by Michele Williamson

A Tree Falls In The Forest: The Ontario Forest Biomonitoring Network Is Listening

In eastern Canada, the health of maple hardwood forests was of concern in the 1980s because of widespread reports that air pollution and acid rain was causing hardwood forests to decline in North America and Europe. Sugar maple forests in Ontario and Quebec were thought to be especially vulnerable as they received acidic deposition and were vulnerable on Canadian Shield soils that were acidic and nutrient poor. Sugar maple was considered an important tree species to monitor as this species is the iconic image for Canada and is a dominant land cover throughout eastern Canada. In addition, maple sugar producers in Ontario and Quebec were concerned about the future of their industry.

Overview of Ontario Forest Biomonitoring Network

To address these concerns, the Ministry of Environment (MOE) initiated the Hardwood Decline Survey in 1985 (MOE 1988). The goal was to monitor visual symptoms of tree deterioration that were known to be linked to acid rain and air pollution in 111 plots within undisturbed sugar maple dominant forest across the range of hardwood forests in the province (Figure 1, above right). This forest decline monitoring has continued and is still active today as the Ontario Ministry of Environment and Climate Change (MOECC)'s Ontario Forest Biomonitoring Network (OFBN).

The Decline Index (DI) was the standardized metric that was developed to assess tree crown health by measuring tree stress symptoms from 0 to 100% (Figure 2). This index was developed from the scientific literature and a tree stress symptom survey that was done by members of the Ontario Maple Syrup Producer Association. A decline severity rating was also developed by categorizing the 0-100% DI measurements into very low, low, moderate, high and severe incidence.

The monitoring program has also included other measurements on trees and vegetation, soil, animal, and climate indicators. The following measurements vary in how often, when and how intensively they have been sampled.

- **Trees:**
  - o Stem map of position of each tree in each plot (50 metres x 50 metres);
  - o Canopy structure of plot and canopy position of individual mature trees;
  - o Crown width, size and characteristics of individual mature trees;
  - o Percent canopy closure of plots;
  - o Tree species of mature trees and saplings;
  - o Tree diameter, age and growth;
  - o Tree injury assessment by physical damage, insects, other animals and disease;
  - o Tree mortality;
  - o Regeneration of juvenile trees;
  - o Timing of bud and leaf flush of canopy maple trees in spring; and
  - o Tree foliage chemistry of sugar maple and yellow birch.
- **Other vegetation:**
  - o Understory species presence, percent cover and height;
  - o Presence of invasive plant species;
  - o Presence of lichen species;
  - o Amount of woody debris;
  - o Amount of leaf litter; and
  - o Timing of bud and leaf flush of understory plants.
- **Soil:**
  - o Soil depth to bedrock and carbonate calcium-rich rock;
  - o Amount of mineral soil and gravel, rocks, and stones; and
  - o Soil types and chemistry.
- **Plot Site:**
  - o Amount, type and location of natural and human disturbances;
  - o Slope type, profile, length and percent; and
  - o Other site features e.g., water seeps.
- **Animals :**
  - o Numbers and species of salamanders and other amphibians; and

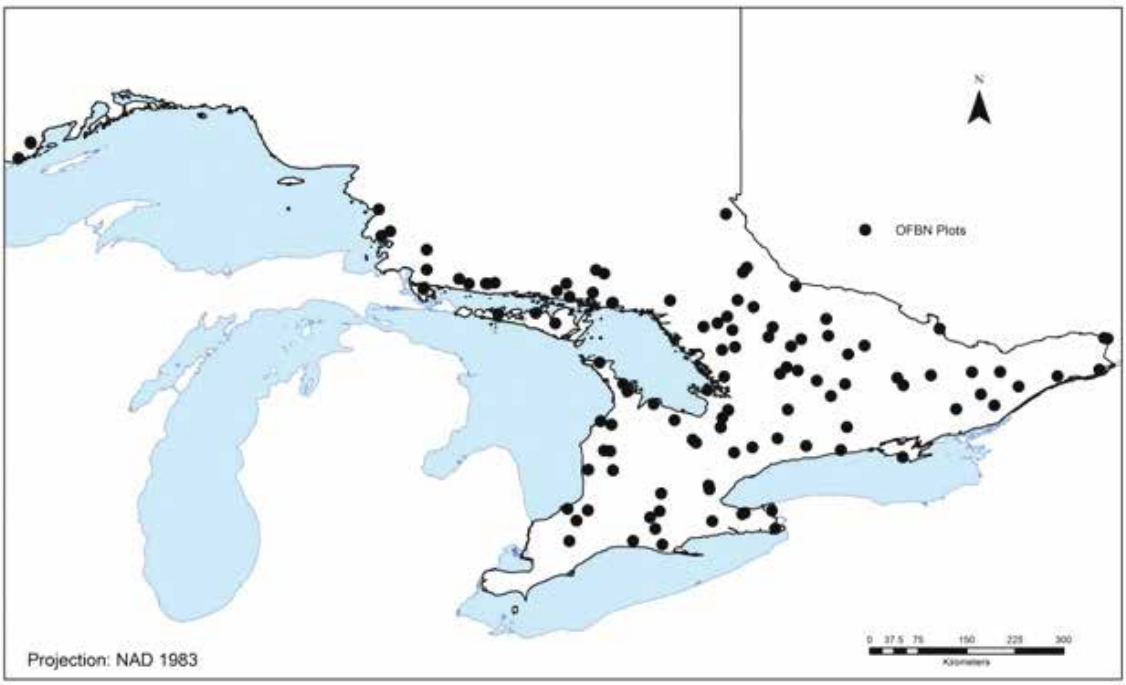

Figure 1: Ontario Forest Biomonitoring Network Plots

- Timing of songbird and amphibian calls in spring.

- **Climate:**
  - Temperature of air, trees, and soil;
  - Air humidity;
  - Soil moisture;
  - Rain fall; and
  - Sunlight intensity.

Forest Decline in Ontario

Overall, Ontario hardwood forests have been healthy with many tree stems and plot averages per year having numerous very low to low, some moderate, and fewer high or severe decline incidence or Decline Index values. Forest Decline Index values and incidence have, however, varied over the 30 year monitoring period (Figure 3, following page). Generally, forest health was 'poorer' during the 1980s, 'improved' during the 1990s, and appears to have 'deteriorated' during the 2000s. It is unknown whether the recent apparent declining trend may improve in the future as decline has previously worsened and then improved over time. Despite these annual increases and decreases of decline, decline has not had a consistent deteriorating or an improving trend from the start of the program to 2017. Fortunately, maple forests were not devastated within a few years of acid rain occurring in the 1980s. Other papers will further explore the impacts of air pollution and acid rain on forest decline.

Regions had different amounts of decline. Two different types of regional classifications were compared. Rowe's forest regions were classified on the dominant tree species, broad- or needle-leaved cover types and associated species (Rowe 1972). The hierarchical Ecological Land Classification (ELC) divided regions into Ecozones, Ecoregions and Ecodistricts based on differences in climatic, geological, soil or vegetation characteristics (Crins et al. 2009). Both regional classifications found consistent decline patterns among regions with a few exceptions.

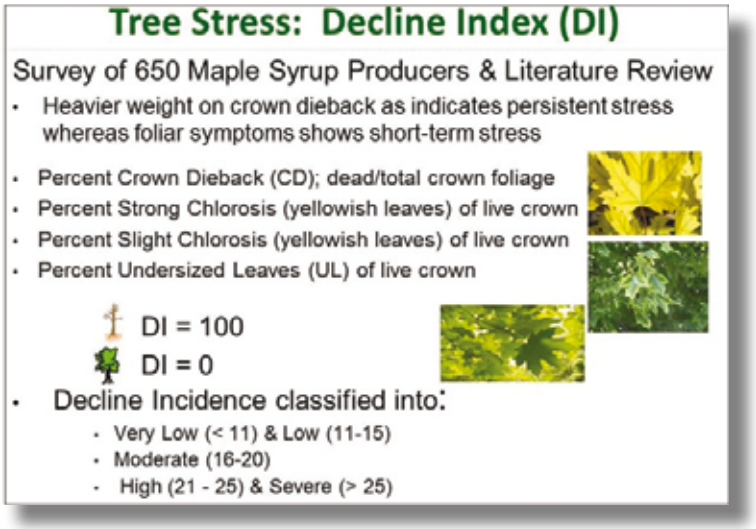

Figure 2: The Decline Index and Severity Incidences

In general, our monitoring results show that hardwood forests on the northern Canadian Shield are not as healthy as forests in the southern parts of Ontario. This is likely because forests on the Shield generally have less favorable growing conditions including cooler temperatures, shorter growing seasons and poorer soils that are acidic and have fewer nutrients. However, some areas were an exception to this general pattern.

Monitoring plots differed in their amount of decline. Many factors can influence decline within plots. The amount of regional decline was, however, not related to the longitude (west-east) or latitude (south-north) coordinates of plots or the physical distances between regions or plots.

Regions and plots had similar increases or decreases in decline from one year to the next. These annual changes in decline depended on which two consecutive years were compared. These annual changes were, however, similar among regions

and plots. Thus, the likelihood of decline improving or worsening from one year to the next is similar throughout the province. These results suggest that broad-scaled factors can affect decline across the entire province in the same year.

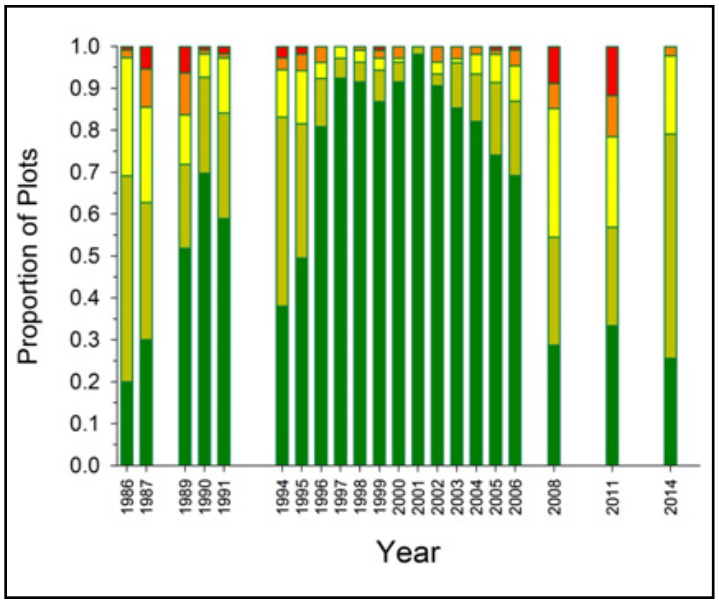

Figure 3. Annual Changes of Decline Incidence

References

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Author's Biography

Michele Williamson is a forest ecologist and the MOECC scientist responsible for the OFBN.