Arboriculture & Urban Forestry 2026
https://doi.org/10.48044/jauf.2026.027

Bridging Perceptions and Practices: Insights from Post-Hurricane Tree and Landscape Damage

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Abstract. Background: The 2024 hurricane season devastated the Southeastern United States, with Florida's Southwestern Gulf Coast counties uniquely impacted. While debris clogged roadways and communities struggled to recover, the full extent of tree and landscape damage was only beginning to emerge. In the wake of disasters, Land Grant University Extension services provide education and technical expertise to residents and policymakers, serving as vital hubs of connection. Extension programs are effective when they address specific community challenges. Methods: To guide program development and outreach, a needs assessment survey was conducted to determine tree and landscape damage, management costs, and whether hurricane impacts altered perceptions of trees. Results: Respondents reported a significant increase in fear of trees following the hurricane, and this increase was not correlated with landscape and property damage. Of the major roof damage cases (8 total), all were associated with large tree failure, while the remaining moderate or minor cases (76 total) occurred without whole tree failure. Although major roof impacts were uncommon, their association with whole tree failure underscores the severity of such events. Fear or perception of trees as dangerous did not show a clear relationship with observed damage or replanting intentions, indicating a perceptual gap. Conclusions: Despite elevated fear of trees, approximately one-third of respondents were still willing to replant. This contrast between concern and behavior reflects the broader perceptual gap identified. Addressing this gap requires community education that emphasizes evidence-based tree planting and management practices. These implications are directly actionable for Extension programming.

Keywords. Extension Education; Hurricane Resilience; Risk Perception; Urban Forestry.

INTRODUCTION

Urban forests in Florida span a diverse social-ecological gradient from densely developed coastlines to cities and rural communities interspersed with forests and wetlands. Collectively, these urban forests cover approximately 607,000 hectares (Florida Forest Service 2024). On average, Florida's urban areas maintain 36% tree canopy coverage, which provides a vital suite of services to residents (Florida Forest Service 2024). In fact, a 2020 analysis of Florida's urban forest values revealed that these forests contribute $605 million (USD) in avoided health care costs, $451 million (USD) in avoided stormwater management costs, and capture 65 million tons of CO_2 (McLean et al. 2020).

Shade and beauty, often the first benefits recognized and valued by the public, are major drivers of canopy conservation, yet ecosystem disservices and the proactive management required to address them have led to practices such as planting appropriately, pruning proactively, and removing potentially risky trees (Cadaval et al. 2024). Recent trends in canopy coverage highlight the vulnerability of Florida's urban forests. Between 2017 and 2021, some regions experienced a distinct reduction in canopy, largely due to the impacts of Hurricane Michael (Florida Forest Service 2024). Historically, hurricanes and other tropical storms have damaged Florida's landscapes, not only by bringing down trees but also by mortality caused by standing water or salt inundation in the aftermath (Duryea et al. 1996).

This vulnerability was underscored in the 2024 hurricane season, when two major storms struck Florida's west coast within two weeks. Hurricane Helene made landfall on September 26 near Perry, Florida, as a Category 4 storm with peak winds of 62 m/s (140 mph). Its trajectory pushed storm surge southward, producing peak levels over two meters in the Tampa Bay area, levels unseen since 1921 (Powell 2024).

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Helene continued through the Southeast, leading to flooding and landslides in North Carolina. Shortly after, Hurricane Milton made landfall in Florida on October 9, near Siesta Key, as a Category 3 storm. Milton's maximum sustained winds reached 80 m/s (180 mph), and the storm generated at least 47 tornadoes, the most on record for a single hurricane in Florida (Powell 2024). These storms led to an estimated 5% canopy loss in the City of Tampa alone (Mayor 2026).

Beyond physical damage, storms influence human behavior and landscape-level decision-making (Conway and Yip 2016). As individuals move through the emotional stages following a natural disaster (DeWolfe 2000), fear often becomes a primary motivator in decisions related to trees and landscapes. For example, a case study of reforestation efforts after tornado devastation in Virginia found that "after the tornado the community was left traumatized and fearful of future storm damage." This fear altered replanting and landscape management behaviors with a majority of respondents reporting that "their planting choices were directly impacted by the tornado event." Many opted for small, ornamental trees planted at greater distances from homes to reduce perceived risk (Virginia Tech Urban Forestry [date unknown]). These patterns make clear that post-disaster outreach must speak to both the visible impacts of storms and the less visible psychological factors shaping community decisions.

The University of Florida's Institute of Food and Agricultural Sciences (IFAS) Extension service plays a pivotal role in disaster response and recovery. Operating offices in all 67 counties, Extension collaborates with public agencies, nonprofits, and governments to provide resources both before and after natural disasters (EDEN [date unknown]). Extension educators develop programs based on community needs, making needs assessments a vital component of program development. Following the 2024 hurricane season, a needs assessment was conducted via an electronic survey with 3 main goals:

1. Assess landscape damage related to Hurricanes Helene and Milton
2. Assess the monetary cost of initial storm cleanup to individuals
3. Explore the impact of storm-related damage on tree perception

The findings from this assessment will inform outreach materials and educational offerings to assist communities in recovery.

MATERIALS AND METHODS

A survey developed using Survey123 and approved under International Review Board (IRB) exemption ET00043738 was used to collect geographic data, qualitative responses, and quantitative measures (Likert scale, multiple choice). Exemption status is granted to projects that present no more than a minimal risk to the participants; this process has become the accepted norm for electronic survey research approval (Gariton et al. 2026). Questions included location; neighborhood description (deed restricted, homeowners association, etc.); previous landscape maintenance practices; whether tree or landscape damage was experienced; what types of damage were experienced; how much money participants spent on initial cleanup; whether tree failure occurred; species of tree that failed if known; intention to replant; and perceptions of trees in landscapes pre and post storm event. It was distributed through Extension contact lists, social media, and professional networks. The survey was designed to assess hurricane-related impacts on landscapes and tree perceptions following Hurricanes Helene and Milton. Development followed UF/IFAS best practices for survey design, emphasizing clarity, logical flow, and alignment with objectives (Israel and O'Leary 2023). Questions were structured to capture both quantitative measures, such as the extent of damage and cleanup costs, and qualitative insights into attitudes toward trees and replanting behaviors. The instrument underwent iterative review by peers and senior IFAS administrators to ensure readability and relevance. The survey was submitted for IRB review and certified as exempt.

Survey123 (ESRI 2024) was selected as the data collection platform to enable integration of spatial data with survey responses. This allowed for mapping of reported damage (Figure 1) and identification of geographic clusters, supporting targeted outreach. The platform also ensured compatibility with mobile devices, improving accessibility for respondents. A mixed sampling approach was employed to maximize reach and representativeness. Probability sampling initially targeted existing UF/IFAS Extension clientele located in counties that experienced documented hurricane damage. The survey was distributed through existing contact lists, shared across social media platforms, and promoted through the newsletters and social media channels of partner and affiliated organizations. This sampling frame included

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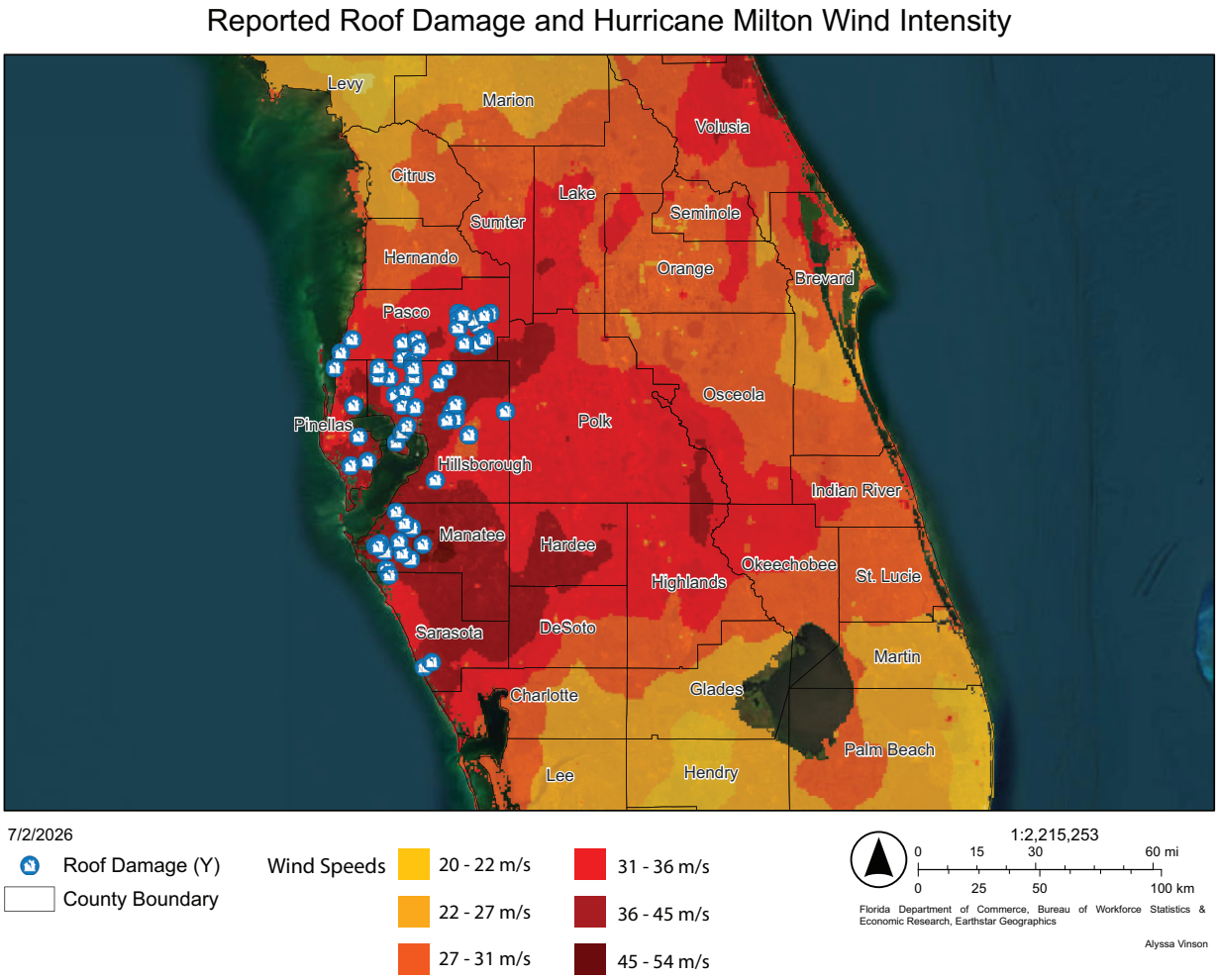

Figure 1. Roof damage and wind speed intensity map. Responses indicating roof damage experience include Yes, Minor; Yes, Moderate; and Yes, Major mapped with the Maximum Wind Intensity of Hurricane Milton.

Master Gardener Volunteers, residents, landscape professionals, HOA representatives, and community partners already engaged with Extension programs, allowing the survey to reach individuals directly affected by Hurricanes Helene and Milton. From this defined population, potential respondents self-selected into the study by choosing to complete the survey distributed electronically.

To broaden participation beyond the immediate Extension network, respondents were asked to share the survey link using standardized invitation language. This produced a controlled form of snowball sampling that extended reach through neighborhood associations, local government networks, and informal community communication channels. Standardizing the language ensured consistent messaging, reduced bias in how the survey was described, and maintained the integrity of the recruitment process. This mixed sampling strategy, probability sampling at the first stage followed by structured snowball sampling, was chosen due to the practical challenges of conducting research in post-disaster contexts.

Geographical analysis was conducted using ESRI ArcGIS to explore spatial patterns in reported storm impacts. Survey responses were geocoded and mapped as point features. These points were then overlaid with relevant spatial layers including county boundaries and land-use or neighborhood-type data where available to assess whether patterns of damage clustered geographically. Spatial queries and map-based filtering were used to visualize distributions of reported roof damage, large-tree failure, and other impact variables (Figure 2). Simple count-based summaries were applied to identify areas with higher concentrations

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of damage types. Survey responses were compared to maximum wind speed, total rainfall, and county boundary. Demographic data were not compared geographically with survey responses in this analysis. Although such analyses may provide valuable insights, they were beyond the scope of the project's initial objectives and were not undertaken due to project time constraints. Future analyses are planned to examine demographic patterns and their relationship to survey responses.

Data preparation involved initial cleaning in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA), removing errors, and generating numerical scores for scaled qualitative text responses. The cleaned survey dataset was uploaded to the statistical analysis platform Google Colab (Google Colaboratory; Google, Mountain View, CA, USA) and generated several derived variables (Table 1) to enable statistical comparisons. Pre- and post-hurricane tree perception Likert scores were used to calculate a binary indicator of score increase, while roof damage reports were consolidated into a dichotomous measure distinguishing any reported damage from none (major roof damage, minor roof damage, no roof damage). Text-based damage descriptions (small branches lost, shrubs or small trees tipped, shrubs or small trees broken, defoliation of plants, brief flooding of landscape, flooding with long-standing water, large branches lost, large tree failure, irrigation damage) were further grouped into broader categories representing tree and vegetation impacts, flooding, and other forms of structural or landscape damage. These steps ensured consistency across respondents and allowed for analysis at both detailed and categorical levels.

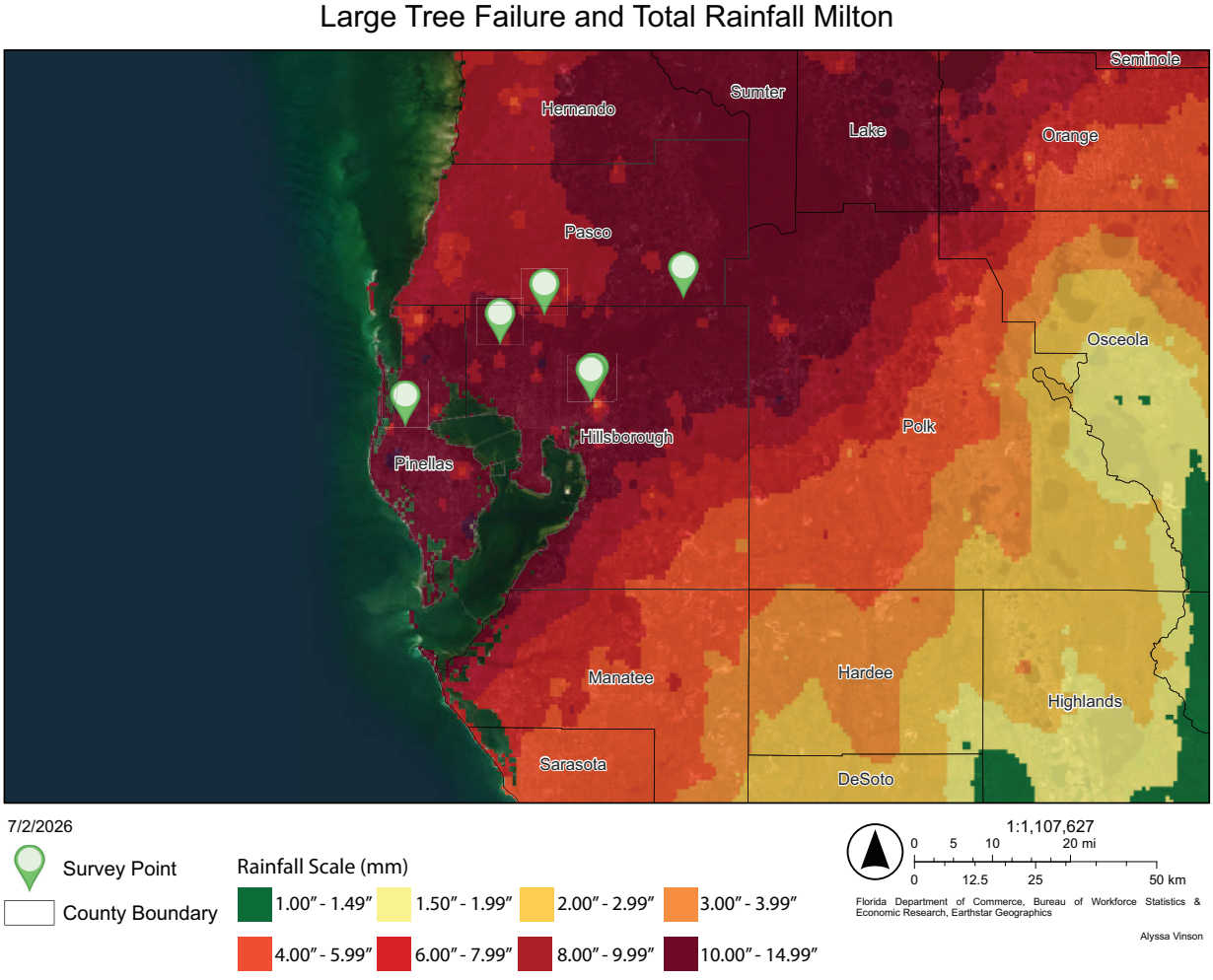

Figure 2. Large tree failure and Hurricane Milton rainfall. Map showing location of tree failure compared to rainfall amounts in Hurricane Milton. All but one reported tree failure indicated uprooting as the cause.

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Analytical procedures included a paired *t*-test to assess changes in respondent perceptions of trees represented as numerical Likert scores (1 = I love trees and actively manage them for their health; 2 = I appreciate having trees on my property; 3 = I don't really think about trees; 4 = Trees are annoying to take care of; 5 = Trees scare me), descriptive statistics to summarize score differences, and visualizations to examine score distributions across the sample. Associations between roof damage and changes in perception scores were evaluated using chi-square and Phi coefficients. A focused subset of 36 respondents whose scores transitioned from lower (1 to 3) to higher (3 to 5) perception/fear levels was also examined to better understand potential drivers of increased concern. For this group, damage types were represented as binary indicator variables for each category to allow correlation analysis with roof damage, and comparative visualizations were produced to contrast their response patterns with the broader dataset. Although Likert data are ordinal, a paired *t*-test was used due to sample size and approximate normality.

To support clarity and consistency in the presentation of these findings, the author used artificial intelligence tools for editorial refinement, including grammar, readability, and flow. All methodological decisions, analyses, and interpretations were developed by the author, and AI tools were not involved in generating or shaping the substantive content.

RESULTS AND DISCUSSION

The survey received 322 responses from 8 Southwestern Florida counties. Most respondents lived in non-deed restricted (a restrictive covenant included in

Table 1. Defined variables.

Variable name	Description
Respondent ID	Unique identifier for each participant.
Likert Score Pre	Perception score before the event (Likert scale 1 to 5). 1 = I love trees and actively manage them for their health; 2 = I appreciate having trees on my property; 3 = I don't really think about trees; 4 = Trees are annoying to take care of; 5 = Trees scare me.
Likert Score Post	Perception score after the event (Likert scale 1 to 5). 1 = I love trees and actively manage them for their health; 2 = I appreciate having trees on my property; 3 = I don't really think about trees; 4 = Trees are annoying to take care of; 5 = Trees scare me.
Likert Score Difference	Calculated as Likert Score Post - Likert Score Pre.
Pre_Range_1_3	True if 'Likert Score Pre' is between 1 and 3 (inclusive), False otherwise.
Post_Range_3_5	True if 'Likert Score Post' is between 3 and 5 (inclusive), False otherwise.
Likert_Increase	1 if 'Likert Score Post' > 'Likert Score Pre', 0 otherwise.
DmgType	Original text field describing multiple damage types (comma-separated). Brief flooding of landscape Defoliation of plants Flooding with long standing water Irrigation damage Large branches lost or small palms lost Large tree failure Other Shrubs or small trees broken Shrubs or small trees tipped Small branches lost
RoofDmg	Original text field indicating roof damage ('No', 'Yes, minor', 'Yes, major').
RoofDmg_Binary	1 if 'RoofDmg' indicates any 'Yes', 0 for 'No'.
Tree_Vegetation_Damage	1 if 'DmgType' mentions tree/vegetation damage, 0 otherwise.
Flooding_Damage	1 if 'DmgType' mentions flooding damage, 0 otherwise.
Other_Damage	1 if 'DmgType' mentions 'other' or 'irrigation' damage, 0 otherwise.

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a property's deed that limits use) communities (about 52%) or HOA-governed (homeowners association: a nonprofit association responsible for the management of common areas, enforcement of restrictive covenants, and levying assessments) neighborhoods (about 36%), with around 23% residing in deed-restricted communities. A small portion reported living in condo associations (1%) or other types of housing (8%). Landscape types were diverse, with multiple landscape elements, including lawn, landscape beds, small trees, palms, and one or two large trees (about 43%). Smaller portions of respondents described yards with several mature or aging trees (about 15%), simpler mixes of small trees and palms (about 13%), with lawn dominated landscapes only representing about 1% of survey respondents. Respondents reported a wide range of debris cleanup costs, with more than 30 indicating they did the work themselves or had help from family or neighbors. Those reporting costs ranged widely, with median costs of $894 (USD), while the highest reported costs reached $25,000 (USD).

Large tree failure was reported by 40%, 58% reported defoliation, and over 80% lost small branches. Of those respondents who reported whole tree failure, 27% plan to replace trees, and 16% intend to plant Florida-Friendly tree species. Although overall a small portion, before the storm season, 3% of surveyed respondents reported fearing trees. After the storm season, 10% reported this sentiment (Figure 3). Analysis of the Likert perception scores indicated that this shift was statistically significant. A paired *t*-test comparing pre- and post-storm Likert scores yielded a *t*-statistic of –5.351 ($P < 0.001$), demonstrating a significant increase in reported fear following the storm season. Descriptive statistics further supported this pattern, with mean scores rising from 1.696 (SD = 0.897) before the season to 1.966 (SD = 1.246) afterward. However, despite these changes in perception, structural impacts did not appear to drive this change. A chi-square test revealed no statistically significant association between roof damage and an increase in Likert scores ($\chi^2 = 1.759$, $P = 0.185$), suggesting that elevated concern may reflect broader experiential or environmental factors rather than specific household damage.

A total of 88 respondents indicated plans to replant trees, including 5 of the 8 individuals who experienced whole-tree failure. This willingness to restore canopy, even after significant loss, reflects an underlying value placed on trees and suggests future-focused landscape recovery goals. This pattern aligns with research on post-disaster landscapes that highlights the role of trees in place attachment, where trees and landscapes contribute to neighborhood identity and emotional connection to place (Lavy and Zavar 2023). In this context, tree loss following hurricanes represents not only ecological damage but also a disruption to meaningful community spaces. Environmental disruption can prompt renewed engagement with nature and motivate community-led restoration efforts (Tidball 2012), which may help explain respondents' intentions to replant. Together, these perspectives suggest that post-hurricane reforestation intentions reflect both ecological recovery goals and deeper social-ecological relationships with the urban forest.

These findings further align with research emphasizing that long-term planning, including thoughtful species selection and strategic replanting, is critical for building hurricane-resilient urban forests (Salisbury et al. 2023; Molnár V et al. 2025). This pattern also suggests that negative storm experiences did not significantly diminish residents' interest in replanting, challenging the assumption that fear of future damage leads to long-term avoidance of trees.

An important limitation of this analysis is the potential sampling and response bias inherent in the population surveyed. Many respondents were individuals who already engage with Extension programming or are Master Gardener Volunteers, which may predispose them to greater tree knowledge, stronger environmental values, and lower baseline fear. This self-selection bias may reduce variation in the outcome, making it less likely to detect associations even when they may exist in the broader population. Response bias may also be influenced by spatial variability in hurricane impacts, differences in storm intensity experienced by respondents, and unequal access to communication technologies necessary to complete an electronic post-hurricane survey.

While the current findings do not support a relationship between storm damage experiences and increased fear, they may not generalize to residents with less horticultural experience or lower engagement with Extension education. Given these limitations, it becomes especially important to consider how Extension efforts can better reach and support a wider range of residents. A majority of participants reported managing all tree and landscape tasks themselves. This indicates a need

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for Extension programs to offer accessible pre-storm tree care resources, explain when professional arborist support is necessary, and help residents differentiate between perceived and actual risk.

Among the 322 respondents, 83 reported roof damage. Of the major roof damage cases (8 total), all were associated with large tree failure, while the remaining moderate and minor cases (76 total) occurred without whole-tree failure. Although major roof impacts were relatively uncommon, their association with whole-tree failure in this dataset underscores the severity of such events when they do occur. Proximal trees to residences in wind storms present a dichotomy, where some wind mitigation is offered by standing trees, while uprooted or broken trees can cause catastrophic damage (Ibrahim et al. 2025). This pattern aligns with existing research where links between catastrophic tree failures were identified with underlying management or site conditions such as root damage, soil compaction, or trenching rather than wind exposure alone, and that structural pruning and appropriate crown architecture can substantially reduce failure risk (Moore 2014; Gilman et al. 2015).

Post-storm field studies indicate that crown architecture and site history including inadequate taper or end-weighting, codominant unions with included

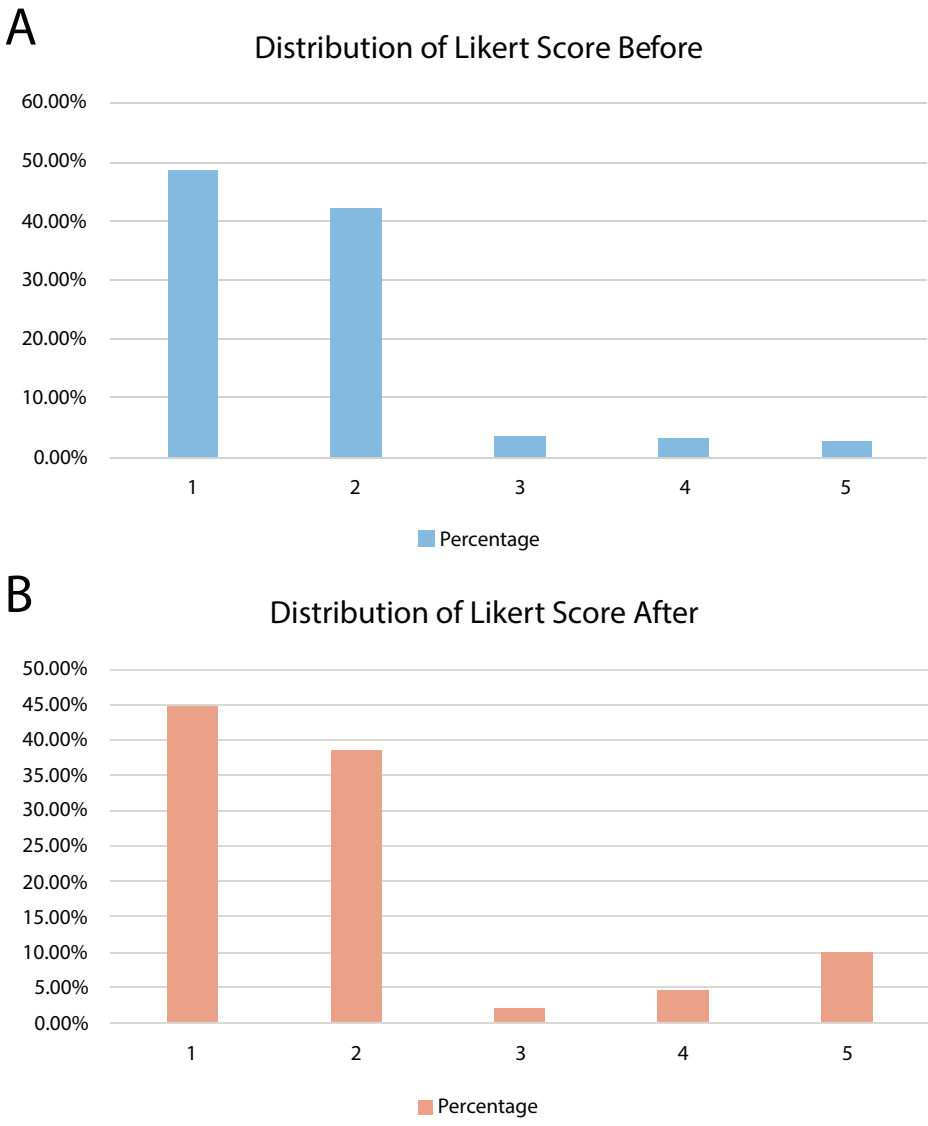

Figure 3. Distribution of Likert Perception scores before (A) and after (B) the event (Likert scale 1 to 5). 1 = I love trees and actively manage them for their health; 2 = I appreciate having trees on my property; 3 = I don't really think about trees; 4 = Trees are annoying to take care of; 5 = Trees scare me.

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bark, restricted rooting space from trenching or compaction, and long-term maintenance history correlate with storm damage in Florida and similar urban environments (Escobedo et al. 2009; Moore 2014; Johnson et al. 2019). More recent investigations nuance how these structural traits should be interpreted: research following Hurricane Ian found that codominant stems and similar growth patterns did not directly predict failure, with no documented failures at the defect originally identified as the primary concern (Koeser et al. 2023). Long-term work by Duryea and colleagues documents consistent species effects on survival and branch loss, the benefits of trees planted in groups, and improved survival for pruned versus unpruned trees emphasizing the roles of species selection and structural maintenance when preparing urban forests for high winds (Duryea et al. 2026).

Fear or perception of trees as dangerous did not show a clear relationship with reported damage or replanting intentions in this sample, suggesting a perceptual gap: residents may worry about tree related risks, yet those fears did not align with observed damage patterns. This perceptual gap has been documented not only in how individuals interpret tree related damage following storm events, but also more broadly in how risk itself is assessed. Misperceptions of risk and the reactionary decisions that follow often lead to the unnecessary removal of trees (Smiley et al. 2025). This same gap can influence the client–arborist relationship, contributing to inconsistencies in professional risk assessments or limiting the effectiveness of recommended mitigation strategies (Stewart et al. 2013; Davison and Kirkpatrick 2014). These disconnects highlight the need for community education that emphasizes evidence-based drivers of risk. Guidance on tree selection is also especially important: wind-resistance ratings and hurricane-resilient planting recommendations stress selecting species adapted to Florida's environment, planting trees in appropriate locations, and grouping trees to reduce wind load (Duryea et al. 2026).

Although early planting and establishment costs may exceed the initial benefits, by year 5 the benefits outweigh those costs at roughly a 3-to-1 ratio (McPherson 1992; Vogt et al. 2015). Professional support further strengthens long-term resilience: ISA-credentialed arborists trained in structural pruning, diagnostic evaluation, and risk assessment help prevent the structural weaknesses and root system issues that often contribute to storm-related failures, thereby reducing immediate risk and enhancing long-term resilience so trees continue to provide sustained ecological and social benefits (Clark and Matheny 2010). Despite these advantages, only 8% (28) of respondents reported hiring an arborist to care for their trees prior to the storm event, compared with 68% (129) who reported doing all tree and landscape work themselves. These findings underscore the importance of perception-informed education paired with long-term management and professional services, key components for building a resilient urban forest.

These implications are directly actionable for Extension programming. While many residents view trees as hazardous, research consistently shows that storm-related risk is more strongly shaped by species selection, adequate rooting space, and consistent maintenance over a tree's life than by the mere presence of trees (Moore 2014). Outreach that clarifies this gap can support better decisions about pruning, planting, and long-term care, reinforcing the need to differentiate emotional responses to damage from the structural, species-level, and environmental variables that actually drive failure risk.

Emerging research continues to refine how arborists and urban foresters interpret defects and structural traits. When placed in the context of long-term studies showing consistent species effects, improved survival of pruned trees, and the protective value of grouped plantings (Duryea et al. 2026), these findings suggest that storm resilience arises from a kaleidoscope of biological and management decisions rather than any single structural feature. This emphasizes the growing importance of evidence-based maintenance practices. The alignment between survey results and prior research points to a substantial perceptual gap between fear, perceived risk, and the actual likelihood of tree failure. These findings emphasize the essential role of Extension educators and professional arborists in clarifying these differences and guiding residents toward informed, evidence-based tree care decisions.

CONCLUSIONS

Effective post-storm urban forest recovery requires situating technical guidance within the social contexts in which decisions are made. This needs assessment shows that residents remain willing to replant even after substantial damage, while shifts in perceived risk highlight the importance of targeted

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communication and clear, actionable pathways to engage certified professionals. Within this Extension-engaged sample, just 10% of respondents expressed fear of trees, whereas 28% planned to replant. Even among those who had experienced large-tree failure, 32% intended to replant, indicating a strong baseline commitment to maintaining canopy despite storm loss.

Taken together with research showing that storm resilience hinges on species selection, rooting space, and structural pruning rather than fear-based avoidance (Moore 2014; Gilman et al. 2015), these results underscore the practical value of continued, research-informed Extension outreach in supporting maintenance and planting of the urban canopy after hurricanes. Continued engagement through Extension and allied programs can help ensure that resident perceptions remain aligned with the structural and environmental factors that truly shape risk.

Future efforts should broaden participation beyond Extension-engaged audiences, integrate canopy inventories with resident surveys, and further evaluate how neighborhood governance structures and norms influence the adoption of recommended practices. Collectively, these steps can translate evidence into locally relevant programs that strengthen community resilience while sustaining the ecosystem services of Florida's urban forests.

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ACKNOWLEDGEMENTS

The author acknowledges the ongoing institutional, administrative, and logistical support provided by the University of Florida during the execution of this project. The author also expresses sincere gratitude to colleagues at the University of Florida's Institute of Food and Agricultural Sciences for their valuable feedback and expertise in reviewing and refining the original survey instrument.

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Conflicts of Interest: The author reported no conflicts of interest.

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