ICE STORM DAMAGE TO TREES NEAR LAKE ONTARIO

by

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Environmental Science 101
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Introduction

When I heard that a devastating ice storm had paralyzed Monroe County, New York, I first thought of the safety of my family, my sister and her father who live on the shores of Lake Ontario and my own father who lives further inland south of the city of Rochester. However, it was not long before my mind was filled with grand ideas of elegant experiments measuring the macro-liter volume of debris from the ice storm in the very peace of a red pine cathedral in Webster Park through which I had skied during the winters of my childhood.

Spring vacation arrived. I found myself in Webster, New York, a suburb of Rochester, designing a method for assessing the extent and form of damage to different species of trees in Webster Park, realizing in the process how fortunate I was to conduct my study with a heated house to return to after hours in the cold, wet forest, a lamp to read by at night, and a functioning telephone to pursue my aggressive search for complete and accurate information relevant to my project.

During the course of this report, I will analyze how various tree species in Webster Park reacted to the climatic stress of the ice storm. At the same time, I would like to convey a feeling for the broad-reaching impact of the storm. As a result of the incredible number of casualties among all site species living in the rural, urban, and suburban areas of Monroe County, the entire infrastructure of the greater Rochester metropolitan area was dislocated. Trees took with them telephone and electrical wires debilitating the city for more than a week, leaving some people without electricity, heat, or telephone for an entire fortnight. The face of downtown Rochester, famous for the summer shade of its tree-lined avenues, is irrevocably altered.
dropped from 52° F to 27° F; a cold air mass had slipped underneath the warm air mass forming a layer of warm air on top of cold. By early morning Monday, March 4, the surface temperature was below freezing and the ground still slightly warm, defrosted by the preceding warm spell. When the precipitation began at 12:35 AM Monday morning, it entered the cold air mass as rain and froze at 30° F on the tree limbs and all other available surfaces. The temperature did not rise above 32° F during the time of precipitation and dropped down to 30° F at the end of precipitation at 11:50 AM only to drop further to a low of 27° F later that night.

During these significant temperature changes, fluctuations in the barometric pressure also indicate the movement of low pressure and high pressure air masses. As the temperature rose to its highest pinnacle, mid-afternoon March 2, the barometric pressure dropped to a low point of 28.845 at 12:50 PM (Appendix C). As the cold air, high pressure system moved into place, with the drop in temperature the barometric pressure rose to 29.245 at 9:50 AM Sunday morning. During the peak of precipitation, the barometric pressure reached its lowest point and then shot up from 28.685 at 6:51 AM, Monday, March 4, to 29.235 at 17:50 PM, Tuesday, March 5.

The fluctuations in wind speed over this span of time are also significant because the periodic gusts of 25 knot winds during the course of the storm may be partially responsible for the extent of damage to trees (Appendix D). It appears there were periodic gusts of wind between 9 and 12 knots on Tuesday morning; and from articles in the local newspapers, high winds following the ice storm by a few days seem to be partially responsible for exaggerating the extent of the damage.

The impact of this meteorological event on the tree population in Monroe County severely disrupted the day-to-day, rush-hour routine of the Rochester
COMPARISON OF ICE STORM DAMAGE AMONG
DIFFERENT TREE SPECIES IN WEBSTER PARK

The first half of my study involved walking the trails of Webster Park taking photographs of different tree species damaged by the ice storm. My primary goal was to determine the frequency of damage among different species of trees and then to observe any trends in the way this damage was manifested among certain species types. In other words, why did certain trees tend to split down the trunk, why did some lose their crowns, why were others uprooted? My conclusions are drawn from the photographs and field notes taken while hiking through Webster Park, from the rather limited statistical information given to me by the Monroe County Park Service, and from my research on the structure of trees conducted since my return to Williams College.

I will compare the effects of the ice storm on ten different species of trees found in abundance in Webster Park: the Eastern white pine, red pine, red spruce, American larch, and red cedar [gymnosperms] and the silver maple, paper birch, sycamore, quaking aspen, and weeping willow [angiosperms]. Among the individuals I have used to represent each species type range various crown shapes, branching patterns, wood structures, ages, states of health, and locations of habitat (i.e. slope, soil type, microclimate, natural or plantation growth pattern). I will compare the typical geometric shape of each tree species—crown and branching pattern—as well as its wood structure to determine how the weight of the ice, distributed in different ways over the surface of each tree, resulted in the varying forms of destruction observed during my field work.

I am assuming for the purposes of this study that these factors are the most measureable and significant differences between each of the studied species.

However, it is important to note that the varying age, health, and habitat location of each species type contributed significantly to the numbers lost.
Comprehensive numbers for damage to all trees in the park were not available. The above numbers combine exact figures of damage to planted trees in the "landscaped" area of the park and speculative estimates of damage to trees such as the Eastern white pine in the "wilder", natural growth and campsite areas.

I spoke with Bob Hoepfl, forester at Highland Park, downtown Rochester, on May 3, 1991. According to Monroe County Park headquarters he has the updated figures on the number of trees lost by each of the county parks. However, he was only able to list by name the species in Webster Park that were damaged by the ice storm and the total number of trees lost or requiring a pruning. Hoepfl said that the most affected species were maple, willow, ash, birch, aspen, hackberry, and locust followed by various other individuals—some oak, linden, Katsura, red bud, dogwood, Douglas fir, Eastern white pine, red pine, spruce, red cedar, and juniper. These numbers indicate that the most noticeable damage occurred among softwoods and rapidly growing species as well as among those species not native to upstate New York. According to Hoepfl, 85 of the park's planted trees were killed and 185 will need professional pruning. Because of the storm's severity and the pressing need to clean up the debris as quickly as possible, numbers for the frequency of damaged trees among certain species are not being carefully tabulated.

Several articles in the Democrat and Chronicle have made observations stating which tree species were most affected by the storm. A March 13 article said that the "street trees that were most significantly affected in the storm were green ash, Norway maple, London plane, hackberry and honey locust..." A March 18 article in the Times-Union stated that rapidly growing softwoods such as silver maples, willows, and poplars were most severely damaged. In the article, Dave Reville, a tree expert with the Cornell Cooperative Extension in Wayne County "recommended replacing [softwoods] with slow-growing hardwoods,
The Eastern white pine is the only 5-needled pine. It is tall and extends few branches horizontally from its trunk forming a rounded, dome-shaped crown. The wood of the white pine is described as "light, soft, straight-grained," and not as resinous as other pines with a specific gravity of 0.38. It is known for rapid growth.

The red pine, like the Eastern white pine, grows in plantation rows in great profusion in the forested areas of the park. In an area near Camp Cattaraugus, a considerable stand of red pines was decimated. Uprooted in some areas and, in other areas, crowns snapped off a third to halfway down the trunk of the trees. (just notice thin part of NY)
cone-shaped crown. Four-sided linear needles cover all areas of the branches and extend out in all directions. The wood is "soft, weak, close-grained, not durable," and pale reddish yellow in color. It is resinous with a specific gravity of 0.45 and grows slowly.

West of the pathway leading to the pine and spruce stands, on an upland slope bordering a wetland area lies a natural growth stand of American larch, also known as tamarack. This stand of trees appeared to survive the storm unscathed.

In mid-March, the American larch is still a skeleton of twig-covered branches without its spring leaves. The branches spread out horizontally with a slight upward slope from the trunk, growing progressively shorter towards the crown of the tree, thus forming a slender, conic tree. This tree grows rapidly and
The silver maple has a silhouette similar to that of the red maple. It is one of the most rapidly growing trees, frequently used in city landscaping to line streets. The wood is "hard, brittle, [and] light brown" with a specific gravity of 0.53. The brittleness of the wood makes the silver maple extremely vulnerable to storm damage: "violent summer gales will sometimes strew the ground with its branches."

Clusters of white paper birch trees are scattered all over the park. Most of the birch that I saw were killed by the ice storm, many of them split down the center of the trunk.
split down the trunk by the disproportionate weight on some of the branches.

The branches of a quaking aspen do not extend out from the trunk in a very regular pattern; the tips of the branches often droop at the ends. Large populations of aspen frequently indicate the first stage of a successional forest. They grow rapidly in poor soils; their seeds are spread by the wind. The wood is "soft, weak, and soon decays" with a specific gravity of 0.40.

The last tree species of this study is the weeping willow. Mature populations of this tree border East Creek and Mill Creek.
close-grained, weak" though durable nature of the wood by the fact that no split
red cedar trunks were observed.

The last two gymnosperm groups were less successful in avoiding ice storm
damage. The Eastern white pine and red pine both lack a defined conic crown;
this may be the reason for the higher frequency of snapped crowns among both
species. Two inches of ice would have had a greater surface area on which to
collect. With the occasional gusts of high winds that followed the storm, a
weakened or cracked crown would have blown off more easily.

It seems strange that I should have observed more damage to red pine
considering it has the harder wood of the two species. According to Horn, there
is a cost benefit trade-off in tree species between a hardwood chemistry and a
softwood chemistry. He writes,

The woods of different trees vary greatly in caloric content and
strength. Hardwood has heavily lignified cell walls, or extensive
deposits of pitch and resin in the compression wood of conifers
(Jane 1956). Hardwood is heavy even when dried; it is very strong
and rigid, but somewhat brittle. Softwood has a much lower caloric
content per unit of volume; it is much lighter than hardwood when
dried, but when it is green there is less difference in weight
(Section 14 in Forbes 1955). Softwood is flexible and elastic, but
of course its thin-walled cells are easily ruptured when a branch
is flexed beyond its elastic limit (Jane 1956). A given volume of
hardwood has a higher caloric cost to the tree than softwood. In
return for its higher cost, hardwood is better able to support the
tree and its leaves against the constant compression and torque of
gravity. Variable winds (or the extra weight of ice accumulation)
call for compromises between the rigid strength of hardwood and the
elastic flexibility of softwood, but these compromising strategies
have not been adequately studied. (p. 107-108; see Appendix C for
reference to Jane, The Structure of Wood)

The second group of trees in this study are the angiosperms. The paper
birch and quaking aspen angiosperm species share the conical shape of the spruce
and larch families yet they did not survive the ice storm. They suffered the
most out of all the angiosperm species that I studied. Horn writes, "...the
conical shape alone is not enough to adapt trees to snow. Aspens and birches
area or stronger wood, both of which increase the weight of the branch. " (p. 108)

These are only a few of the forces at work within the wood structure and geometrical shape of a tree. Other forces include wood texture and grain, the number of rings in the trunk of a tree per unit measure, the number of vessels, and the wood lignite content, percentage air, and water holding capacity—many forces which need to be studied at the cellular level. In addition, the complicating factors of age, health, and location of habitat for each tree, strongly influenced the outcome of this project in many unmeasurable ways.
The gridded map (Appendix 1) of the area indicates the relative position of each individual tree and a description of the type of damage suffered by each tree. The lines have been drawn to indicate the position of each row of trees. The red pine trees are planted approximately three to four paces from one another. Certain areas of the map reveal patterns of damage that may have been amplified by the artificial growth pattern of the trees. For example, in quadrant BIV the tree furthest north leaning south seems to have caused a group of four trees to lean. In rows 4, 7, and 9, uprooted trees are followed by trees that have lost more than 50% of their crown and stem.
without a mixture of other tree species overlapping and changing the surface of the canopy, may also be responsible for the extent of damage to this plantation stand of trees.

The eastern half of the grid contains greater species diversity which may have shielded the more vulnerable red pine crown from ice storm damage. Therefore, the stand of red pine trees may have been more vulnerable to ice storm damage because of the single species, row-planted pattern.
will remain much longer than the damage to wooded areas of Webster park.

**SOURCES:**


*Democrat & Chronicle*

*Times-Union*

*Webster Herald*

*Webster Post*

*National Weather Service*

*Monroe County Park Service: Bob Hoepfl and Bob Yaw*
Appendix G: Density, Proportions, and Specific Gravity of Wood (p. 265. The Structure of Wood)

<table>
<thead>
<tr>
<th>Density (lbs. per cu. ft.)</th>
<th>Proportions Wood:Air</th>
<th>Relative Density (Specific Gravity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.011</td>
<td>0.016</td>
</tr>
<tr>
<td>10</td>
<td>0.105</td>
<td>0.100</td>
</tr>
<tr>
<td>20</td>
<td>0.210</td>
<td>0.220</td>
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<tr>
<td>30</td>
<td>0.316</td>
<td>0.316</td>
</tr>
<tr>
<td>40</td>
<td>0.421</td>
<td>0.404</td>
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<td>50</td>
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<tr>
<td>60</td>
<td>0.631</td>
<td>0.562</td>
</tr>
<tr>
<td>62.4 (Water)</td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>70</td>
<td>0.737</td>
<td>1.121</td>
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<tr>
<td>80</td>
<td>0.862</td>
<td>1.282</td>
</tr>
<tr>
<td>90</td>
<td>0.945</td>
<td>1.444</td>
</tr>
<tr>
<td>95-35</td>
<td>1.000</td>
<td>1.528</td>
</tr>
</tbody>
</table>

Since the density of wood is an indication of the amount of wood substance contained in unit volume, it might appear that density should be a guide to the general strength of a timber, and it is well-established that this is so. It has been stated, indeed, that where the average density and strength values for a species are known, the density of a given clear specimen may be a better indication of its strength properties than strength tests. Some strength properties, like stiffness, vary almost directly with density, while for others the relation is less direct: toughness, for example, varies almost as the square of the density. Dadeid and Nicholls (1959) found that in *Pinus elliottii* var. *elliottii* specific gravity (i.e., relative density) was a good index of average cell wall thickness, this latter being related, in its turn, to the proportion of late wood present in the rings. It was found that specific gravity increased in successive rings from the pith, becoming fairly constant from about the 15th ring outwards, although the specific gravity of the early wood tended to decrease from the pith outwards and that of the late wood to remain more or less constant. We have seen (p. 200) that juvenile wood has less dense late wood than does mature wood, and that this late wood forms a smaller proportion of the growth ring, so that these results are what might be expected. (p. 265)
Nature, pruning, can work wonders

By STEPHEN LOWE

TREES UNION

Don't despair. While the ice storm damaged untold thousands of trees in the Rochester area, experts say many can be salvaged.

"Damaged trees can thrive," said Dana Martin, a Canadensis tree pathologist. "It properly cared for, you're on the road to rebuilding health."

Proper pruning can help prevent the onset of deadly disease. And with time, many trees will rebound with new growth.

"Nature is a funny thing and anything can happen," said Chuck Crandall, a certified arborist with Crabell Tree & Landscape Inc. "Let the tree take its course and see what happens."

As spring and summer come, dormant buds will start growing.

"They'll pop out all over," said Robert Morrison, a regional forester with the Department of Environmental Conservation. "The trees will fill out again."

Still, trees that lost a large portion of their limbs may struggle to survive. Along with the roof, the crown of hives feeds a tree and provides energy to heal wounds.

"When a tree loses a crown, you're taking away its center of energy," said Andy Pieninger, a city forestry assistant.

As a rule, arborists say a tree that has lost much more than 30 percent of its crown will be gnawed and may die. Pieninger estimates that up to 50 percent of city-owned trees between sidewalks and streets may die.

But pruning can help many battered trees recover.

Experts stress that people need to be careful when pruning dangling limbs.

"Our concern is people who don't know what they're doing," said Terry Clifford, executive director of the Cornell Cooperative Extension-Monroe County. "It really can be a degrading situation."

Improper pruning can damage a tree.

"You don't want to cut too close and you don't want to leave a stump," said Mark Keister, a regional DEC forester.

After pruning, harmful insects will gravitate over the wounds, protecting the tree. Open wounds from snapped off limbs provide an easy entrance route for disease.

"Trees that had the tops stepped off almost are certainly to get heart rot disease," Keister said.

Diseases can take from a few years to 20 or more before a tree finally dies or weakened limbs break off.

Wounds also provide openings for voracious insects. "There are many types of wood borers that will jump at the opportunity," Keister said.

Trees already stressed by disease or poor growing conditions will be less likely to survive. And a late frost or hot, dry summer will knock out more trees.

Growing conditions, such as soil and nutrition, play the most important role in recovery, much more than species type, said Nina Bashe, director of the Urban Horticulture Institute at Cornell University.

"The major thing is how well it's growing and how well the environment in it," she said.

Many trees will survive by drawing on their energy reserves. "They may be able to live on carbohydrates for several years," said Terry Reintinger, a Cornell University tree pathology education agent. "Before you eliminate a tree, have a professional arborist look at it."

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**TIPS ON CARING FOR DAMAGED TREES**

- Prune damaged trees to help prevent disease. A tree limb should be cut just above a bud, at a swelling where the limb joins the trunk. While some trees normally have one or two buds, people should prune away and others in the summer, experts said to save damaged trees should be pruned in the spring.

- When pruning off a damaged limb, make a cut just above the bottom side of the limb so that when it's time to plant it, the tree remains strong enough to support itself.

- Check arborist's reputation before hiring one. Many arborists are unlicensed and may do a poor job.

- Trees that are near danger should be closely examined by a professional arborist or certified arborist before a tree is cut down.

- Trees can be saved by using proper pruning techniques. Some arborists recommend applying "gibberellic acid" to wounds to prevent the spread of disease.

- Shaded trees, like hedges and trees over a bridge, are more susceptible. Arbo"
Composting

on compounding processes

Proposed

Residents want dialogue

County rejects plan to compost storm debris

THE SAND DESK OF 91