land

MDPI

Article

Community Perceptions of Tree Risk and Management

Abbie Judice, Jason Gordon *, Jesse Abrams and Kris Irwin

Warnell School of Forestry & Natural Resources, University of Georgia, Athens, GA 30602, USA; abbie.judice@uga.edu (A.J.); jesse.abrams@uga.edu (J.A.); kirwin@uga.edu (K.I.)
* Correspondence: jason.gordon@uga.edu

Abstract: Urban forests (trees growing in urban and peri-urban areas, including villages and large cities) are vital to mitigating the effects of climate change and urbanization but require special considerations such as risk mitigation in developed landscapes. Despite abundant research on risk perceptions of natural hazards, there is limited knowledge about risk perceptions associated with urban trees. As such, this research examines community perceptions of urban tree risk mitigation with a focus on four cities in the U.S. south. To better understand risk perceptions and mitigation, this study employs key informant interviews with community members. Guided by a socio-ecological resilience framework, the findings identify factors affecting resident attitudes towards tree management on the individual parcel and the community levels. The findings benefit tree risk governance in the face of climate variability, which increases societal and environmental vulnerability in urban settings.

Keywords: urban forestry; tree risk management; community perceptions; resilience

Citation: Judice, A.; Gordon, J.; Abrams, J.; Irwin, K. Community Perceptions of Tree Risk and Management. *Land* **2021**, *10*, 1096. https://doi.org/10.3390/land10101096

Academic Editors: Silvija Krajter Ostoić and Dagmar Haase

Received: 31 August 2021
Accepted: 11 October 2021
Published: 16 October 2021

1. Introduction

The concept of the "urban forest" includes public and private trees and other vegetation existing within a mosaic of pervious and impervious surfaces from the urban core to the wildland–urban interface [1,2]. Over the past three decades, research about the broad range of ecological, social, and economic benefits provided by the urban forest to urban areas has expanded significantly and has helped provide justification for protecting and enhancing these systems [3–5]. Similarly, there has been a proliferation of research regarding urban forest ecosystem benefits such as carbon sequestration, temperature reduction, and stormwater interception, which, in turn, has informed the role of urban forests in climate change adaptation [6–8]. For example, research has documented that large, long-lived tree species are especially beneficial to mitigating climate change due to their high rates of carbon storage and sequestration [7–9].

Nevertheless, political, social, and economic factors combine with the technical challenges of urban tree care to complicate successful urban forest management [10,11]. In particular, municipal tree care managers may be tasked with managing for ecosystem services but may compete with other public service departments for funding, personnel, and political support [12,13]. Previous research has also cited communication with the public as a barrier to successful management, with the public lacking knowledge about the benefits of trees and tree maintenance, and limited participation in efforts towards achieving urban forest goals [13–16]. Public recognition of the benefits associated with a healthy tree canopy and support for municipal and private tree management is vital to sustainable urban forest management [17].

Furthermore, climate change impacts such as increased intensity of weather events, shifting species ranges, disease and pest outbreaks, and changing soil properties will affect trees and those who manage them in the future [18]. In particular, extreme weather events enhance the risk of tree or tree part failure due to lightning strikes, wind events, and saturated soils [19]. In simple terms, risk is the likelihood that an adverse event may occur, causing some sort of harm [20]. Tree or tree part failure can cause significant

damage to public infrastructure, personal property, and even human life [21]. Damages can lead to legal action and negative implications for urban forest management by local government [22,23]. Meanwhile, urbanization often decreases plantable soil space and volume, and exposes trees to harmful pollutants, leading to stress and decline.

The goal of urban forest management in cities is to maximize the benefits of the forest canopy while minimizing disservices, including real or perceived harm to human health and the built environment [24]. Using four cities in the U.S. south as case studies, and guided by a socio-ecological resilience framework, the research presented in this article employed key informant interviews to better understand perceptions of the benefits and risks of the urban forest, as well as community-level risk mitigation actions. In short, this case study illuminates the ways cities balance the protection of valuable tree canopy with residents' safety, particularly in the context of extreme weather events. The research findings provide insights on community characteristics associated with successful risk management and governance. Additionally, the findings contribute to the body of research on urban risk, vulnerability, and local resilience.

Three questions framed our research objective:

(1) What practices are cities undertaking to reduce risk while managing canopy benefits?
(2) How do community leaders characterize tree risk perceptions in their communities?
(3) How do resident attitudes inform tree care and municipal forest management?

1.1. Urban Forest Management

1.1.1. Criteria and Indicators of Success

A survey of highly regarded urban forestry programs found that the technical competence of personnel was necessary but not the most important component of a successful program [25]. Successful programs cross administrative boundaries to include other departments in decision-making. Moreover, programs must be linked with the community's social values and culture [26,27]. At the community level, successful programs have tree and planning commissions with historical understanding of the importance of urban forestry, contain a dedicated governing body with continuity of support, have long-term citizen support and professional assistance, provide education for decision-makers and relevant volunteer commissions, and have dedicated and educated volunteers [14,28–30].

Baur et al. [26] suggest that understanding community attitudes towards the urban forest is important to determine appropriate management strategies and to gain local support. Community support for urban forestry programs presents itself in the form of, for example, institutional collaboration, neighborhood engagement, environmental volunteerism and education, and business alignment [31]. Carmichael and McDonough [32] noted that community input is sometimes overlooked or ignored by municipal forestry programs.

From a biological perspective, successful urban forestry programs are in the process of developing or have developed a resilient urban forest ecosystem including maintaining age and species diversity and are able to maintain long-lived trees distributed across the landscape [25]. To do this, tree managers must make regular tree canopy assessments. Establishing and maintaining quality vegetative resources requires a broad list of criteria and indicators of urban forest planning and management. While some studies have shown that the concentration of programming elements and activities are associated with urbanization [33,34], the community size, wealth, or population makeup are not prerequisites to maximizing the socio-ecological benefits of the urban forest while minimizing the risk of tree failure [25,35]. Furthermore, regardless of the city size, municipal staff consistently report challenges related to funding, political support, communication with the public, and organizational capacity [13,14,16].

1.1.2. Urban Forest Risk Management

Although municipal agencies in the northeastern U.S.A. appointed personnel with the authority to manage hazard trees as early as the late 1800s [36], the inclusion of formal tree risk management did not become mainstream nationwide until the 1990s [37]. Within

the past three decades, court cases have demonstrated the importance of cities having a formal process for assessing and mitigating public tree risk [23]. Proactive management of tree risk involves monitoring trees for weaknesses such as root damage, decay, pests and disease, poor structure, and negative human impacts. The associated liability that comes with not maintaining the urban forest resource can be devastating, resulting in tort and criminal liability for property damage and loss of human life [38]. Despite variability in court cases, some authors have recommended a base level of the standard duty of care that municipalities are responsible for maintaining must involve some form of basic assessment of public trees (trees on public property) on a regular basis [23,39].

Conversely, fear or aversion to the legal implications of tree risk can lead municipalities and individuals to overcompensate with the removal of significant live tree mass or entire trees [21]. In these cases, the reactionary approach to tree risk is often not cost-effective from a management perspective and negatively affects the health and quality of benefits derived from the urban tree canopy [40]. Instead, researchers have urged tree managers to take a proactive approach to risk mitigation, including steps such as creating tree risk management plans, practicing proactive pruning, conducting target-based risk assessments, and creating policies for root protection from construction disturbances [37,40].

Tree risk management is not just a concern for municipalities. Private landowners are held responsible for tree damages caused from a lack of hazard identification [41]. Research suggests assistance to private individuals is needed in the form of systematic tree risk assessments and public education about tree assessments and preventative care [42]. However, research on residents' tree risk perceptions is lacking. There is a need for a deeper understanding on how risk management is influenced by the residents that experience it in order to govern for reduced vulnerability and increased agency towards addressing urban forest risks at the community level [43].

1.2. Community Risk Perceptions

A number of mental shortcuts, biases, and assumptions play into a person's assessment of individual risks. Many people simply do not have the time, desire, or information to understand the interrelated components of a single risk when it falls outside of their personal expertise [44]. This limitation in knowledge of a specific type of risk may result in reliance on "mental shortcuts" to determine the probability of harm and whether resources should be devoted to mitigating the risk. People use many forms of alternate decision-making tools instead of relying on probability or direct cost–benefit approaches [45,46].

One mental shortcut is trusting those who have more knowledge about the risk, such as professionals (experts), institutions, or some other resource [47]. In allowing a trustworthy institutional or social actor to determine the level of risk, individuals can outsource the mental task of assessing the probability that a negative event may occur. Another shortcut is tied to familiarity, or experience, with a risk. Lack of experience can lead to the assumption that an event will never occur since it has not yet occurred [44]. Similarly, low-probability/high-consequence risks, such as a catastrophic storm, can result in faulty expectations of risk probability, since direct experience with this type of event is likely to be minimal, even if the consequences are great. Social institutions (e.g., traditional and social media, religious organizations, governmental organizations, and advocacy groups) can exert an unreasonable perception of tree risk when low probability catastrophic tree failures are communicated [42,48].

In this research, we use the term "community risk perceptions" to denote that risk perceptions and mitigation are informed by interactions between individuals and their communities. The unacceptable level of community risk is determined through social interactions to warrant the use of time and resources to mitigate that level of risk. Assessment of community risk involves input from "experts" and laypersons, both of whom have valid approaches [49]. Studies have found patterns of similar risk association between members of subgroups that have been influenced by related social, cultural, and institutional factors [20,43]. This may reveal itself through regional patterns, professional

groups, socioeconomic class, sexual orientation, or any number of subgroupings. Likewise, in social systems with widely shared understanding, risk perceptions may be confirmed or amplified when communicated among members of similar groups or individuals with similar mental schemes [50].

Urban Forest-Based Solutions Framework

The European Forest Institute (EFI) addresses risk in its Urban Forest-Based Solutions framework (Figure 1) [51]. The framework refers to the ability of a system to accommodate disturbance while retaining core relationships between populations, the local economy, and the local environment that supports the system [31]. This ability highlights community resilience and the capacity to self-organize, learn, and adapt in the face of change [52]. Resilience is enhanced by linking human agency and local ecological systems, for instance, the adaptation from monoculture to an emphasis on species diversity after the loss of a valuable resource [53]. In an urban forestry context, a lack of resilience was demonstrated through the widespread loss of American elm street trees due to the introduction of Dutch Elm Disease in the 1920s. Some cities learned from this experience to include greater diversity in subsequent plantings, thereby increasing resilience [54]. The incorporation of healthy trees into a city landscape is a critical factor of urban resilience [55]. Additional examples of intervention include incorporating public access to vegetated spaces, retaining mature vegetation, creating wildlife refuge, and connecting human experiences through vegetated spaces. Urban forests contribute to resilience at various scales by providing a multitude of ecosystem services in the urban setting such as enhanced air quality, stormwater reduction, water quality, cooling factors, wildlife and microorganism habitats, and much more [56,57].

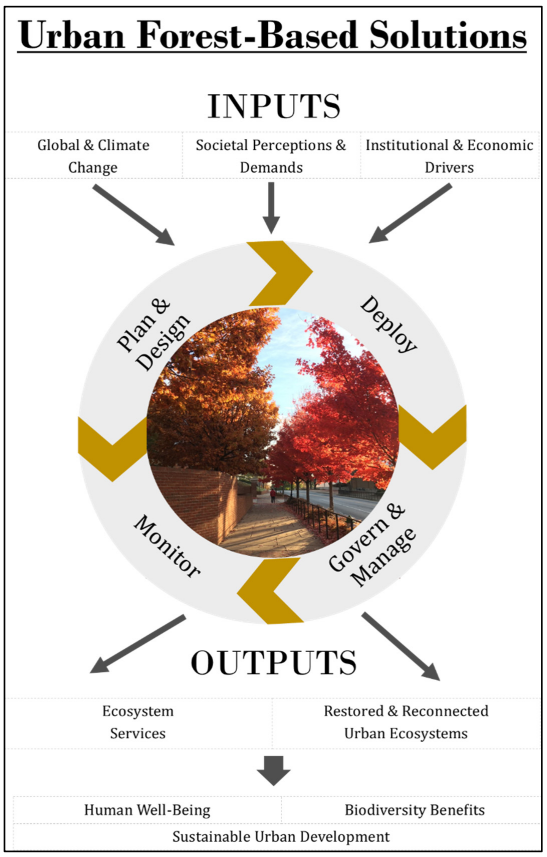

Figure 1. Resilience framework modified from the European Forest Institute Resilience Research Programme [51].

Included in EFI's framework are inputs such as the effects of climate change, societal perceptions and demands, and institutional and economic drivers. The qualities of these three factors must be assessed related to the specific ecological units of scale to which solutions will be applied. Within the framework's governance section, a feedback loop depicts the stages of governance: planning and design, deployment, management, and monitoring. Each element is vital to adaptation towards change and should be iterative based on changing stimuli. Planning and design should reflect findings from the environmental, social, and economic inputs, while deployment should ensure equitable impact and community engagement. Governance and management of existing solutions should include continual monitoring to ensure the effectiveness and appropriateness of deployed solutions. If conditions such as effectiveness, equity, or appropriateness are not met, governments should return to the planning stages in assessing the inputs and developing adaptations to solutions.

2. Materials and Methods

2.1. Study Sites

This study employed interviews with municipal employees and community leaders in four cities in the southern United States of America. Study sites were selected according to the state forestry agency's urban forestry program operational districts and city population size (see [58] for demographic information). Within each region, one site was selected based on population size, classified by a combination of USDA and US Census population thresholds: (1) <2500, (2) 2501–10,000, (3) 10,001–50,000, and (4) >50,000. The state's largest city and places with less than 500 residents were not considered within the scope of this research. Of the population cohort for each region, a number was assigned to each individual city and a random number generator determined which four cities were ultimately chosen. The final cohort consisted of four cities, one for each population classification within the four agency regions. For privacy purposes, pseudonyms are used for each study site in reporting findings.

The four study sites contained variation in demographic and socio-economic characteristics. The City of Aurora, the largest city studied, with over 100,000 residents, has experienced continual growth over the last decade, and had the second highest medium income (Table 1). The City of Chandler contained a population of just under 50,000 and has also experienced significant growth. Chandler had the highest medium income of the four study sites. Leeds contained a population of under 5000, with a decline in population over the last decade. It had a poverty rate of over 40% Clovis, the smallest site studied, contained less than 1000 residents, a declining population rate, and the third-highest median income.

Table 1. Study site characteristics *.

Study Site	Population	Growth Rate (%)	Median Income ($)
Aurora	100,000	+0.80	36,000
Chandler	50,000	+5.00	56,000
Leeds	5000	−0.80	19,000
Clovis	1000	−1.70	33,000

* The statistics are approximated to protect anonymity. This information is intended to provide context with specific demographic data not requisite to the research results or conclusions. Source: [58].

2.2. Data Collection

Data were collected using key informant (KI) interviews. KIs are individuals knowledgeable about the issue/community and were selected so as to be broadly reflective of various interest/social groups, including municipal staff as well as homeowners [59]. In each of the selected sites, a minimum of six key informant interviews were conducted, with interviews in each city continuing until replicability of the data occurred (saturation). It is important to recognize that the objective of this research was not to provide statistically representative findings; therefore, this research did not base the sample on statistical rep-

resentativeness. For example, unfilled informant categories for the two smallest towns were due to a limited pool of potential participants. Regardless of the category total, data saturation was achieved in these sites. The number of informants was inconsequential to the findings, which were not reported based on frequency; rather, findings were reported based on the themes' relationship with the research objective (for a discussion on qualitative robustness and representativeness of qualitative results, see [60,61]).

After speaking with the urban forester, city arborist, or person most involved in tree planning, a modified snowball sample provided other local participants. Additional community representation included individuals from, e.g., tree boards, garden clubs, members of the news media, the real estate industry, commercial arborists, cooperative extension, and the state forestry agency. Table 2 describes key informants. Of 59 KIs, 41 percent were female and five percent were people of color.

Table 2. Participating key informants by study site and participant group (key informant type).

Key Informant Type	Aurora	Chandler	Leeds	Clovis
Public tree manager	12	11	1	0
Municipal administrator	14	14	1	1
Private arborist	12	16	0	1
Community environmental group member	14	14	2	0
Real estate developer	15	14	0	2
News media participant	14	12	1	0
County extension agent	11	11	1	1
State Forestry Commission representative	11	11	1	1
TOTAL PARTICIPANTS	23	23	7	6

Interviews occurred in person and virtually in 2020 (due to COVID-19). An interview instrument consisting of open-ended questions guided each interview. Interviews were recorded for transcription, line-by-line analysis, and internal validation. The issues addressed were: (1) the level of importance the urban forest holds to the community, (2) how communities perceive and prepare for disasters, (3) municipal policies and practices in place for urban forest storm damage, (4) community attitudes towards risk management actions, and (5) the effects of tree failure risk on local lives and/or livelihoods. A combination of analytic induction and thematic analysis was used after interviews were transcribed [62]. Analysis was informed by field notes and post-interview reflection. Using a concurrent and iterative process, every new experience articulated by participants was evaluated against initial themes developed in the field. As analysis proceeded, additional codes were developed, and the initial coding scheme was revised and refined. This type of design is appropriate for seeking to uncover emergent phenomena [63]. Relationships among categories were identified and themes compared within and across cases. Exemplars for each code, category, and case were likewise identified.

3. Results

Results concentrate on: (1) structure, practices, and challenges within the four study sites; (2) participants' perceptions of parcel-level risk management; and (3) participants' perceptions of community-level risk management within the study sites.

3.1. Community Descriptions and Risk Mitigation Practices

3.1.1. Structure

Of the four sites, only Aurora and Chandler employed staff responsible for specific tree regulation activities, including educational outreach to residents. In particular, Aurora staffed two ISA-certified arborists with the titles Community Forester (i.e., urban forester) and Arborist—Planner II. The planning arborist reviewed commercial applications and

monitored completed projects for adherence to the tree ordinance. The Community Forester was responsible for guiding public tree maintenance activities with work completed by city crews or contracted parties, regulating utility pruning with work done by utility providers, and responding to resident requests regarding city right-of-way trees. The Community Forester spent much of his time addressing aging canopy issues and planting to increase tree species diversity. He also addressed environmental inequality issues through community engagement with the local university and publicly assisted populations. Both natural resource managers worked closely with the Community Tree Board, made of resident volunteers, from across the municipality. The Public Works Superintendent directed all post-storm response and debris clean-up using streets and drainage crews as well as landscape management crews, if necessary. Individuals such as the city Sustainability Officer, Keep Aurora Beautiful Executive Director, and Landscape Administrator also played minor roles in urban forest management through special projects such as invasive plant removal, conservation easement developments, and planting project initiation.

Chandler employed one non-ISA-certified employee, the Zoning Administrator, who addressed tree issues as part of the planning department. This individual reviewed commercial development submissions and performed limited services to private homeowners. These services consisted of visual assessments of tree risk on private trees upon request and responding to resident inquiries about tree pests and diseases. Chandler previously employed a certified arborist with a full range of duties but removed the position due to budget cuts. The Public Works Manager directed pruning and removals of hazard trees along rights-of-way and on public property. Notably, the county government employed a tree worker who was seeking professional certification; however, city and county staff reported limited collaboration regarding tree management. Although Chandler had a volunteer tree board, participants said it had limited input in decision-making. Of four members, three were city employees.

Participants from Leeds and Clovis reported their cities did not employ a staff person solely focused on tree care. Leeds's Public Works Department maintained clearance on roadways with approximately seven full-time staff members. The small city of Clovis tasked two individuals to monitor and manage stormwater, traffic, and parks. The Mayor of Clovis took responsibility for tree maintenance, directing tree cleaning and removals. Small, limited period grants were available through the state forestry agency; however, only Aurora had pursued this opportunity for a project related to a tree inventory.

3.1.2. Practices

Table 3 provides a summary of each community's personnel and their associated activities as described by study participants. Interview data suggest practices varied considerably in intensity and frequency within Aurora and Chandler, the two cities with the most active level of risk mitigation. In Aurora, the Community Forester regularly performed tree risk assessments in public rights-of-way and maintained a tree inventory of public trees. The municipality had long documented instances of public tree failures and retained records on tree hazard mitigation success. Furthermore, city crews were educated on proper tree pruning and lawmakers annually provided for a tree work budget. Primary means of risk mitigation in Chandler included right-of-way pruning and dead tree removals. The Public Works Director used Chandler Zoning Administrator as a resource for assessing trees in questionable condition. The city appropriated an annual budget for hazard tree removals that could not be completed in-house, and a limited windshield survey was the primary means of hazard identification in Chandler.

Both Aurora's and Chandler's respective municipal codes contained tree preservation provisions (i.e., retaining or replacing trees in construction zones, new developments, or within environmentally sensitive areas). These ordinances were implemented to meet goals specified in the cities' respective comprehensive plans. Therefore, at least to some extent, tree management, laws, and the comprehensive plan were integrated in both cities. Furthermore, Aurora had specific canopy goals for different land uses, specifications to

protect roots during development, and a plan for monitoring trees following construction. In Chandler, participants reported regulations regarding root protection either did not exist or were not enforced. Demonstrating variation between city and county governments, tree preservation specifications were reportedly stricter in the county than within the city of Chandler. This was notable because cities often have stricter tree ordinances due to greater development pressure compared with county jurisdictions.

Table 3. City tree management personnel and risk management activities by study site.

Study Site	Tree Management Personnel	Risk Mitigation Activities
Aurora	Community Forester (C.A.) * Arborist-Planner II (C.A.) Public Works Superintendent Sustainability Officer Beautification Director Landscape Management Administrator Community Tree Board (volunteers) Streets & Drainage crews Landscape Management crews	Maintain city tree inventory Conduct basic tree risk assessments Prescribe preventative pruning activities Respond to requests for public tree assessments Conduct private property outreach/assessments Monitor right-of-way and utility pruning cycles Document tree failure rates Contract for hazard tree removals Remove storm debris affecting rights-of-way Enforce tree ordinances before, during, and after development activities
Chandler	Zoning Administrator Public Works Director Sustainability Manager Tree Board Public Works crews	Conduct basic tree risk assessments upon request Respond to requests for public tree assessments Provide private property outreach/assessments Conduct right of way/utility pruning cycles Contract for hazard tree removals Remove storm debris affecting rights-of way
Leeds	Public Works Manager Public Works crew	Conduct right of way/utility pruning Conduct limited visual assessments annually Respond to requests for public tree assessments Contract for hazard tree removal Remove storm debris affecting rights-of way
Clovis	Mayor City maintenance crew	Respond to requests for public tree assessments Request state Department of Transportation for pruning/hazard response on state roadways

* C.A.—ISA Certified Arborist.

Risk mitigation practices in Leeds and Clovis were less comprehensive compared with their counterparts. Municipal tree care consisted of limited visual assessments for clearly visible hazards as well as the removal of fallen branches from roadways. No local ordinances regulated tree care, maintenance, or removals. Municipal staff noted that very little funding was allocated towards landscape maintenance in these cities. The Public Works Manager assessed tree hazard issues throughout the city of Leeds during winter months and occasionally requested an allocated budget for hazard tree removals. The municipal administrator in Leeds claimed that the city owned minimal public property containing trees, making tree risk mitigation a rare task on public land. Rights-of-way management were either transferred back to private citizens or informally released by the city for residential maintenance. In Clovis, participants said municipal staff allowed trees to fail, even when notified of dead or diseased trees beforehand. A state highway acts as the Main Street in Clovis, making utility line clearance the primary tree management activity performed by the State Department of Transportation (GDOT) upon the municipality's request.

3.1.3. Challenges

All four communities struggled with efficiently managing their resources according to the volume of annual public tree maintenance. The number of staff, their training, and equipment were often a factor of community size (and therefore tax base), as were the

associated budgets for maintenance activities such as tree risk reduction. As illustrated in the interview excerpts below, key informants noted these challenges when assessing their municipality's risk management activities.

> So I hate to sound like every other government person that's talked about resources, but the reality is that our tree budgets have not increased in 15 years. And what they used to buy, they buy a lot less of from the inflation of services. Forty thousand dollars used to get you 30 to 40 tree removals. It now gets you 15 maybe.
>
> (Municipal administrator, Aurora)

> I think that comes down to resources and time. I also think if it was widely advertised that there was a [city forester], they'd probably need three [of them to meet demand]. I don't think the county could afford that either.
>
> (Community environmental group member, Aurora)

The second excerpt suggests that residents recognized funding and time as barriers to effective tree care programs. Participants who were not municipal staff also acknowledged tree maintenance competes with higher priority municipal functions for resources. Tree program services were neither fully staffed nor made known to the public as a core public service. Nevertheless, participants noted public interest in increasing the number and visibility of tree program services.

3.2. Resident Perceptions and Actions to Reduce Tree Risks on Private Property

3.2.1. Responsibility for Risk

Study participants consistently referred to land ownership when discussing responsibility for tree risk mitigation in the urban forest. The findings suggest inconsistencies in attitudes about tree maintenance depending on the unit of scale.

> From my own experience, I don't see a lot of people taking initiative or caring as much about the trees that are directly in their backyard or on their street. They're going to gravitate towards the places that are maybe government-owned or publicly-managed or privately owned or whatever—the places that other people have to take care of, rather than putting in the effort to take care of the space in their own neighborhoods. But then I think that also goes into the issue of depending on who owns the land, what happens to that land can like be drastically different.
>
> (News media participant, Aurora)

As described above, participants reported variations in tree maintenance expectations based on whether the tree was a publicly owned tree versus a privately owned tree. They tended to perceive homeowners having less responsibility for private trees compared with the city's responsibility for managing public trees. Participants seemed to think residents were unable to distinguish the legal expectation for managing trees with an ethical responsibility for managing tree benefits and risks. The dilemma of environmental management on private property is a common issue in the United States of America and is evident at many management scales in various natural resource fields of study. In this study, discussions about the ownership of risk focused on the constructs of public or private property and the responsibilities each carry. Participants rarely acknowledged the collective actions of private individuals in contributing to community risk vulnerability. Reflecting one of the few exceptions, a private arborist in Chandler said, "You try to get people to understand that yes, you're all part of the big forest and if you preserve your trees, it's better for everybody."

To some extent, participants associated interpretations of collective, or community, risk with the failure of municipalities to communicate risk to the public. The participant below explained that the property rights dilemma had much to do with this lack of communication.

> Urban tree risk, in my mind, is a shared responsibility. There is the requirement for the municipality to be responsible for trees in their rights of ways and to educate the population about trees on their property—which they refuse to do because the residents don't want the government telling them what to do.
>
> (Public tree manager, Chandler)

As a whole, attitudes towards a safe and healthy tree canopy were rarely communicated unless referring to municipal actions on public or right-of-way trees. The public tree manager above, and perhaps residents in general, seemed to conflate the communication of tree risk and its associated mitigation with government interference. This is a common challenge of effective risk communication, regardless of whether it applies to natural resource management, health care, finance, education, or other industries. This finding also reflects the tendency of people to be more likely to accept voluntary risks and less likely to accept risks they perceive as involuntary.

3.2.2. Factors Contributing to Failure to Mitigate Risk on Private Property

Findings suggest that residents think very little about tree risk on their private properties until an event occurs that makes tree care noticeably relevant. According to private arborists and public tree managers alike, tree assessment requests significantly spiked after storm events, most notably in the areas where damage occurred. One public tree manager in Aurora said, "Those calls [tree hazard mitigation requests] do get a little bit greater after a big storm . . . But they kind of fade into the background the following week and we get our standard level of stuff after that." As the fear and relevancy of tree damage decreased over time, so did resident requests for treatments. Interview participants said relatively few residents took preventative measures to care for their trees in times of calm weather, minimizing their influence on the likelihood of tree failure.

> Well, I don't think they really take a look until there's something wrong. [laughing] You know, nobody's going to really pay attention until something happens.
>
> (Community environmental group member, Chandler)

The immediacy of a hazard forced residents to acknowledge the potential for danger from their trees, something they may not have considered during calm weather. Either the need to check for tree defects was not apparent to property owners or this responsibility was ignored until damage occurred.

Although a number of explanations suggest why homeowners did not address tree risk on their property (e.g., lack of knowledge about trees and imperceptible damage), participants often cited the cost of ongoing care (e.g., pruning and pest management) for large, mature trees as a deterrent to mitigation. One private arborist compared tree care with turf management:

> It's sad because a lot of what we do is relatively expensive, versus like, getting your lawn sprayed. For $35 to $50 bucks six times a year, you got a good-looking lawn. When it translates into trees, it's usually less frequent but more expensive.
>
> (Private arborist, Chandler)

In his explanation, visual preference was likely a primary driver of homeowner behavior regarding purchasing services. Often, tree care is not obvious or immediately observable to laypersons who may want immediate results; as such, the value of the service may be obscured. A municipal administrator in Aurora said, "We're trying to educate people [that] trees have a lifespan, and even though it's a huge, beautiful tree, it [can] become[s] unsafe." Rather than investing in long-term tree maintenance, homeowners more frequently paid for the removal of a tree after a storm event. Tree service firms may or may not discourage removal, a key income generator for many companies.

In contrast to visual benefits, interpreting and acting upon the likelihood that a tree located close to a home could cause damage was more difficult for residents. Along with a lack of knowledge, such probability biases often led to inaccurate judgements.

> I've had a number of people say to me, "Hey, I had a tree fall and hit my house. I'm going to cut every tree within 60 yards of my house down." So that's definitely something I've heard more than I'd like to.
>
> (Public tree manager, Leeds)

This excerpt suggests that many homeowners overestimate the likelihood that a tree may fail based on the proximity of their home, not on the health of the tree. Personal variation in acceptability of risk was recognized by public and private tree care workers as a motive for entire tree removal versus long-term maintenance. Participants noted that residents' life stage also appeared to impact their perception of risk, with elderly residents more likely to request tree removals.

A second factor impacting risk mitigation on private properties was laypersons' assumption that trees do not require maintenance. For instance, a private arborist in Aurora said:

> Because most people can point out a dead tree, but a lot of people can't figure out that [although] the tree is green and healthy and looks great, it's a ticking time bomb waiting to break at the base because of this cavity you can't see for the vines that are growing around it.

Potential signs of failure were not widely known among residents. Participants noted that residents tended to define tree health based on the development of spring leaves. Residents often neglected to look closer for signs of tree risk due to a lack of knowledge and skills. This was probably compounded by the tendency to take trees for granted in the southeastern United States of America, where climate and soils encourage tree growth and trees surround communities (e.g., parks, natural woodlands, and pine plantations).

In addition, some participants observed that plantings (such as the annual municipal Arbor Day celebration) were the primary way residents interacted to benefit the urban forest. Little subsequent attention or additional training was given once trees were planted.

> It sometimes can be bad because folks really are so interested in trees that they sometimes only see planting trees as a positive. They don't really recognize how the maintenance of trees is so important.
>
> (Municipal administrator, Aurora)

Ongoing care after community tree plantings tended to be left to municipal employees on public property or "mother nature" on private properties. Early care and ongoing maintenance were not common experiences for private individuals. A public tree manager remarked: "Tree maintenance is just as important as house maintenance . . . It's just that people (A) don't want to spend the money, but (B) maybe do not know about it."

3.3. Resident Perceptions and Actions to Mitigate Tree Risk at the Community Level

3.3.1. Values and Behaviors towards Public Trees

Residents' values towards the urban forest centered around aesthetics and shade. Regardless of the study site or key informant type, participants cited aesthetics as the primary benefit of city trees. Trees enhanced the livability of these communities and provided a sense of place.

> I think the biggest thing is aesthetic beauty of a town. It looks more genuine, more welcoming if you have a mixture of plants and trees. Just going in and doing a cityscape with nothing but concrete, is not something anybody will—It's just not appealing.
>
> (Real estate developer, Chandler)

> I think shade and making the area attractive to want to be in, to spend time in, is actually one of the most important benefits. And I think that's what people appreciate [here].
>
> (Community environmental group member, Aurora)

Although a majority of properties containing the collective urban forest belonged to private owners, citizens perceived canopy trees as public resources that contributed to their city's sense of place. In Aurora and Chandler specifically, where more development and land clearing activities occurred, individuals or interest groups put pressure on those developments that appeared to subtract the value of the urban forest.

> When you go to an area and there isn't trees and there's a lot of development . . . it just doesn't feel right. It doesn't look right. So I think having those trees, it provides shade, it provides the buffers between properties, it provides ambiance and a feeling—this may just be perceived but I think you feel healthier when you're around trees in your environment, when they're there and they appear to be healthy. You know there's birds—there's things that there's supposed to be. So, I think that's a good thing.
>
> (Real estate developer, Aurora)

In Leeds and Collins, which had very limited development, participants nevertheless expressed the value of trees within their respective community contexts. Trees were described as contributing to both the towns' and surrounding landscapes' unique sense of place.

> I would think that they would want a piece of property that is not stripped out. That to me is the ideal country living. Where you've got pecan trees or oak trees or pine trees and a pond or a field to plant a garden in. I do feel the trees are important in that rural area.
>
> (Real estate developer, Clovis)

> I think most people don't appreciate some of the things we like to talk about, like traffic-calming and carbon sequestration and stuff like that. Definitely, [they appreciate] more of the aesthetic value [of the urban forest]—what it brings to the community and feeling like they've taken care of the town appearance. [It's] more of a sentimental aesthetic value than anything else in these small towns with trees.
>
> (Public administrator, Leeds)

The degree to which other ecological services impacted community value for the urban forest varied by interest group within each city. Many participants that referenced the social, environmental, and economic benefits of the urban forest commented that these services did not resonate with residents in an action-evoking way.

3.3.2. Risk Governance

Findings revealed that participants felt residents were comfortable ceding responsibility for collective tree risk mitigation to their local municipality. This contrasted with the municipal desire for cooperation from private property owners. All four sites demonstrated a lack of community feedback as long as hazard response services ran smoothly. Participants did not describe residents as expressing a desire for additional engagement in municipal tree management and risk mitigation. Nevertheless, study participants in all communities said citizens expected a prompt response to their calls to local government about hazardous public trees. Again, the motivation for the call was often related to aesthetic cues.

> The biggest response is they want it cleaned up. [chuckles] As far as the debris and things . . . if it's a fallen tree, get it cleaned up and get it out of the way.
>
> (Real estate developer, Chandler)

The ability to remove tree debris and restore a street, park, or neighborhood's appearance played a strong role in residents' positive perceptions of municipal tree risk management. The shorter the length of time a failed tree remained in a right of way or park, the more efficient public tree managers appeared to residents.

A number of interview participants who were not tree managers suggested improvements to their city's risk management. Example improvements included burying utility lines to reduce the likelihood of tree and utility line conflicts, revising ordinances to require broader tree protection standards, and instituting incentives towards community tree care. Despite articulating these ideas in interviews, few had communicated them to their local government, further suggesting challenges with resident engagement.

Local governments were likewise unlikely to engage with the public when developing solutions to improve management of the urban forest. Participants employed by city governments provided applications of adaptation in urban forest management in all four cities when faced with scarce resources. Examples of agency and flexibility were evident through interdepartmental collaboration when addressing hazards in light of limited funding, development impacts, and risk identification.

> Our stormwater inspectors are on site on these commercial projects fairly regularly. I've got good communication with those folks. They have been more and more proactive about it; I really have to commend them. Even if it's just something of, "Hey, we need you to come out here and take a look at this." "Maybe everything's okay but come out here and take a look." And so those folks have been great. They're generally my eyes because I don't go out on site and inspect sites until they're done.
>
> (Public tree manager, Aurora)

The benefits of interdisciplinary collaboration were evident in Aurora and Chandler, where tree management spread effectively across two or more departments. Aurora showed flexibility dealing with budget constraints when mitigating immediate instances of tree risk, while both Chandler and Aurora built internal relationships to accomplish cross-departmental goals. No participants in either city discussed conflicts with shared expectations and responsibilities about trees.

In some cases, municipalities incorporated urban forest improvements into broader socio-ecological contexts. Aurora notably showcased a culture of asking questions and applying innovation when approaching social and ecological dilemmas, for example, in examining the equitable management of public tree resources. However, these adaptation practices occurring within city governments were not communicated back to the community at large. Cities were more likely to focus their tree program communication on the positive aspects of the urban forest such as tree plantings than risk management actions such as removals.

> I do think the city, if they could do anything better, it might be that they could help educate me better so that people like myself could pass it along. Maybe tap people on the shoulder so that there are business leaders inside the city, so that we could make sure that we pass that on to everybody else.
>
> (Real estate developer, Chandler)

4. Discussion

This research addresses a need in urban forestry research regarding the intersection of urban forest risk management and community perceptions of tree risk [45,64]. A large body of work exists that focuses on community-level mitigation of natural disaster risk, such as wildfire and flooding. However, there are few studies that focus on the context of perceptions and community mitigations of risk of tree failure (one exception is [65], who assessed the use of the tree risk assessment model by professionals and a specific resident group of volunteers). To this end, a primary finding in this paper was the reported nuanced differences in perceptions about tree risk management on private property compared with the community as a whole.

This discrepancy between private property versus the community level of risk management impacts community vulnerability [51]. Without planning and implementing tree risk mitigation on the community level, recognizing the impact of climate variability,

community perceptions, and economic opportunities and challenges, communities are leaving themselves open to higher vulnerability. A community with high tree canopy coverage faces higher risk probabilities if they are not managing for tree health and human safety compared with its counterpart. By contrast, a community that reduces their canopy coverage to avoid tree risk contributes to other vulnerabilities associated with the absence of benefits that trees provide to the local community, ecosystem, and economy. A balance must be achieved between appropriate proportion of tree canopy coverage and ability to adequately manage and maintain that canopy.

This research responds to Klein et al.'s [43] call for research on how municipal tree care workers communicate risk in the urban forest. Findings from our research confirm that risk communication from municipalities is often lacking, an issue when considering resident limitations in assessing and acting on signs of tree risk. Private property rights, which are a function of local culture and structure, was the most commonly identified explanation for this disconnection between responsibility for the urban forest and personal convenience when managing personal trees. As private land comprises the majority of ownership in most U.S. cities, risk reduction on private property is an important component of building community resilience and reducing vulnerability. Individual maintenance of trees within the urban forest impacts not only personal safety for residents but also affects public safety when hazardous tree or limb failures interfere with public rights-of-way, utilities, and neighboring properties. Fay [42] suggests that the arboriculture profession should take a leading role in connecting community and municipal goals towards risk mitigation and, therefore, bridging the property rights gap identified in this research.

Urban Forest Management

In the wake of climate variability and increased urbanization, effective tree risk management is an increasingly important element of urban forestry governance in cities. However, limitations such as funding, personnel capacity, and public communication were found to be evident in this study, thus confirming previous research on challenges cities face in managing their urban forests [13,14,16]. Although urban forest programs can function effectively regardless of community size [43], these findings also reflect that the addition of resources, policies, and staffing towards city trees is positively associated with city size and urbanization [33]. Although the tax base facilitates improved tree management resources, efficient budgetary approaches and prioritization of community needs, in combination with resident engagement, may also improve municipal tree management, regardless of city size.

Socio-ecological resilience was explored at all four sites based on their ability to self-organize, learn, and adapt throughout periods of minimal and maximum disturbance [52]. In applying EFI's Urban Forest Based Solutions resilience framework [51], findings showed that Aurora applied elements of addressing the social, environmental, and economic inputs when developing governance strategies towards an ever-changing urban forest. While they were most likely to have a pulse on various community groups' attitudes towards the urban forest and retained records to monitor success, they still faced the challenge of balancing equitable tree management and public engagement with the local government in addressing risks. Chandler showed elements of resilience when using interdepartmental collaboration towards risk identification and tree management but lacked attention towards monitoring for success and opportunities for adaptation. The strengths of Clovis and Leeds came from the direct access community members had to decision-makers in each city, making the communication of societal perceptions and demands less convoluted than in Aurora and Chandler. Although none of the four cities experienced a recent catastrophic natural disaster that would clearly test their level of resilience, KIs in all four locales expressed experiences with damage from weather events, making risk mitigation a relevant priority.

The EFI framework was useful in assessing city resilience in each government of this study, incorporating the three pillars of sustainability (environment, society, and economy)

as inputs towards inclusive, appropriate, and iterative governance towards the urban forest. However, the framework lacked the capacity to address bottom-up resilience building within each community [66]. An opportunity exists for a complementary framework, exploring community agency and its intersection with municipal actions in pursuit of urban forest resilience. The disconnect between community perceptions towards public versus private risk mitigation lacks a framework for outlining community-led resilience. Theoretical frameworks describing community-driven risk and resilience, such as wildfire and technical disaster research [30], may prove beneficial in this case. Incorporating diverse populations and social groups in private sector solutions to tree risk mitigation would likewise incorporate a greater level of inclusivity and diversity in approaches, increasing resilience at the individual and community scales [27].

A connection also arose between residents' attitudes towards the urban forest and municipal adaptation. Although, on the surface, participants characterized their communities as appreciative of urban trees, the specific expectations of each community varied and indirectly influenced urban forest management. The most resilient communities influenced municipal tree activities through the positions, ordinances, and resources they supported. The expectations and allowed innovative flexibility of each community towards their municipal government appeared to be associated with the quality of urban forest management, validating the EFI resilience framework.

To address financial limitations discussed by participants, adaptive programs cited exploration into alternative sources of funding, such as community fundraising, grant applications, and cost-sharing partnerships. For example, resilient communities could be more aggressive in leveraging tree assessment data for grant funding through the state forestry agency grant program. Community members were brought into this process, bringing awareness to the tree activities in cities who practiced diversity in funding. However, it is notable that risk mitigation was not a part of the publicly communicated narrative around these activities, even when the funded activity included risk reduction as a goal.

5. Conclusions

To address the need for increased private property engagement towards risk management, long-term solutions for enhanced community tree knowledge and improved decision making should be applied. Furthermore, this should be paired with direct approaches to developing a broader audience of laypeople with the agency to identify signs of risk on their own properties [67]. Addressing community groups and shared social sectors for direct engagement with citizen groups who share similar interests [68]. For example, neighborhoods or homeowners' associations, business- and homecare-related professional associations, or community groups/nonprofits would be effective social groups to engage in tree risk mitigation campaigns.

A lack of access to affordable tree care was also addressed in this research as a hindrance to tree maintenance on private property. Local governments may have knowledgeable tree managers on staff, the workforce capacity or equipment to complete tree work, and the funding to remove immediate hazards, but homeowners often lack one or more of these resources [26]. Tree care affordability is a factor of market demand for services and price set by individual companies, with professional qualifications and safety-insured businesses often costing more. By informing citizens of the benefits of early tree care (for planted and ingrown trees) on long-term tree health and growth, a more accessible and affordable system of tree care can be pursued over the tree's lifespan [41]. Municipalities with strong urban forest values and existing programs could be the first to communicate these strategies of tree maintenance, but private tree care companies could play a role as well [42]. Several professional tree care companies involved in our study commented on informing clients of tree maintenance options rather than total tree removal (when appropriate). Municipalities share the responsibility of educating the public with the

tree care industry as they likewise have much to gain economically from a healthy and well-maintained urban forest.

When planning for public engagement towards the urban forest, many programs already exist within communities that support and enhance the urban forest directly or indirectly. This engagement, and the perceptions it impacts, is crucial because perceptions of tree risk and management can be different from those of other ongoing city projects but may influence the effectiveness of urban tree policies and implementation. The results from this study and others [7,68–70] demonstrate that tree programs typically focus their community involvement on planting trees and educating youth and adults about tree benefits. However, urban trees' future requirements and possible problems must be part of educational content as well. This may be incorporated into tree planting events or standalone activities. For example, measuring tree growth and crown spread can be an annual community task worth celebrating. Conducting beneficial maintenance tasks such as mulching or fertilizing trees can be advocated by institutions. The knowledge and experience that practices such as this bring to communities reduces uncertainty and unease with tree care decisions on private properties [71]. The urban landscape can be a difficult place for trees to thrive, so a community that practices socio-ecological resilience is one that incorporates the full life cycle of trees into its urban system, which includes humans.

Finally, findings on laypeople's attitudes and behaviors towards ambiguous tree risk and the lack of direct actions taken to mitigate those risks warrant future study. These findings are not unique to tree risk but speak towards a larger human pattern of risk prioritization of unknown or limited topics of knowledge [48]. More research is needed to understand what the thresholds of tree risk knowledge are for the average citizen and to identify effective tree risk communication and policy strategies. Adaptation should be applied as to how municipalities and tree-related agencies on multiple scales (e.g., professional tree care associations, state forestry commissions, national environmental groups, and others) can reduce the ambiguity associated with identifying tree hazards prior to irreversible tree decline [20]. More research into how communities can be incorporated into the risk mitigation narrative also needs to be explored. Future research should address researchers' perceptions and biases towards risk and risk mitigation (see [72]).

Author Contributions: Conceptualization, A.J. and J.G.; writing—original draft preparation, A.J.; writing—primary review and editing, J.G.; writing—secondary review and editing, J.A. and K.I. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Society of American Foresters, Kurt Gottschalk Science Fund, and the National Garden Club, Louisiana Chapter.

Institutional Review Board Statement: The University of Georgia Human Research Protection Program has determined that the research is Exempt. The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board of the University of Georgia (protocol code PROJECT00002385 4 June 2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy concerns.

Acknowledgments: The authors acknowledge the Society of American Foresters (Forest Science & Technology Board) and the National Garden Club, Inc. (Louisiana Chapter) for their award funding towards this research.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

1. Moeller, G.H. The Pinchot Institute: Toward Managing our Urban Forest Resources. *J. Arboric.* **1997**, *4*, 181–186.
2. Nowak, D.J.; Randler, P.B.; Greenfield, E.J.; Comas, S.J.; Carr, M.A.; Alig, R.J. *Sustaining America's Urban Trees and Forests: A Forests on the Edge Report*; Gen. Tech. Rep. NRS-62; Department of Agriculture, Forest Service, Northern Research Station: Newtown Square, PA, USA, 2010.
3. Seamans, G.S. Mainstreaming the environmental benefits of street trees. *Urban For. Urban Green.* **2013**, *12*, 2–11. [CrossRef]
4. Nowak, D.J. Institutionalizing urban forestry as a "biotechnology" to improve environmental quality. *Urban For. Urban Green.* **2006**, *5*, 93–100. [CrossRef]
5. Hull, B.R. How the Public Values Urban Forests. *J. Arboric.* **1992**, *18*, 98–101.
6. Kuehler, E.; Hathaway, J.; Tirpak, A. Quantifying the benefits of urban forest systems as a component of the green infrastructure stormwater treatment network. *Ecohydrology* **2017**, *10*, e1813. [CrossRef]
7. Pincetl, S. Implementing Municipal Tree Planting: Los Angeles Million-Tree Initiative. *Environ. Manag.* **2009**, *45*, 227–238. [CrossRef] [PubMed]
8. Nowak, D.J.; Dwyer, J.F. Understanding the Benefits and Costs of Urban Forest Ecosystems. In *Urban and Community Forestry in the Northeast*; Springer: Dordrecht, The Netherlands, 2007; pp. 25–46. [CrossRef]
9. Maas, J.; Verheij, R.A.; De Vries, S.; Spreeuwenberg, P.; Schellevis, F.G.; Groenewegen, P. Morbidity is related to a green living environment. *J. Epidemiol. Community Health* **2009**, *63*, 967–973. [CrossRef] [PubMed]
10. Dombrow, J.; Rodriguez, M.; Sirmans, C.F. The Market Value of Mature Trees in Single-Family Housing Markets. *Apprais. J.* **2000**, *68*, 39–43.
11. Ordóñez, C.; Threlfall, C.G.; Kendal, D.; Hochuli, D.F.; Davern, M.; Fuller, R.A.; van der Ree, R.; Livesley, S.J. Urban forest governance and decision-making: A systematic review and synthesis of the perspectives of municipal managers. *Landsc. Urban Plan.* **2019**, *189*, 166–180. [CrossRef]
12. Johnson, C. Political and Administrative Factors in Urban Forestry Programs. *J. Arboric.* **1982**, *8*, 160–164.
13. Driscoll, A.N.; Ries, P.D.; Tilt, J.H.; Ganio, L.M. Needs and barriers to expanding urban forestry programs: An assessment of community officials and program managers in the Portland—Vancouver metropolitan region. *Urban For. Urban Green.* **2015**, *14*, 48–55. [CrossRef]
14. Elmendorf, W.F.; Cotrone, V.J.; Mullen, J.T. Trends in Urban Forestry Practices, Programs, and Sustainability: Contrasting a Pennsylvania, U.S., Study. *Arboric. Urban For.* **2003**, *29*, 237–248.
15. Grado, S.; Measells, M.; Grebner, D. Revisiting the Status, Needs, and Knowledge Levels of Mississippi's Governmental Entities Relative to Urban Forestry. *Arboric. Urban For.* **2013**, *39*, 149–156. [CrossRef]
16. Hauer, R.J.; Peterson, W.D. *Municipal Tree Care and Management in the United States: A 2014 Urban & Community Forestry Census of Tree Activities*; Special Publication 16-1; College of Natural Resources, University of Wisconsin—Stevens Point: Stevens Point, WI, USA, 2016; 71p.
17. Treiman, T.; Gartner, J. Community Forestry in Missouri, U.S.: Attitudes and Knowledge of Local Officials. *J. Arboric.* **2004**, *30*, 205–214.
18. Young, R.F. Mainstreaming urban ecosystem services: A national survey of municipal foresters. *Urban Ecosyst.* **2013**, *16*, 703–722. [CrossRef]
19. U.S. Global Change Research Program. *Climate Science Special Report: Fourth National Climate Assessment*; Global Change Research Program 2017–2018: Washington, DC, USA, 2017. Available online: https://science2017.globalchange.gov/ (accessed on 30 August 2021).
20. Slovic, P. Perception of Risk: Reflections on the Psychometric Paradigm. In *Social Theories of Risk*; Krimsky, S., Golding, D., Eds.; Praeger: Westport, CT, USA, 1992; pp. 45–67.
21. Gullick, D.; Blackburn, G.; Whyatt, J.; Vopenka, P.; Murray, J.; Abbatt, J. Tree risk evaluation environment for failure and limb loss (TREEFALL): An integrated model for quantifying the risk of tree failure from local to regional scales. *Comput. Environ. Urban Syst.* **2019**, *75*, 217–228. [CrossRef]
22. Kabir, E.; Guikema, S.; Kane, B. Statistical modeling of tree failures during storms. *Reliab. Eng. Syst. Saf.* **2018**, *177*, 68–79. [CrossRef]
23. Barrell, J. Balancing tree benefits against tree security: The duty holder's dilemma. *Arboric. J.* **2012**, *34*, 29–44. [CrossRef]
24. Schwab, J.C. Planning the Urban Forest: Ecology, Economy, and Community Development. 2009. Available online: https://www.planning.org/publications/report/9026879/ (accessed on 30 August 2021).
25. Kenney, W.A.; van Wassenaer, P.J.E.; Satel, A.L. Criteria and Indicators for Strategic Urban Forest Planning and Management. *Arboric. Urban Plan.* **2011**, *37*, 108–117.
26. Baur, J.W.; Tynon, J.F.; Ries, P.; Rosenberger, R.S. Public attitudes about urban forest ecosystem services management: A case study in Oregon cities. *Urban For. Urban Green.* **2016**, *17*, 42–53. [CrossRef]
27. Janse, G.; Konijnendijk, C.C. Communication between science, policy and citizens in public participation in urban forestry—Experiences from the Neighbourwoods project. *Urban For. Urban Green.* **2007**, *6*, 23–40. [CrossRef]
28. Dwyer, J.F.; Schroeder, H.W. The Human Dimensions of Urban Forestry. *J. For.* **1994**, *92*, 12–15.
29. Sievert, R.C. Public awareness and urban forestry in Ohio. *J. Arboric.* **1988**, *14*, 48–51.

30. Gordon, J.S.; Luloff, A.; Stedman, R.C. A Multisite Qualitative Comparison of Community Wildfire Risk Perceptions. *J. For.* **2012**, *110*, 74–78. [CrossRef]
31. Holling, C.S. Resilience and Stability of Ecological Systems. *Annu. Rev. Ecol. Syst.* **1973**, *4*, 1–23. [CrossRef]
32. Carmichael, C.E.; McDonough, M.H. The trouble with trees? Social and political dynamics of street tree-planting efforts in Detroit, Michigan, USA. *Urban For. Urban Green.* **2018**, *31*, 221–229. [CrossRef]
33. Lavy, B.; Hagelman, R.R. Protecting the urban forest: Variations in standards and sustainability dimensions of municipal tree preservation ordinances. *Urban For. Urban Green.* **2019**, *44*. [CrossRef]
34. Conway, T.; Urbani, L. Variations in municipal urban forestry policies: A case study of Toronto, Canada. *Urban For. Urban Green.* **2007**, *6*, 181–192. [CrossRef]
35. Galenieks, A. Importance of urban street tree policies: A Comparison of neighbouring Southern California cities. *Urban For. Urban Green.* **2017**, *22*, 105–110. [CrossRef]
36. Ricard, R.M. Shade Trees and Tree Wardens: Revising the History of Urban Forestry. *J. For.* **2005**, *103*, 230–233.
37. Pokorny, J.D. *Urban Tree Risk Management: A Community Guide to Program Design and Implementation*; USDA Forest Service Northeastern Area State and Private Forestry: Newtown Square, PA, USA, 2003. Available online: https://www.fs.usda.gov/treesearch/pubs/11070 (accessed on 30 August 2021).
38. Adams, J. Dangerous trees? *Arboric. J.* **2007**, *30*, 95–103. [CrossRef]
39. Koeser, A.K.; Hauer, R.J.; Miesbauer, J.W.; Peterson, W. Municipal tree risk assessment in the United States: Findings from a comprehensive survey of urban forest management. *Arboric. J.* **2016**, *38*, 218–229. [CrossRef]
40. Ellison, M. Moving the Focus from Tree Defects to Rational Risk Management—A Paradigm Shift for Tree Managers. *Arboric. J.* **2007**, *30*, 137–142. [CrossRef]
41. Mortimer, M.J.; Kane, B. Hazard tree liability in the United States: Uncertain risks for owners and professionals. *Urban For. Urban Green.* **2004**, *2*, 159–165. [CrossRef]
42. Fay, N. Towards Reasonable tree risk decision-making? *Arboric. J.* **2007**, *30*, 143–161. [CrossRef]
43. Klein, R.; Koeser, A.; Hauer, R.; Hansen, G.; Escobedo, F. Risk Assessment and Risk Perception of Trees: A Review of Literature Relating to Arboriculture and Urban Forestry. *Arboric. Urban For.* **2019**, *45*, 26–38. [CrossRef]
44. Freudenburg, W.R. Heuristics, Biases, and the Not-So-General Publics: Expertise and Error in the Assessment of Risks. In *Social Theories of Risk*; Krimsky, S., Golding, D., Eds.; Praeger: Westport, CT, USA, 1992.
45. Kunreuther, H. A Conceptual Framework for Managing Low-Probability Events. In *Social Theories of Risk*; Krimsky, S., Golding, D., Eds.; Praeger: Westport, CT, USA, 1992; pp. 12–34.
46. Tversky, A.; Kahneman, D. Judgment under Uncertainty: Heuristics and Biases. *Science* **1974**, *185*, 1124–1131. [CrossRef] [PubMed]
47. Wynne, B. Risk and Social Learning: Reification to Engagement. In *Social Theories of Risk*; Krimsky, S., Golding, D., Eds.; Praeger: Westport, CT, USA, 1992; pp. 89–102.
48. Visschers, V.; Meertens, R.M.; Passchier, W.F.; Devries, N.K. How Does the General Public Evaluate Risk Information? The Impact of Associations with Other Risks. *Risk Anal.* **2007**, *27*, 715–727. [CrossRef]
49. Renn, O. Perception of Risks. The Geneva Papers on Risk and Insurance. *Issues Pract.* **2004**, *29*, 102–114.
50. Kasperson, R.E. The Social Amplification of Risk: Progress in Developing an Integrative Framework. In *Social Theories of Risk*; Krimsky, S., Golding, D., Eds.; Praeger: Westport, CT, USA, 1992; pp. 145–167.
51. De Vreese, R. Urban Forest-Based Solutions for Resilient Cities. 2018. Available online: Resilience-blog.com (accessed on 1 May 2021).
52. Adger, W.N.; Hughes, T.P.; Folke, C.; Carpenter, S.R.; Rockström, J. Social-Ecological Resilience to Coastal Disasters. *Science* **2005**, *309*, 1036–1039. [CrossRef]
53. Godschalk, D.R. Urban Hazard Mitigation: Creating Resilient Cities. *Nat. Hazards Rev.* **2003**, *4*, 136–143. [CrossRef]
54. Jonnes, J. *Urban Forests: A Natural History of Trees in the American Cityscape*; Viking: New York, NY, USA, 2016.
55. Gill, S.E.; Handley, J.F.; Ennos, A.R.; Pauleit, S. Adapting Cities for Climate Change: The Role of the Green Infrastructure. *Built Environ.* **2007**, *33*, 115–133. [CrossRef]
56. Steenberg, J.; Duinker, P.N.; Nitoslawski, S. Ecosystem-based management revisited: Updating the concepts for urban forests. *Landsc. Urban Plan.* **2019**, *186*, 24–35. [CrossRef]
57. Huff, E.; Johnson, M.; Roman, L.; Sonti, N.; Pregitzer, C.; Campbell, L.; McMillen, H. A Literature Review of Resilience in Urban Forestry. *Arboric. Urban For.* **2020**, *46*, 185–196. [CrossRef]
58. United States Census Bureau. *Annual Estimates of the Resident Population: 1 April 2010 to 1 July 2018*; US Census Bureau: Washington, DA, USA, 2019. Available online: http://www.census.gov/ (accessed on 1 October 2021).
59. Bryman, A. *Social Research Methods*, 4th ed.; Oxford University Press: Oxford, UK, 2012.
60. Berg, B. *Qualitative Research Methods for the Social Sciences*, 5th ed.; Pearson/Allyn & Bacon: Boston, CA, USA, 2004.
61. Morgan, D. Focus Groups. *Annu. Rev. Sociol.* **1996**, *22*, 129–152. [CrossRef]
62. Boyatzis, R.E. *Transforming Qualitative Information: Thematic Analysis and Code Development*; Sage Publications: Thousand Oaks, CA, USA, 1998.
63. Strauss, A.; Corbin, J. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*; Sage: Newbury Park, CA, USA, 1990.
64. Willis, K.; Petrokofsky, G. The natural capital of city trees. *Science* **2017**, *356*, 374–376. [CrossRef]

65. Koeser, A.K.; Klein, R.W.; Hasing, G.; Northrop, R.J. Factors driving professional and public urban tree risk perception. *Urban For. Urban Green.* **2015**, *14*, 968–974. [CrossRef]
66. Santiago, L.; Flores, D.; Hong, C.-Y. The impact of extreme weather events on community risk planning and management: The case of San Juan, Puerto Rico after hurricane Maria. *Urbe. Revista Brasileira de Gestão Urbana* **2020**, *12*, 20190062. [CrossRef]
67. Moskell, C.; Allred, S.B. Residents' beliefs about responsibility for the stewardship of park trees and street trees in New York City. *Landsc. Urban Plan.* **2013**, *120*, 85–95. [CrossRef]
68. Wyman, M.; Escobedo, F.J.; Stein, T.; Orfanedes, M.; Northrop, R. Community Leader Perceptions and Attitudes toward Coastal Urban Forests and Hurricanes in Florida. *South. J. Appl. For.* **2012**, *36*, 152–158. [CrossRef]
69. Ordóñez, C.; Duinker, P.N. An analysis of urban forest management plans in Canada: Implications for urban forest management. *Landsc. Urban Plan.* **2013**, *116*, 36–47. [CrossRef]
70. Hewitt, V.; Mackres, E.; Shickman, K. *Cool Policies for Cool Cities: Best Practices for Mitigating Urban Heat Islands in North American Cities*; American Council for an Energy-Efficient Economy: Washington, DC, USA, 2014; 53p.
71. Wilkinson, K. *The Community in Rural America*; Greenwood Press: New York, NY, USA, 1991.
72. Wang, C.; Wang, Z.-H.; Kaloush, K.E.; Shacat, J. Perceptions of urban heat island mitigation and implementation strategies: Survey and gap analysis. *Sustain. Cities Soc.* **2021**, *66*, 102687. [CrossRef]