Ice Storm Assessment Group Meeting
USDA Forest Service
Durham NH
March 31

10:00 – 2:30
(Lunch 11:45-12:30)

Agenda Topics

Presentation of Ice Storm Assessment Data
    (Chris Eagar & Bob Smith)

Technical Report
    (Group Discussion)

Long-Term Monitoring Summaries & Ice Storm Web Site
    (Margaret Weeks)

Ice Storm Assessment Data

REGIONAL SURVEY - Polygon Numbers (multiple plots were surveyed in each polygon)

Vermont:
1-15, 206-210, 220-222   (23 polygons)

New Hampshire:
2-13, 15,18,19,39-42, 44,45, 101-105   (25 polygons)

Maine:
1-41, 333-337   (46 polygons)

New York:
11-17, 23-32   (17 polygons)

SUGARBUSH SURVEY – Sugarbush Numbers (multiple plots were surveyed in each sugarbush)

New Hampshire:
900-906   (7 sugarbushes)

New York:
        (12 sugarbushes)

FIA SURVEY - See attached plot lists (4 points were surveyed for each plot)

New Hampshire:
78 plots

New York:
461 plots

Vermont:
118 plots

Maine:
130 plots (still surveying additional plots)

Total FIA: 787

		Number of Trees and Percent						
Ice Storm Data Summaries								
		By Spp	By Sz Class (4 in)	By For Type	By Sz Class and Spp	By Elev Cl (300 ft)	By Aspect (N,S,E,W)	By Hgt Cl (5 ft)
Crown Damage Class								
Maine - Polygon								
Maine - FIA								
Maine - All								
New Hampshire - Poly								
New Hampshire - FIA								
New Hampshire - All								
Vermont - Polygon								
Vermont - FIA								
Vermont - All								
New York - Polygon								
New York - FIA								
New York - All								
Region - Polygon								
Region - FIA								
Region - All								
Bole Condition								
Maine - Polygon								
Maine - FIA								
Maine - All								
New Hampshire - Poly								
New Hampshire - FIA								
New Hampshire - All								
Vermont - Polygon								
Vermont - FIA								
Vermont - All								
New York - Polygon								
New York - FIA								
New York - All								
Region - Polygon								
Region - FIA								
Region - All								
Descriptive Data		Total spp (spp list)	# of trees by spp	# of trees by sz class	# of trees by szcl&spp	# of trees by for type		
Maine - Polygon								
Maine - FIA								
Maine - All								
New Hampshire - Poly								
New Hampshire - FIA								
New Hampshire - All								
Vermont - Polygon								
Vermont - FIA								
Vermont - All								
New York - Polygon								
New York - FIA								
New York - All								
Region - Polygon								
Region - FIA								
Region - All								

METHODS

Damage Assessment Surveys

Ice storm damage assessment surveys were initiated soon after the storm occurred. State Forestry agencies in New York, Vermont, New Hampshire, and Maine, as well as the USDA Forest Service State and Private Forestry Unit in Durham, NH, cooperated to collect information. Several components were incorporated into the regional assessment:

I.   Aerial Surveys and Aerial Photography
II.   Ice storm Damage Regional Survey
III.   Forest Inventory and Analysis Sites
IV.   Forest Health Monitoring Sites
V.   Sugarbush Assessment Survey, including North American Maple Project Sites
VI.   Vermont Hardwood Health Survey

For the ground surveys, core data elements were established to be able to compile the data from the different survey components into a regional assessment. Specific site information relating to location, elevation, aspect, and forest type was collected at each sample site. Tree data elements included species, diameter, tree height, crown position, leaning or uprooted, percent crown breakage, broken or split bole, and general tree condition. An estimate of fuel loading, based on the type and amount of woody debris present, was also made to determine fire hazard.

I. Aerial Surveys and Aerial Photography:

Aerial surveys were conducted in New York, Vermont, New Hampshire, and Maine soon after the storm and again, in some areas, during the summer months. These surveys provided general information on the location, pattern, and severity of the damage. This information was used to create state and regional maps *(Figure 1)*. Aerial photography was also used to help with damage assessment. Maine acquired 2.8 million acres of photography to map the damage and the US Forest Service photographed selected areas in New York, Vermont, and New Hampshire to compare with some of the aerial survey mapped information.

II. Ice Storm Damage Regional Survey:

The objective of this survey was to characterize the damage to the forest resource, which was mapped during aerial surveys and aerial photography. The mapped areas, referred to as polygons, were stratified into light to moderate and heavy, based on amount of tree breakage. A minimum of 10 to 15 polygons were selected in each state. The areas were selected to represent the various topographic and forest type conditions statewide. To facilitate ground crews, areas with reasonable road or trail access were used. The sample

sites, called plots, where information was collected, were located at least 100 to 200 feet off the access road or trail.

Between 5 to 10 plots were sampled in a transect across each selected polygon depending on the size of the area. The plot design was a 1/24th acre plot, which is the same design as the Forest Health Monitoring and most recent Forest Inventory and Analysis plots. All trees greater than 5 inches in diameter within the 24 foot plot radius were tallied. To assess damage to the smaller sapling size trees, a 6.8 foot radius microplot was nested within the larger plot. The center of the microplot was offset at 90-degree azimuth, 12 feet from plot center.

Information was collected on the following data elements:

1. Sample Site: location, elevation, aspect, and forest type.
2. Fire Hazard: Estimated within a 60 foot radius of plot center, including fuel load (high, medium, low, or none) and fuel type (based on percent hardwood and softwood slash).
3. Tree Species
4. Diameter Breast Height
5. Crown Position: open grown, dominant, codominant, intermediate, or overtopped
6. Bent or Leaning ($\geq$ 45 degrees, $\geq$ 45 degrees with crown touching ground), or Uprooted
7. Percent Crown Damage: Amount of crown broken or removed due to ice damage, in 10 percent breakage classes, from 0 with no ice breakage to 100 % where the entire crown is gone. Branches that were broken but still attached were included, however, older, previously broken branches or dieback was not.
8. Bole Condition: bole broken below the crown or severely split below the crown
9. General Tree Condition: Previous damage agent (for example beech bark disease)
10. Tree Height: Estimate of total height

Standard Forest Inventory and Analysis and Forest Health Monitoring data codes were used to record the information.

III. Forest Inventory and Analysis Sites:

Forest Inventory and Analysis (FIA) has an extensive network of sample sites throughout the United States. The data from these sites provides basic information about the forest resource in individual States. The most recent FIA surveys were in New York in 1993, in Maine in 1995, and in New Hampshire and Vermont in 1997. To obtain information on the impact from the storm, plots that were within the ice storm damage areas were revisited. By resurveying FIA sample sites within the storm "footprint," valuable information was collected about the storm's effect. Information was collected for the same data elements described in the regional characterization survey. This resurvey was carried out by the USDA Forest Service Northeastern Research Station FIA group and the Maine Forest Service.

IV. Forest Health Monitoring Sites:

Forest Health Monitoring (FHM) sample sites have been in place in New England since 1990. A portion of the sites are visited every year to obtain information on tree health. All FHM sites in Vermont, New Hampshire, and Maine that were in the storm impact area were measured this year. The existing FHM measurement methods were used, plus additional ice-related measurements were taken. In New York, scheduled to join the Forest Health Monitoring Program in 1999, the planned plot locations were identified. These FHM plots are co-located with FIA plots and were visited in 1998, as part of the FIA resurvey, to determine the impact of the storm on sample sites.

V. Sugarbush Assessment Survey:

The maple sugar industry was impacted by the ice storm. In order to determine the extent of the damage to sugarbushes, both North American Sugar Maple Project (NAMP) sample sites and additional sugarbushes that were damaged were visited. The North American Maple Project is a United States and Canadian program implemented in 1988 to assess and monitor the health of sugar maple. Sample sites, located in both natural forests and sugarbushes (trees maintained for maple syrup production), were measured..

Since many commercial sugarbushes did not fall within the NAMP plot system, additional sugarbush sites were measured to better determine the storm's effect on the maple industry. The additional sugarbush sites were surveyed in New Hampshire and New York. Within the additional sugarbush stands, the plot design and core data elements were the same the regional survey, to provide consistency with the regional assessments. Also, NAMP dieback and transparency measurements were recorded for all trees greater than 5 inches dbh, to relate to the regional NAMP database. Three to five 24 foot fixed radius plots were established within each sugarbush, depending on the relative size of the sugarbush.

VI. Vermont Hardwood Health Survey:

This survey was begun in 1985 to assess the condition of Vermont's hardwood forests. Permanent ground sample sites were established around the State. All sites were visited in the spring of 1998, before the trees leafed out, to determine if there was damage. Follow-up visits were made over the summer.

Analysis

Description of types of data analysis....

Monitoring Effects
From the January 1998 Ice Storm
In New York, Vermont, New Hampshire, and Maine

As a result of the ice storm, questions were raised as to the long-term impact on trees, forest stands, and wildlife, as well the effects on forest resources and landowners. The Federal Emergency Appropriation for the recovery included funds for studying long-term effects. The following list describes the various projects that have been initiated or proposed in each of the affected states and the project contact.

Maine:

Tree Damage — Investigation of long-term damage from ice storm injury, related to stocking and stand condition, and post-storm harvest impacts. Looking at various stand conditions: precondition (undamaged stands), damaged stands, and post harvest stands. Planning training sessions to share management recommendations based on research. *(Bill Ostrofsky — University of Maine, Orono, Maine)*

Secondary Insect Impacts — Conducting general surveys for various insect pests such as callous borers, sugar maple borers, bronze birch borer, and ambrosia beetles. Planning to compare previous years insect populations with future population development. Have already observed significant increases in beetle populations in affected red pine plantations. Will also be looking at potential build up of larch beetle populations. *(Dick Dearborn — Maine Forest Service, Entomology Lab, Augusta, Maine)*

Aerial Photography — Planning to compare current true color (1:9,000 scale) photography to aerial photos obtained 5 and 10 years after the storm to determine change in stand condition. The information on the photos will be augmented by information from permanent plots within the photographed area, including Forest Health Monitoring plots, Forest Inventory and Analysis plots, Beech Survey plots, and Birch Survey plots. *(Dave Struble — State Entomologist, Maine Forest Service, Augusta, Maine)*

New Hampshire:

Land Cover Type Mapping — Developing digital mapped data layer to support identification and assessment of areas damaged during the ice storm. Cooperative effort will rely on remotely sensed data (Landsat Thematic Mapper imagery) and imaging radar data (Radarsat, ERS-1, ERS-2) to characterize landscape "patches". The project will incorporate a pre-event vegetation type map of susceptible areas above a specific elevation and post-event imagery to provide data on specific locations of damage. The overlay will provide an assessment of damage areas by location and vegetation type, and provide baseline information to managers to assist in monitoring long-term impacts. *(Barry Rock - Complex Systems Research Center, University of New Hampshire, Durham, NH)*

Natural Heritage Assessment and Management - Assessing the condition of rare plant populations and natural communities influenced by the ice storm. Planning to Identify appropriate management actions to insure their survival. Currently 281 occurrences on non-federal lands in NH. Planning reconnaissance on the ground in storm damaged areas to assess condition, habitat and management options. Will coordinate with White Mountain National Forest working on US Forest Service lands.
(NH Division of Forests and Lands, Concord, NH)

Wildlife Habitat – Working within ice storm damaged areas to develop long-term plans for ice damage recovery, forest stewardship, and wildlife habitat conservation. Collaborating with NH Fish and Game Department, Regional Planning Commissions, and Conservation Commissions.
(Extension Wildlife Specialist, Cooperative Extension, University of New Hampshire, Durham, NH)

Amphibian Populations – Researching amphibian responses to changes in forest structure associated with ice storm damage. Studying changes in amphibian populations, which can potentially have a significant impact on the forest food web. Provides a model for examining the effects of natural disaster events.
(Kimberly Babbitt, University of New Hampshire, Durham, NH)

New York:

Forest Plant Communities – Quantifying the nature of losses in various stands to assist managers in planning responses for future events. Relating post-damage condition and future growth of surviving trees to their pre-storm canopy position and extent of crown breakage. Documenting size, species, and conditions of trees lost to ice loading and describing structural changes in forest plant community and effect on plant and animal habitat.
(D. Leopold, SUNY Environmental Science and Forestry, Syracuse, NY)

Forest Health – Continuing random sampling of ice storm damage to assess impact to forested areas. Establishing plots to determine: the relative damage within tree species and across forest types; the proportion of forest managed and how management affected impacts and recovery from the storm; and the relationship of previous disease induced defects to responses to the storm and impact of ice damage on future forest health.
(Paul Manion, SUNY Environmental Science and Forestry, Syracuse, NY)

Wildlife Communities – Focusing on white-tailed deer population responses to the ice storm, specifically assessing deer impact on regeneration of tree seedlings in forest communities. Assessing interaction of deer and vegetation to determine: if deer populations will increase dramatically as a result of increased understory vegetation; if the impact of deer browse on species composition of the regenerating forest is dependent on the scale of the disturbance; and if failure of sugar maple regeneration is due to factors other than deer. Field surveys are also planned to evaluate impacts of ice storm caused changes in forest structure and composition on birds, amphibians, and small mammals.
(J. Gibbs, SUNY Environmental Science and Forestry, Syracuse, NY)

Forest Insects – Evaluating the economic impact of various bark beetles and borers, specifically *Dendroctonus valens* on white pine, *Glycobius speciosus* on sugar maple, and ambrosia beetles on hardwoods and conifers. Planning to assess the impact of the insect populations in damaged and undamaged stands, the effect of individual tree damage on insect populations, and level of damage from insects to healthy and lightly damaged trees. Also identifying the insect/host relationship associated with mortality and decomposition of damaged trees.
(Doug Allen, SUNY Environmental Science and Forestry, Syracuse, NY)

Economic Impact Analysis – Determining the financial impacts of the storm on forest resources, with emphasis on short and long-term impacts on timber and forest-related recreation. Incorporating data on the quantity and extent of timber loss volume and the extent and future development over the next 10 to 20 years of accelerated volume and grade loss due to ice storm damage. A schedule of expected product and grade recovery will be developed, along with an estimate of losses due to inability to recover material. Regional estimates will be determined regarding number of recreationists affected and financial losses.
(J. Wagner, SUNY Environmental Science and Forestry, Syracuse, NY)

Social and Policy Issues – Assessing various public policy questions associated with natural catastrophic events including: threat of increased fuel load to landowners, fire dangers, funding mechanisms for rural fire districts, regulations related to sanitation and salvage, public assistance to private landowners to assess damage, private-public partnership for better management, response of communities to loss of street trees.
(D. Floyd, SUNY Environmental Science and Forestry, Syracuse, NY)

Evaluation of SIP - Evaluating the delivery of technical assistance to landowners affected by the ice storm. Assessing the awareness and understanding of landowners, DEC agency staff and consulting foresters regarding how to apply for SIP funds will be assessed. Evaluating the ease of the application process and the communication between the various agencies and landowners will be evaluated.
(Tommy Brown, Cornell University, Ithaca, NY)

Educational Efforts: Assessment of educational efforts and needs of private woodland owners, maple producers, and tree care professionals. This project will characterize the degree to which educational materials and programs have assisted landowners and if any additional educational assistance is needed.
(Tommy Brown, Cornell University, Ithaca, NY)

Aquatic Habitats: Assessing immediate and long-term impacts on streamsides and aquatic habitats. Investigating the immediate impacts of the storm on riparian zone trees and assess the resulting effects on the fish and invertebrate communities and on physical processes in associated streams. The second component will consist of a long-term monitoring program of the recovery of the streamside and stream habitats.
(Rebecca Schneider and Cliff Kraft, Cornell University, Ithaca, NY)

Sugarbushes – Evaluating recovery of sugarbushes in northern New York. Examining growth rates, stocking levels, tree vigor and quality, changes in successional patterns and invasion of species, rate of compartmentalization of taphole wounds, and increased susceptibility to insects and disease. Establishing permanent plots, in impacted stands that were active in sap production prior to the storm, to be remeasured over a 4 year period.
(Lewis Staats, Marianne Krasny, and Peter Smallidge, , Cornell University, Ithaca, NY)

Urban Trees – Initially re-examining trees damaged in the Rochester, NY 1991 ice storm to supply background for a sound urban canopy monitoring project in the North Country. Eventually, a parallel study of the rural forest recovery project that has already been initiated will be implemented. Determining the long-term effects of urban storm damage, evaluating the consequences of leaving trees with 50% - 70% crown damage, and planning to provide better guidelines for tree managers.
(Jerry Bond, Cornell University, Ithaca, NY)

Vermont:

Impact on Butternut - Relocating and evaluating butternut trees in the Champlain Basin of northwestern Vermont to determine the overall extent and impact of ice damage. Also, evaluating the extent and impact of ice damage on other tree species growing in association with butternut.
(Dale R. Bergdahl, Department of Forestry, University of Vermont, Burlington, VT)

Bird Populations – Assessing changes in breeding bird populations in ice damaged forests. Investigating the ice storms effect on the relative abundance, diversity, and composition of forest breeding bird populations in Vermont.
(Steve Faccio, Staff Biologist, Vermont Institute of Natural Science)

Growth and Survival of Sugar Maple - Examining the relationships among crown damage, root and stem carbohydrate storage, and subsequent growth and survival in sugar maple trees in stands in Vermont.
(Timothy Perkins and Betty Wong, Proctor Maple Research Center, UVM and US Forest Service, Northeastern Research Station, Burlington, VT)

Crown Canopy Changes - Following the recovery or decline of tree crowns in ice-damaged stands compared to nearby non-damaged stands using image analysis as a means to monitor changes over time in canopy cover, leaf area, and standard crown health ratings.
(Ronald Kelley, Department of Forests, Parks & Recreation, Stowe, VT)

Remote Sensing - Assessing ice-affected foliage using remotely-sensed infrared imagery to detect on-going stressed vegetation. Attempting to provide additional information on the location and extent of forest damage based on visible imagery analysis.
(Lesley-Ann Dupigny-Giroux, University of Vermont, Geography Department, Burlington, VT)

Changes in Forest Stands - Monitoring changes in growth, composition, and health throughout the forest vegetation structure in a severely damaged ice stand and comparable undamaged site on Vermont State land.
(Jay Lackey and Florence Peterson, Vermont Department of Forests, Parks & Recreation, Barre, VT; and US Forest Service, Forest Health Protection, Durham, NH)

Ecological Effects — Monitoring long-term ecological effects on vegetation monitoring plots at Shaw Mountain preserve.
(Ana Ruesink, Vermont Nature Conservancy)

USDA Forest Service:

Response of Forests - Monitoring the response of the entire plant community, including herbaceous and understory woody species dynamics, to openings created by the ice storm. Also assessing the fate of injured trees. Using detailed, permanent vegetation study sites to be located throughout Vermont, New Hampshire, and Maine.
(Christopher Eagar, USDA Forest Service, Northeastern Research Station, Durham, NH)

Tree Damage — Examining the damage caused by ice storm injury to northern hardwoods. Determining the effect of crown loss, due to ice injury, on stemwood formation 5 years after injury and the effect of wood exposure on wood quality. Also, assessing the types of wood stains and rots that develop after injury. Creating a library of digital images to produce photo guides and educational materials. Study trees located in Maine, New Hampshire, and Vermont.
(Water Shortle and Kevin Smith, USDA Forest Service, Northeastern Research Station, Durham, NH)