Trees and Ice Storms: Developing Ice Storm Resistant Urban Tree Populations

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The Beauty of Ice Storms

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What's the worst that can happen
The Not So Beauty of Storms

The Not So Beauty of Ice Storms
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Trees, Ice Storms, and Power Lines

Severe Ice Storms
Transmission Tower Failure

Significance of Ice Storms: Safety, Property Damage, and Economic Hardship!

Safety
Cleanup
Repair
Overtime

Monetary Losses from Ice Storms

- $16.3 billion (in 2000 U.S. dollars) in property losses between 1949 and 2000
- Actual losses are even greater as this total excludes non-insured losses
- Majority of winter storm losses
  - 60% of winter storm losses within the U.S.
  - $226 million mean total annual cost
Monetary Losses from Ice Storms

- 1998 NE United States and SE Canada
  - Estimated $6.2 billion
  - Four million people without power
  - Over 40 deaths attributed to the ice storm

- In 1990, more than $1 million in damage to parkway trees alone Urbana, IL

- In 1991 in Rochester, MN – $16.5 million worth of property damage

Ice Storm Climatology: Frequency and Formation

- Occur annually within North America
- Extreme storms occur regionally every 10 to 20 years
- Among most severe disturbance factors in Eastern Deciduous Forests
- Defined as >= ¼ inch of ice accumulation on surfaces
- Warm front passing over cold front (generally)
Tree damage to electrical systems are the primary cause of outages.

In one of the earliest documented accounts of an ice storm in the United States, von Schrenk (1900) describes the potential severity of ice storms and tree damage – the enormous loading of the trees over the 5,000 square mile region of Missouri, Illinois, Indiana, and Ohio was exacerbated by ice accumulation and strong winds.


More recently, on Valentine’s Day 1990, a severe ice storm in Urbana, Illinois, damaged at least 26 percent of the city’s parkway trees. About 5 percent of the entire public tree population was severely damaged and required immediate removal or repair.


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“The ice-storm! the ice-storm! … and even the laziest sleepers throw off the covers and join the rush for the windows.”

From Following the Equator by Mark Twain, 1897

“great tree branches ripped from their moorings with startling suddenness came hurtling downward through the air to strike the ground with such force that the sounds at times resembled those of a thunderstorm. Pedestrians kept to the middle of the thoroughfares and many people remained indoors rather than risk the uncertainties of the public streets.”


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<table>
<thead>
<tr>
<th>Table 2: The pre-storm value of trees that were severely damaged by an ice storm in dollars.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree species</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Norway maple</td>
</tr>
<tr>
<td>Red maple</td>
</tr>
<tr>
<td>Sugar maple</td>
</tr>
<tr>
<td>Silver maple</td>
</tr>
<tr>
<td>White ash</td>
</tr>
<tr>
<td>Bird cherry</td>
</tr>
<tr>
<td>Cherry</td>
</tr>
<tr>
<td>Fr hickory</td>
</tr>
<tr>
<td>Cottonwood</td>
</tr>
<tr>
<td>Snowbell</td>
</tr>
<tr>
<td>White pine</td>
</tr>
<tr>
<td>Ponderosa pine</td>
</tr>
<tr>
<td>Deciduous</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

*Trees in other species were marginal between requiring immediate removal or repair. Small discrepancies in totals are likely due to rounding errors.
Do You See any Defect?

Why do Trees Fail During Ice Storms?

- Is it Because Trees are Weak Wooded?

- The wood strength of sound branches matters less than the ability of a tree to withstand breakage at branch junctures

- The accumulation of weight exceeds the capacity of trees to hold the extra load

Preexisting Conditions

Wounds and Decay

Why did this honeylocust fail?

Why Did This Tree Fail
Root Damage

Tree Architecture

Rooting Profile

Potential for Failure

Shallow root systems (i.e., red oak) are more prone to tipping during ice storms.

Deep-rooted species (i.e., white oak and bur oak) less prone to tipping.

Deep-rooted species (i.e., white oak and bur oak) less prone to tipping.
Table 1. Ice Storm Susceptibility of Tree Species Commonly Planted in Urban Areas

<table>
<thead>
<tr>
<th>Susceptible</th>
<th>Intermediate</th>
<th>Resistant</th>
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</thead>
<tbody>
<tr>
<td>American elm</td>
<td>Bur oak</td>
<td>American sweetgum</td>
</tr>
<tr>
<td>American linden</td>
<td>Eastern white pine</td>
<td>Arbutus</td>
</tr>
<tr>
<td>Black cherry</td>
<td>Northern red oak</td>
<td>Black cherry</td>
</tr>
<tr>
<td>Black locust</td>
<td>Red maple</td>
<td>Black locust</td>
</tr>
<tr>
<td>Bradford pear</td>
<td>Sugar maple</td>
<td>Bradford pear</td>
</tr>
<tr>
<td>Caucasian holly</td>
<td>Tilia spp.</td>
<td>Caucasian holly</td>
</tr>
<tr>
<td>Green ash</td>
<td>Eastern hemlock</td>
<td>Green ash</td>
</tr>
<tr>
<td>Honey locust</td>
<td>Ginkgo</td>
<td>Honey locust</td>
</tr>
<tr>
<td>Pin oak</td>
<td>Ironwood</td>
<td>Pin oak</td>
</tr>
<tr>
<td>Russian elm</td>
<td>Kentucky coffee tree</td>
<td>Russian elm</td>
</tr>
<tr>
<td>Silver maple</td>
<td>Littleleaf linden</td>
<td>Silver maple</td>
</tr>
<tr>
<td>Swamp white oak</td>
<td>Norway maple</td>
<td>Swamp white oak</td>
</tr>
</tbody>
</table>

Adapted from Hauer et al. (1992).
Siberian Elm – the poster child of ice storm susceptibility

Bio …. Logical in the Urban Forest

How to Develop Ice Storm Resistant Tree Populations

1. Minimize the abundance of susceptible species (i.e., diversity)
2. Remove included branches
3. Use proper pruning methods
4. Small trees and power lines are compatible
5. Develop disaster recover plans before the disaster occurs

What we Know From Tree Risk Management:
1) Divide the community into tree risk zones
2) Tree failure is often predictable and preventable

Spruce Tree (not a palm) in Crookston, MN

Treatment Options: Move the Target
Treatment Options: Treat the Tree

Modern Advancements in Arboriculture

Treatment Options:
Close the site: often not practical in urban settings
Remove the tree: often an emotional decision

Basal Pruning a Hazardous Situation …
99% of the job is removal

Basal Pruning Gone Bad

The Disaster Cycle

1) Mitigation: activities to reduce the effects of disasters
2) Preparedness: plan a response prior to disaster
3) Response: activities during a disaster to minimize hazards in effective, efficient, and equitable ways
4) Recovery: returning to normal following a disaster
Why is Safety Important?

Opps

For more information

- Search
  - Trees and Ice Storms
  - Hauer UWSP

- Thank you! Any questions?