. For example, some participants were concerned about how much a removal would cost if an issue arose in the future but decided that keeping the tree outweighed these concerns.

My results also suggested that decision-making about both consent and objection to utility tree removals were also influenced by trust or distrust in utility officials and tree crews. While there are many definitions of trust, Barber's (1983) definition is commonly used in assessing trust in natural resource managers (e.g., Leahy et al., 2004), and is based on the public's perception of the resource manager's moral and technical competence. In my study, moral competence (i.e., the manager putting the needs of the community above his or her own needs) did not emerge as a trust issue between the residents and the utility company, utility arborists, or tree crews. However, perceived technical competence (i.e., residents' confidence in the manager's expertise to make decisions) was verified by several participants that consented to tree removals. Elsewhere in this project (co-author, unpublished data), survey respondents who considered vegetation managers to be accountable (i.e., trustworthy, caring for trees, professionals) were more likely to accept roadside tree removals. Conversely, in my study, technical competence was questioned by participants that objected to removals. Such distrust is consistent with Kuhns and Reiter (2007), who found that participants did not believe that utility officials involved in tree pruning cared about trees and had low levels of trust that these officials would treat trees properly. The distrust observed in my study is also consistent with declining trust in natural resources-related institutions, as observed elsewhere (Bengston & Fan, 1999; Leahy et al., 2004). However, other studies have identified factors that can promote trust in

resource managers, including formal and informal interactions between community members and personnel (Leahy et al., 2004; Needham & Vaske, 2008), community involvement in decision-making (Leahy et al., 2004), and reflection of constituents' views in management when possible (Needham & Vaske, 2008).

Several theories other than MEC theory, including the Theory of Reasoned Action, Theory of Planned Behavior, and the Value Belief Norm Theory, could be applied to understand the behavior of homeowners in consenting or objecting to utility vegetation management. Besides evaluating how decisions are made, the MEC approach and laddering interviews also allowed me to elicit which tree attributes were important to residents and how those attributes related to their values. However, the MEC approach did have limitations in this study. First, with a focus on the attributes that homeowners considered important, the MEC framework did not capture additional factors that contributed to homeowner decision-making. Some of these factors emerged elsewhere in the interviews (e.g., trust in the utility company). However, there are likely other factors that were not captured in my study (e.g., the role of subjective norms, perceived behavioral control) that could be explored with other theoretical frameworks. Second, the mentioned amenities and disamenities likely were limited to attributes that were salient to the participants at the time of the interviews. Finally, with my focus on the context of utility vegetation management, risk to power lines was likely overrepresented in the responses.

Methodological differences likely contributed to inconsistencies between my study and previous work. The qualitative approach used in my study included semi-structured, open-ended questions, and interviews were conducted face-to-face; therefore, participants developed responses spontaneously. Questions in this study also focused on a specific tree in each participant's yard. Other studies used a variety of approaches and involved different objectives or

research questions. Camacho-Cervantes et al. (2014) used a written survey with open-ended questions to a sample of parents of kindergarteners in one Mexican city in order to elicit the benefits offered or harms caused by trees in participants' cities. Other studies cited in this article largely used closed-ended questions. Conway and Yip (2016) used closed-ended questions and a mail survey to collect data from residents of a city that had recently experienced an ice storm. Lohr et al. (2004) used a telephone survey of residents of major US metropolitan areas to measure participants' agreement with a series of statements about the benefits and problems of urban trees. To understand negative attitudes towards trees in cities, Kirkpatrick et al. (2013) used a written and online survey that included Likert-based lists of possible reasons for removing trees in gardens, and benefits of and problems with trees. Despite the range of possible methodological options, in my case, open-ended questions provided opportunity for depth and detail for a response or idea (Neuman, 2006). I observed a wide diversity of responses for amenities and disamenities, some of which may not have been revealed otherwise (e.g., provide pinecones for crafting, involvement in fatal accident). Conversely, amenities and disamenities associated with trees not identified during the interviews may have been selected from a close-ended list if one had been provided.

In conclusion, my results indicated that people have diverse reasons to consent or object to tree removals from their properties. Understanding the attributes of trees that residents consider important and how those attributes relate to their deeply-held values can help forest managers and arborists communicate with residents by appealing to what matters most to those residents. Utility vegetation management on private properties largely depends on property owner consent to management; therefore, ability to appeal to residents is a critical step in facilitating effective management around powerlines. Further, the diversity of responses by the

respondents suggested opportunity for one-on-one communication to understand priorities and concerns of individual residents.

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Tables

Table 1. Amenities and disamenities associated with front yard trees identified by participants (n=32).

Amenities	n[a]	Self and Household[b]	Community and Environment[b]	Disamenities	n[a]	Self and Household[b]	Community and Environment[b]
Attractiveness, Beauty	22	X		Threat to Power Lines	16	X	X
Shade	19	X		Dead or Diseased	10	X	X
Visual Barrier or Privacy	12	X		Danger to People	9	X	X
Birds and Wildlife Habitat	10		X	Property Damage	9	X	
Oxygen	8		X	Debris, Other Than Leaves	7	X	
Sound Barrier	5	X		Leaves	6	X	
Environmental Protection	4		X	Too Tall or Large	6	X	
Neighborhood Character	3		X	Blocks Sun/Too Much Shade	6	X	
Interesting Tree	2	X		Cost of Removal	5	X	
Air Quality	1		X	Too Many Trees	5	X	
Biodiversity	1		X	Road Blockage or Damage	4		X
Carbon Dioxide Sequestration	1		X	Undesirable Aesthetics	3	X	
Define Property Line	1	X		Hard to Mow Around	3	X	
Low Maintenance	1	X		Involved in Fatal Accident	2	X	X
Provide Pine Cones (Crafting)	1	X		Branches Scratch House	1	X	
Rural Environment	1		X	Encroach on Property	1	X	
Floodwater Mitigation	1		X	Require Maintenance	1	X	
				Attract Pests	1	X	X

[a] "n"indicates the number of participants that identified that characteristics as an amenity or disamenity.

[b] Each "X" indicates how participants framed each amenity or disamenity – either as self- and household-focused or community-and environment-focused. If an amenity or disamenity was framed both ways, an "X" is indicated in both columns.

Figure Legends

Figure 1. The Means-End Chain Theory encompasses three levels of abstraction, which are shown from most concrete on the bottom (attributes) to the most abstract at the top (values) (Gutman and Reynolds, 1979; Reynolds and Gutman, 1988; Walker and Crittenden, 2012).

Figure 2. Hierarchical value map for the positive attributes (amenities) associated with front yard trees identified by participants (n=32).

Figure 3. Hierarchical value map for the negative attributes (disamenities) associated with front yard trees identified by participants (n=32).

Figure 1.

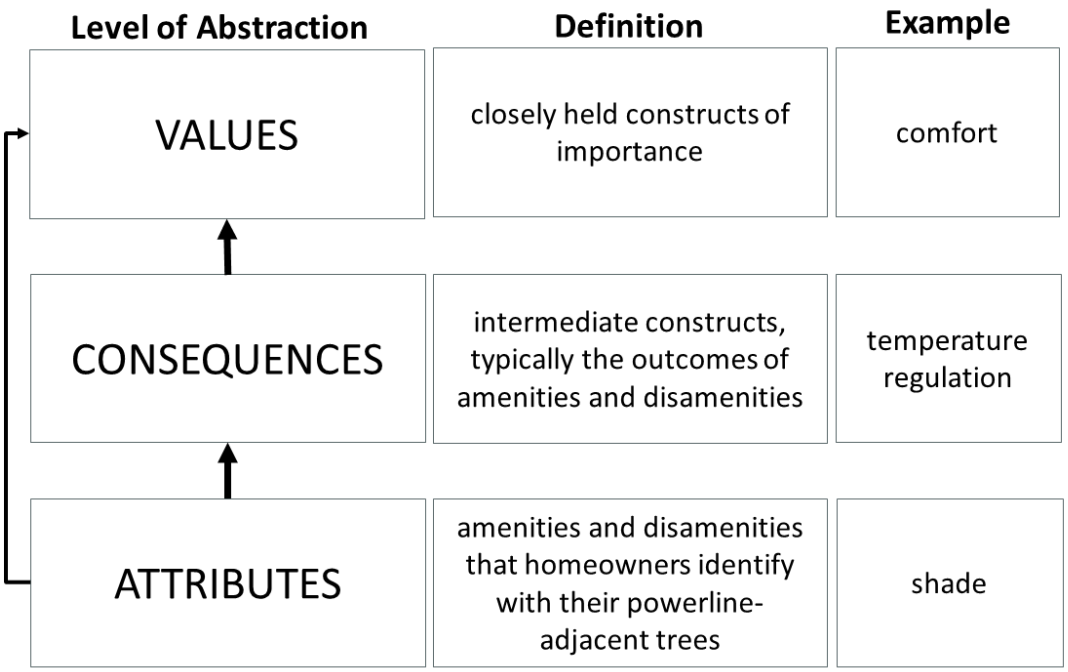

Level of Abstraction
Definition
Example
VALUES
closely held constructs of importance
comfort
CONSEQUENCES
intermediate constructs, typically the outcomes of amenities and disamenities
temperature regulation
ATTRIBUTES
amenities and disamenities that homeowners identify with their powerline-adjacent trees
shade

Figure 2.

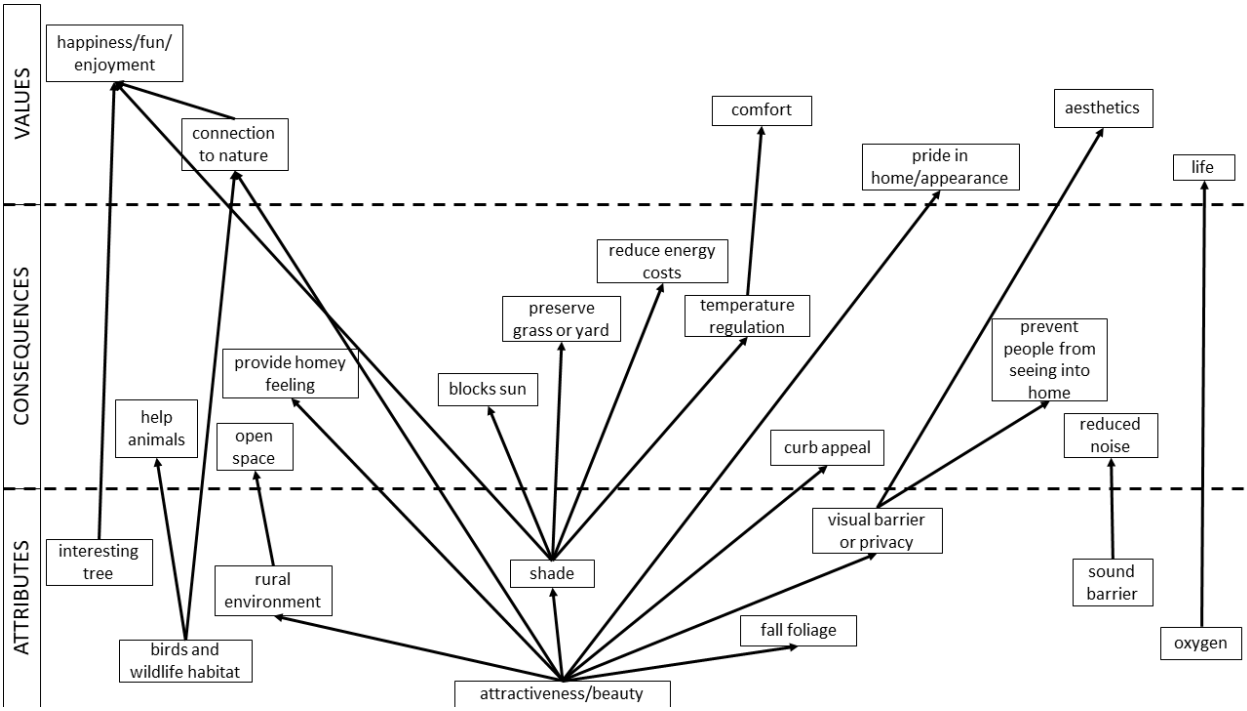
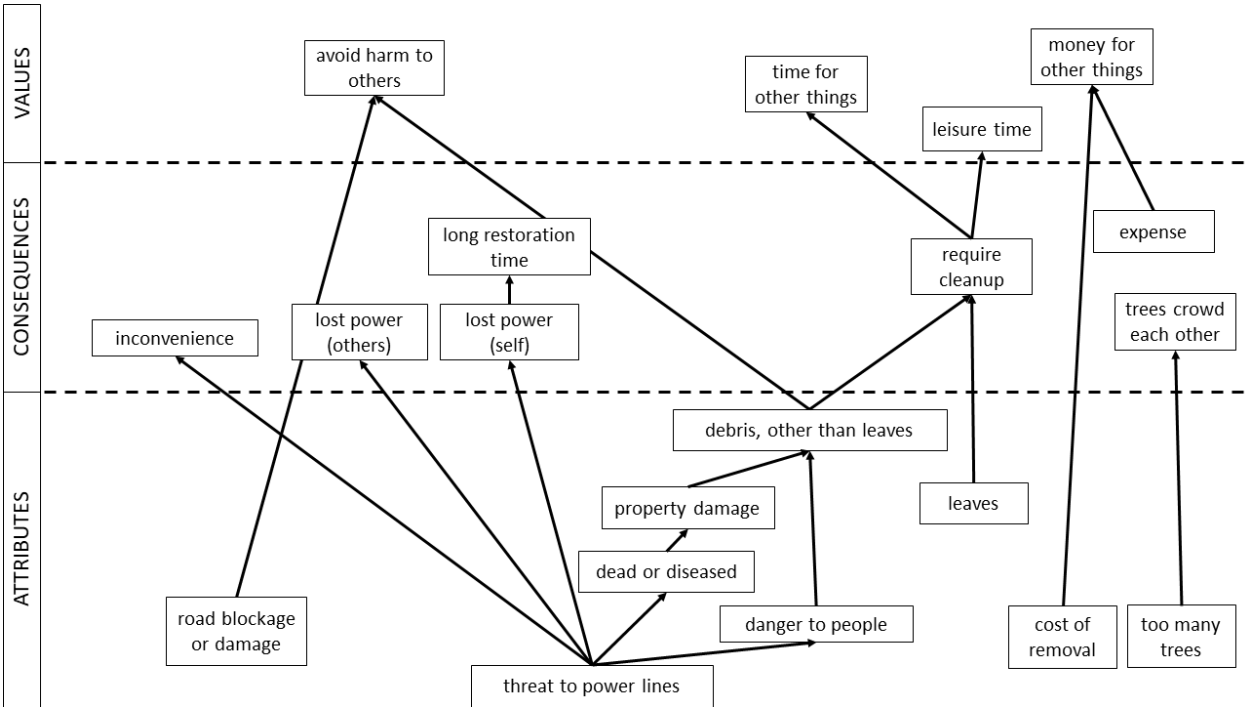

VALUES
CONSEQUENCES
ATTRIBUTES
happiness/fun/ enjoyment
connection to nature
comfort
aesthetics
pride in home/appearance
life
reduce energy costs
preserve grass or yard
temperature regulation
prevent people from seeing into home
provide homey feeling
blocks sun
help animals
open space
curb appeal
reduced noise
visual barrier or privacy
interesting tree
rural environment
shade
sound barrier
fall foliage
birds and wildlife habitat
oxygen
attractiveness/beauty

Figure 3.


VALUES
CONSEQUENCES
ATTRIBUTES
avoid harm to others
time for other things
money for other things
leisure time
long restoration time
require cleanup
expense
inconvenience
lost power (others)
lost power (self)
trees crowd each other
debris, other than leaves
property damage
leaves
dead or diseased
road blockage or damage
danger to people
cost of removal
too many trees
threat to power lines

Conclusion

Following major storms in the northeastern U.S. in 2011 and 2012, utility vegetation management received heightened attention as a risk management strategy for future storms and storm damage. The overarching goal of this research was to better understand the human dimensions of roadside forest management by utility companies. I used media analysis to assess how responsibility for and solutions to storm-related power outages were considered in media coverage of major storm events in the northeastern U.S. I then used the context of a wood recovery pilot program for utility vegetation management to explore the perceptions of tree crews related to that program. Finally, I used the Means-End Chain Theory framework and one-on-one semi-structured laddering interviews with homeowners in Connecticut to understand how homeowners made decisions to consent or object to utility tree removals on their property.

The objective of my first chapter was to evaluate media coverage of major storms in the northeastern U.S. during 2011 and 2012 to determine which stakeholder voices were represented, what solutions to power outages were suggested, and who or what was considered responsible for power outages. Results suggested that the storms did act as focusing events to bring media, public, and government attention to the vulnerability of utility infrastructure. One finding was that the stakeholder groups included in media coverage affected the solutions explored in the coverage. I also found that the solutions offered in media coverage of power outages were reflected in the actions taken by public officials and utility companies in subsequent years. Future research may explore whether these patterns hold true for media coverage of other environmental events. If so, the inclusion of diverse stakeholders in media coverage can contribute to a broader array of solutions considered in response to natural hazards and other environmental concerns.

The objective of my second chapter was to evaluate the perceptions and experiences of utility-contracted tree crews regarding a wood recovery program. I found generally positive attitudes toward such a program among the crew members and identified some key modifications that could address their concerns. Results suggested that a wood recovery program has the potential to successfully reduce wood waste from utility vegetation management and generate income for communities, especially in urban environments. Further research may assess how the costs to the utility company of implementing a wood recovery program (e.g., additional crew time and other resources required) could be offset by the benefits of such a program.

Finally, in my third chapter, my objective was to explore the amenities and disamenities of roadside trees that residents considered important and how those amenities and disamenities influenced their decision-making for utility vegetation management. The findings suggested that people had diverse reasons to consent or object to a tree removal on their property by the utility company. Decisions to consent to a utility tree removal tended to be made without direct consideration of amenities, and were instead based on risk to power lines, risk of dead or dying trees, and risk to people or property. Conversely, decisions to object to utility tree removals often were made with amenities of the tree as a consideration. Trust played a role in both consenting and refusing tree removals, so future research may explore how the interactions between utility arborists, tree crews, and residents influences residents' trust and decision-making.