Ice storm 1998:
Lessons learned

Jim McCready R.P.F.
Eastern Ontario Model Forest
Kemptville ON
jmccready@cyberus.ca

ABSTRACT

Ice storms are natural recurring disturbance events in northern ecosystems, but the storm of 1998 was unique because of the broad geographic area it affected and the amount of freezing rain it deposited. Indeed, the extensive damage suffered by municipalities, utility companies, homeowners, forest owners (including maple syrup producers) and farmers, makes this event arguably the most destructive single disturbance recorded in North America.

Damage to trees was extensive in woodlots as well as in the urban setting. Ice-laden branches and trees were everywhere. The immediate objectives were for safety, including the opening up of roads for the public, the removal of limbs from hydro lines and the repair of these lines. Following the ice storm everyone was calling oneself an "arborist". Trees were removed that did not have to be removed, as traumatized homeowners were afraid that the ragged looking trees on their property would collapse resulting in further damage. There were trees trimmed by unskilled labourers, which would be healthier today if they had been trimmed by a professional arborist. There was a strong emotional response to the loss of trees resulting from the storm, with much media coverage of the effects on trees and the associated industries (e.g., maple syrup producers, Christmas tree growers, etc.). Such groups were starting to request aid, but it soon became apparent that much of the initial aid response was intuitive and immediate while the actual magnitude of the event had not yet been quantified.

Decisions were being made based upon news reports, anecdotal information, visual images and lobbying by those requesting aid. However, government departments, agencies, community groups and the public needed to know the size and severity of the

event to properly design and implement an efficient and effective response. This paper discusses how partners in eastern Ontario organized themselves to: collect information communicate to the public decide upon science needs and strategies for conveying the research results develop assistance programs for woodlot owners and municipalities.

INTRODUCTION

From January 5-10, 1998, a combination of meteorological events (namely moist warm air from the Gulf of Mexico flowing northeast and rising above the cold Artic air from Hudson's Bay) occurred over eastern Ontario and western Quebec, spreading through upstate New York, into parts of New England and the Maritimes (Savage 1998). These conditions produced extended periods of supercooled rain across the area, which froze on contact, producing extensive damage to infrastructure and trees (Figure 1).

Figure 1. Supercooled rain created thick deposits of ice that caused damage to trees and other infrastrcuture.

This ice storm was unique because of the broad geographic area it affected and the amount of freezing rain it deposited. In parts of eastern Ontario and western Quebec, 70-110mm were deposited - roughly twice the maximum previously recorded in this area (Savage 1998). More than 5 million people were affected by at least one power outage. In Quebec, an estimated 3.5 million people (half the population) were left without power

The longest residential blackouts lasted 33 days. In Ontario, about 600,000 people lost power.

In Quebec, more than 3,000 kilometres of Hydro-Quebec's power network broke down. In total, 24,000 poles, 4,000 transformers and 1,000 steel pylons were damaged, costing some $800 million to repair. In Ontario, an estimated 11,000 poles, 1,000 transformers and 300 steel towers were damaged.

Without power, more than 5,000 dairy farmers reportedly had to dump 13.5 million litres of milk worth an estimated $7.8 million. In Quebec, 17,000 farms were affected by the storm, with losses estimated at $14 million. In eastern Ontario, 10,000 farms were affected by losses estimated at $11 million. The Insurance Bureau of Canada estimated the claims for this storm exceeded $1.1 billion. The short-term economic cost of the storm was estimated at $1.6 billion.

Millions of trees were damaged or destroyed by the weight of the ice, and there is no means of measuring the extent of such damage to the area affected. However, on Montreal's Mount Royal alone, at least 140,000 trees were damaged, which represents roughly 80 percent of the trees on the mountain. Another 5,000 were completely destroyed. The cost of the clean-up, pruning and replacement of trees on the mountain was estimated at $15 million. Depending on the geographic location of trees in the area of affected by the storm, 50 to 100 times the weight of the branch was added which resulted in 30 kilograms of ice being added for every square metre of branch. This additional weight to the tree meant that the average tree was weighted with approximately two tons of ice.

WE NEEDED INFORMATION

After the many serious human welfare issues in the broader community were dealt with (e.g., shelter, restoration of hydro and phone service), people started thinking about the devastation to the forests, along with approaches to hasten its recovery. It soon became apparent that actual magnitude of the event had not yet been quantified, but agencies were being asked to make decisions. Decisions were being made based upon news reports, anecdotal information, visual images and lobbying by those requesting aid.

However, government departments, agencies, community groups and the public needed to know the size and severity of the event to properly design and implement an efficient and effective response. An immediate need was for a broad-level, extensive forest survey to delineate the affected area and to quantify the damage.

On January 17-22, 1999 the Ontario Ministry of Natural Resources (OMNR) conducted an aerial survey to map the extent of the damage in eastern Ontario to give some immediate information to those on the ground. This survey was followed by a more scientific survey with the Canadian Forest Service (CFS) and OMNR using low-level helicopter surveillance with forest health specialists. This survey was conducted by flying a grid pattern with flight lines 5 kilometres apart at a height of 30-60 metres observing the status of the forest for 500 metres on either side. Urban, ornamental and fence rows were not specifically surveyed as these trees suffered more severe damage than forest trees as they stood alone in the open. These flights were followed up by ground checks.

Damage was variable depending on the tree species, stand age and composition, management practices, wind direction, topography, and ice deposition patterns. Detecting the damage to trees was problematic, as observers had to quantify something that was not always there anymore such as missing branches or crowns. The former tree parts were hidden on the ground by snow, ice, or bent trees. As such, several jurisdictions opted for ground surveys using existing road networks (Burns, 1998).

The severity of damage to the trees was measured using the following criteria (Scarr, Hopkin and Howse, 2003):

Healthy	– no damage
Light	– less than 25% of the tree crown damaged or missing
Moderate	– 25%-75% of the tree crown damaged or missing
Severe	– more than 75% of the crown damaged or missing

There was no consistency in the damage observed. In general, damage varied greatly among species and stands. Trees at the edge of the forest usually suffered more than trees in the interior. Conifers suffered less damage than hardwoods although some

conifer species such as red pine and eastern white cedar suffered substantial damage in given stands. Table 1 summarizes the severity of damage observed in several species.

Table 1. Level of damage by species

High	Medium	Low
Basswood	Sugar maple	White ash
Butternut	Beech	Shagbark hickory
Poplar	White pine	Spruce
Silver maple	Gray birch	Hemlock
Black cherry	Red oak	
	Elm	

HOW DID WE ORGANIZE OURSELVES

Once the agencies understood the magnitude of the damage, it was time to get together to begin the thinking around an action plan. The Eastern Ontario Model Forest (EOMF) was asked to facilitate the bringing together of the agencies, as the majority were members or partners of the EOMF. On January 22, 1998 the partners met. Present at the meeting were the Canadian Forest Service (CFS), the Ontario Ministry of Natural Resources (OMNR), the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), five Conservation Authorities (CA), Stewardship Coordinators, the Tree Canada Foundation, the Ontario Woodlot Association, the local maple syrup producer associations and Human Resources Development Canada.

The attending agencies and associations formed what was to be called the *Ice Storm Forest Recovery Group,* whose overall goal was to assist in the recovery of eastern

Ontario forests. There was tremendous co-operation with two main goals set as priorities: Short-term responses for the immediate care of the forest. Long term plans through science. To achieve these goals, a number of working groups were established as follows: a) a monitoring/assessing group, b) a communications group, c) a science and research group d) an urban/community trees group, e) a workshops/extension group, and f) a human resources group.

INFORMATION TO THE PUBLIC

It was crucial to get information to the public and to have a process in place through which the public could have questions answered. It was also crucial to have some key messages that were easy to understand and delivered in a manner that would reach as many people as possible. To address this, a 1-800 number was established, news releases were issued immediately, extension notes were created, and workshops were delivered in communities across the landscape. The key message from all partners to the public was: Safety first Pause don't panic, trees are resilient; time is on your side. Get proper help to assess your trees and woodlots. Trees should be assessed for short-term and long-term health. A news release focusing on key messages was issued on January 17, 1998. It was extremely important that people did not panic, focusing first on their safety. However, there were thousands of trees being removed because the branches were broken and landowners were making the wrong decisions.

Once the news releases appeared in the local papers with the key messages, it was important to produce extension notes to give the public the more detailed information they needed to care for their trees. Three extension notes were prepared: *Caring for Ice-Damaged Trees, Caring for Ice-Damaged Woodlots and Plantations, and Maintaining Healthy Urban Trees.* Information in these extension notes included who to call for information, how to prune safely, what do about ice-coated trees, what to expect concerning bent trees, how to repair torn bark, how to repair broken conifers, and future care. This information was well-received by the public and other agencies.

It was imperative that consistent messaging got out to homeowners and landowners. Consultants were hired to prepare presentations, as follows: *How to Care for your Ice*

Storm Damaged Trees (residential, landscape and street trees) and *How to Care for your Woodlot and Plantations.* These were packaged over time as an ice storm "Course in a Box". The Ontario Ministry of Natural Resource's stewardship coordinators (there is one stewardship coordinator for each county in eastern Ontario) were responsible for setting up and delivering the workshops. Using the presentations, which had been prepared by a consultant, they were able to share consistent messages concerning approaches to dealing with ice-damaged trees. The "Course in a Box" included: CD Rom overheads, speakers' notes, presentation handouts, worksheets and Extension Notes. The workshops put on by the stewardship coordinators were well attended and well received. One stewardship coordinator made 85 presentations. The workshops attracted large numbers of landowners and homeowners wanting to do what was right for their trees. These workshops were instrumental in saving trees and in ensuring that individuals were applying the correct treatments to damaged trees or had the foresight to call an expert when needed.

SCIENCE NEEDS

Immediate questions were being asked by various forest industries (e.g., maple syrup producers, Christmas tree growers) and landowners. In particular, the sugar maple industry in eastern Ontario was significantly affected. Approximately 12.5% of sugar maple taps in Ontario were estimated to be lost (Ireland, 1998). The major effect of the damage to trees in woodlots and plantations is expected to be a short-term decrease in the quality of commercial products, increased costs for harvesting (salvage) and decreased income to landowners (Lautenschlager, Nielsen, 1998).

A literature review was immediately undertaken to produce a summary of current published knowledge covering the effects of storms and ice damage to trees and forests and what the recovery probabilities would be. Much of this information was used immediately in the workshops and associated extension materials. Some material was used in the long-term to assist with information gaps.

A multi-disciplinary research study known as the Ice Storm Forest Research and Technology Transfer (ISFRATT) initiative was launched in October of 1998 to address

the many questions and concerns raised by local maple syrup producers and landowners. The study was developed by the Ice Storm Science Committee who identified these two areas as having information gaps and the need for scientific information to assist with short-term and long-term management. The Science Committee was comprised of representatives of the Ontario Ministry of Natural Resources, the Ontario Ministry of Agriculture, Food, and Rural Affairs (representing the maple syrup industry), the Canadian Forest Service and the Eastern Ontario Model Forest. From the studies that were conducted following the ice storm some key findings emerged as follows:

Red Pine Plantations: Following the ice storm many landowners with red pine plantations were directed to clean up tops, branches and damaged trees for fear that insects would travel to neighbouring plantations. Studies concluded that insects did not travel to healthy trees on neighbouring properties. However, the insects did travel to other damaged and weaker trees within the same plantation.

Maple Syrup Industry: There was a reduction in sap production in the first three years, and then production returned to normal after three years. There was growth reduction observed in the increments after the ice storm. For those who were managing younger stands of maple and hoping to get trees to the proper diameter for tapping (25 to 35 cm in diameter -1 tap), a longer-than- average wait was to be expected.

Mortality of Trees: People really did not know what was going to happen to the damaged trees. It was originally thought a tree with fifty percent (50%) crown damage would show signs of mortality. However, from the studies undertaken, the cut-off for mortality was shown to be seventy five percent (75%) crown damage.

Damage to Species Composition on the Ground: There was fear that damage to the crowns would result in damage to species on the ground or alter the composition of the vegetation and species on the ground. In year one after the ice storm, there was more vegetative growth in the understory. However, after year one the crowns closed in and this vegetative growth died out. A number of publications have been produced by the science community to assist landowners. These publications are listed in Table 2 and can

be found on the Eastern Ontario Model Forest web site at http://eomf.on.ca/ISFRATT/pubs.htm.

Table 2. Publications related to the Ice Storm

Title	Author
Ontario's forest Science Efforts Following the 1998 Ice Storm	R.A. Lautenschlager, C. Nielsen Forestry Chronicle July/August 1999
1998 Eastern Ontario Ice Strom Maple Producers Survey	Dave Chapeskie Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA)
Effects of Ice Storm Damage and other Stressors on Sugar Bush Health and Sap Productivity Literature Review	C. Coons, 1999 Ontario Ministry of Agriculture, Food, and Rural Affairs
Impacts of 1998 Ice Storm on Sugar Bushes and Summary Management Recommendations	Dave Chapeskie, 2000 (OMAFRA) Extension Note
Tapping and Sap Collection Techniques in Ice-Damaged Sugar Bushes	Dave Chapeskie, 2000 (OMAFRA) Extension Note
Harvesting and Maintenance in Ice-Damaged Sugar Bushes	Mark Richardson, 2000 (EOMF) Extension Note
Operating to Minimize Ice Storm Impacts on Tree Health	Mark Richardson, 2000 (EOMF) Extension Note
Protection of Ice-Damaged Sugar Bushes	Mark Richardson, 2000 (EOMF) Extension Note
Ice Storm Forest Research and Technology	Eastern Ontario Model Forest (EOMF)

Transfer- What We Have Learned

Decay, Stain and Wood-boring Beetles	Sylvia Greifenhagen, Anthony A. Hopkin (EOMF)
Ice Storm 1998-Forest Research Conference	C. Nielsen, 2000, Ontario Ministry of Natural Resources (OMNR)
A Literature Review of Ice Impacts on Forests in Eastern North America	O. Van Dyke, 1999 (OMNR)
Management of Ice-Storm Damaged Woodlots and Plantations	Meating et al., 2000 (OMNR)
Caring For Ice Damaged Trees	Extension Note
Caring For Ice-Damaged Woodlots and Plantations	Extension Note
Maintaining Healthy Urban Trees	Extension Note

The science efforts associated with the Ice Storm of 1998 were also documented in detail in the Forestry Chronicle – see Volume 79, No.1 January/February 2003.

Additional information on the science efforts conducted under the ISFRATT initiative can be found on the Eastern Ontario Model Forest web site at www.eomf.on.ca.

FINANCIAL ASSISTANCE

Ministry of Municipal Affairs and Housing: Currently in Ontario, the Ministry of Municipal Affairs and Housing (MMAH) is the lead agency responsible for emergencies declared by a municipality. The MMAH deals with the federal government once the province declares an emergency. In Ontario, there are now legislative guidelines for emergencies and each ministry must have an emergency response plan, as is the case with

municipalities. During the ice storm of 1998, financial assistance for forests came in a number of forms. In some cases, this assistance lasted up to six years.

Human Resources Development Canada: This federal department was present from the beginning offering funds of $10.0 million to fulfill post-emergency clean up. The funding was crucial to the Ice Storm Recovery Group and allowed the group to move forward by:

- Hiring an ice storm program coordinator to work with the many different groups and agencies
- Establishing a toll free number (and staff), allowing the public to get answers concerning damaged trees
- Hiring consultants to prepare a "course in the box" for woodlot owners in rural areas and for homeowners in urban areas
- Preparing extension notes and press releases
- Allowing for the development and delivery of workshops, along with the preparation of appropriate extension materials by consultants
- Allowing for a quick assessment of trees in towns and cities by trained staff, in particular dealing with aspects of safety
- Assigning work crews under the supervision of conservation authorities and stewardship coordinators to assist with the clean up of public parks, trails, and plantations
- Encouraging municipalities to remove dangerous and hazardous trees Providing on-site advisory service for woodlot owners.

Disaster Financial Assistance Arrangement (DFAA): This was the Canada/Ontario Ice Storm Assistance Program (ISAP). This assistance was for economic recovery for rural eastern Ontario – aimed at restoring economic activity to pre-disaster levels. The lead

ministry in Ontario was the Ministry of Municipal Affairs and Housing. The funding from this program was used to:

- Re-establish sugar bushes
- Prune and replace Christmas trees
- Clean up roads and trails on public lands
- Clean up public parks
- Clean up waterways
- Fund the Ice Storm Forest and Research Technology Transfer project, described previously.

Forest Recovery Assistance Program (FRAP): A number of landowners did not qualify for assistance under the DFAA program. In cases where landowners did not qualify, they could apply to the Ontario Disaster Relief Assistance Program and could be covered under the Forest Recovery Assistance Program (FRAP). A total of $3.5 million dollars was available in this program. This program covered $150 for a property assessment by a trained specialist (including recommendations), and $2,000 to assist with clean up efforts. Of the 6,500 woodlot owners who were eligible for this program, approximately 1,000 took advantage of it.

Tree Replacement & Management Strategy for Public Authorities: In 1999 an assessment was undertaken to identify what was not covered by assistance programs. Although most parks, sugar bushes, and private woodlots had some sort of assistance to help restore to pre-ice storm conditions, it became very evident that very few municipalities were requesting assistance to restore the urban forest canopy on public lands. Municipalities cleaned up the mess and removed hazardous trees but had no programs for tree replacement or maintenance. A joint initiative of the Ontario Ministries of Municipal Affairs and Housing and Natural Resources *(Tree Replacement & Management Strategy*

for Public Authorities) was launched in September of 1999 to assist communities. Some of the key aspects of this 3 year, $13 million program are summarized below:

- Financial assistance up to 75% provided for eligible works on priority sites for ice storm damaged trees.
- An inventory of damaged trees on public property had to be completed by a qualified arborist.
- A 3-year plan was submitted by the municipality using data from the inventory on how many trees were to be trimmed, cabled, braced, bark traced, planted and maintained, and removed following established costing guidelines.
- Progress was field audited annually by OMNR on work carried out
- Any revisions to the plan had to be approved by MMAH.

Public works and parks departments in eastern Ontario praised this program as they had funding to do maintenance that they could not normally do. The two to three year wait after the ice storm gave municipalities a chance to see what branches really had to be trimmed and what trees really had to be removed.

Operation Re-Leaf: Given that the assistance to affected municipalities was slow in materializing, the Tree Canada Foundation began a program which supplied some caliper stock to municipalities for their tree planting programs.

WHAT DID WE LEARN

Eastern Ontario, Quebec and New Brunswick now know how to better deal with prolonged ice storms, based on the experience following the 1998 storm. This experience has brought us to the conclusion that there are key elements that must be carried out to be successful in saving the urban forest canopy after such a disaster:

- Cooperation of all agencies, groups, and levels of government is essential.

- Know who you can pull together if there is an emergency and what each partner can bring to the table. In eastern Ontario, everyone was scrambling at the beginning. However, since the Eastern Ontario Model Forest was already working with many of the diverse groups affected by the storm, it was called upon to facilitate the bringing together of partners – resulting in the formation of the Ice *Storm Recovery Group*

- Emergency plans should include an arborist who can assist municipal staff when clean up efforts begin to ensure that trees are not unnecessarily removed. For example, the City of Ottawa Forestry Service was not called upon until day five of the 1998 ice storm, which was too late for a number of trees.

- Trees in the urban setting that had regular maintenance faired better than those that did not. To this day, there is less damage during windstorms due to the maintenance of trees following the ice storm.

- Make sure each municipality has a list of arborists they can call upon and make such lists available to the public.

- There is a need for information on how to care for trees.

- Get news releases out quickly, followed by extension notes for those that are interested in more detailed information. Hold workshops, focusing on communicating consistent messages, and including the technical information that many will seek. Key messages include: Safety First Don't Panic, Time is on Your Side, Get Advice from Experts, Trees are more resilient than we first thought.

- We were expecting mortality with trees having 50% crown damage. Mortality was actually found in trees with 75% crown damage or higher.

- Maple syrup production was back to normal after three to four years.

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