

# Field observations of northern white-cedar (*Thuja occidentalis*) crown dieback in Maine and Michigan (*NE-EM-07-01*)

KaDonna Randolph<sup>1</sup>, Bill Ostrofsky<sup>2</sup>, Jim Steinman<sup>3</sup>, Manfred Mielke<sup>3</sup>, and William Bechtold<sup>1</sup>

<sup>1</sup>US Forest Service, Southern Research Station <sup>2</sup>Maine Forest Service <sup>3</sup>US Forest Service, Northeastern Area State & Private Forestry

**Background** – As part of the 2006 National Forest Health Monitoring (FHM) report [1], spatial clusters of plots with crown dieback of 10 percent or more were discovered among several of the plot-level averages of northern white-cedar in Maine and northern Michigan (Figure 1). These elevated averages for northern white-cedar were not necessarily accompanied by elevated averages among the hardwoods and other softwoods on the plots (Figure 2). Such levels of dieback were of concern because unlike hardwood trees, conifers often do not exhibit crown dieback unless the tree is under serious stress. Aside from stem decay, northern white-cedar is a species relatively free from serious injury by insect and disease pathogens; therefore, the reasons for the elevated levels of dieback were unclear.



Figure 1. Crown dieback plot averages for northern white-cedar, 2000-2004 FIA assessment. Plot locations are approximate.

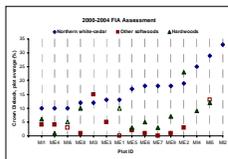


Figure 2. Crown dieback plot averages by species group, 2000-2004 FIA assessment. Hollow symbols indicate that the average is based on n < 5 trees.

**Methods** – A two-year Evaluation Monitoring (EM) study of northern white-cedar has been implemented to further evaluate these findings. The first stage of this study was accomplished during the summer of 2007 in which we visited the plots identified in the FHM report as having an average cedar crown dieback greater than 10 percent. These averages were based on assessments made by the Forest Inventory and Analysis Program (FIA) between 2000 and 2004. In addition, we also visited a small number of plots that had an average NWC crown dieback less than 10 percent for comparison.

In total, 18 FIA plots were visited (Figure 3). These EM assessments occurred 4 to 7 years after the FIA assessment on which the FHM report was based. Plot visits in Maine were made between June 18 and June 28. Plot visits were made in Michigan between July 9 and July 19. Tree status (live/dead), crown conditions, and diameter at breast height (dbh) were recorded for the cedar trees during each plot visit. Additional observations were made about individual-tree damages and stand-level growing conditions.

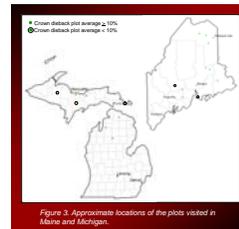


Figure 3. Approximate locations of the plots visited in Maine and Michigan.

## FIELD OBSERVATIONS

**Crown Conditions** – Overall, northern white-cedar crown conditions ranged from very good to very poor. Average crown dieback based on the northern white-cedars was lower in 2007 than at the previous FIA assessment for 12 of the 13 plots (Figure 4). However, this does not necessarily indicate improved tree condition. When FIA assessment plot averages are recalculated to include only the trees that survived to 2007, average crown conditions improved on only 8 of the 13 plots. Field notes indicate that 15.6 percent of the survivor trees on the plots with improved dieback averages had dead tops or dead branches with no fine twigs, neither of which qualify as “recent dieback” according to FIA protocols.

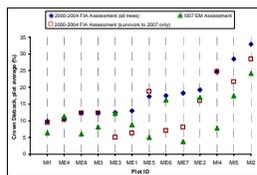


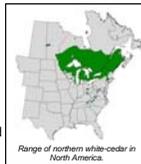
Figure 4. Crown dieback plot averages for northern white-cedar at the 2000-2004 FIA assessment and at the 2007 EM assessment.



Range of crown conditions observed during the 2007 EM plot visits.

Northern white-cedar is an ecologically and economically important species that ranges across the northern part of the United States from Maine to Minnesota and covers a similar east-west range in southern Canada. It also may be found at other scattered locations throughout the Eastern US[2].

Northern white-cedar grows in a wide range of soil conditions, from peat swamps and bogs to dry upland sites, and is a favored shelter and browse in winter deer yards[3]. It ranked fifth among all species in average annual removal of growing stock volume on Maine timberland between 1999 and 2003 according to the 2003 *Forests of Maine* report[4].



Range of northern white-cedar in North America.



**Mortality** – Northern white-cedar mortality occurred on 10 of the 13 plots with an elevated crown dieback average (11.1 percent of the trees died). The mortality trees ranged between 5.1-in. and 13.1-in. dbh and two-thirds had a crown dieback rating of 20 percent or more at the previous FIA assessment (Figure 5). Half of the mortality trees were in the understory with little or no exposure to sunlight. The remaining mortality trees were in the overstory (Figure 6). In contrast, mortality occurred on 2 of the 5 “good” plots (4 out of 121 trees died); only one of the mortality trees was in the overstory. The others were in the understory with no exposure to direct sunlight.

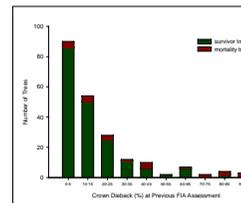


Figure 5. Crown dieback at the 2000-2004 FIA assessment, by survivorship.

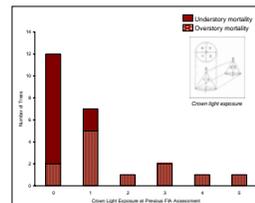


Figure 6. Crown light exposure at the 2000-2004 FIA assessment for the mortality trees, by crown position. Crown light exposure is the total number of sides of the crown that receives sunlight when the sun is directly overhead.

**Bole and Root Conditions** – Pistol-butted trees were prominent among the northern white-cedar, particularly in Maine. Wind events were the apparent cause of many of the leaning and fallen trees; however, leaning trees were common even in areas not obviously disturbed by wind. Nearly 11 percent of the trees assessed were noted as leaning or fallen. Because of the pistol-butting or lean, many trees had exposed roots. The ability of northern white-cedar trees to survive with substantial portions of dead cambium[5] was apparent. Strips of dead cambium starting at the base of the tree and tapering up the bole, often in a spiral fashion, were present on many trees. Brown cubicle rot identified as that caused by the fungus *Postia sericicollis* was observed and was often accompanied by large holes created by woodpeckers or sapsuckers.



**Site Conditions** – The plots were located on one of five physiographic types: flatwoods, bays and wet pocosins (MI only), rolling uplands (ME only), moist slopes and coves, and swamps/bogs (ME only). The flatwood sites included moist sites with high hummocks and flowing water underneath as well as drier sites with a less undulating floor. The rolling upland and moist slope-cove sites were relatively drier with rocky soil. The bay-wet pocosin and swamp-bog sites contained low hummocks with standing or flowing water beneath. Harvesting, both recent and in years past, was evident on the plots visited as were disturbances caused by wind and flooding. A shallow water table was evident for many of the plots and water stood at depths of 0.1-ft to 0.6-ft at the previous FIA assessment.



**Outcomes** – The field visits were successful in verifying the elevated levels of northern white-cedar crown dieback on the selected plots; however, no single cause for the high levels of crown dieback was identified. There seemed to be a variety of factors contributing to the dieback including tree age, weather events, soil conditions, and past harvesting practices.

The profusion of leaning trees observed during the field visits identified a gap in the FIA data collection protocols: no measurement of lean angle is recorded for live trees. Describing the lean angle of live trees provides additional information to help explain unusual conditions in the tree crown condition indicator; for assessing damage after harvesting, hurricanes, tornadoes, floods, and snow or ice storms; and for projecting the trees’ future status (i.e., leaning trees may be more susceptible to premature mortality, more likely to fall during storm events, etc.). As a result of our observations we are working through the FIA change management system to add a simple measurement of lean angle for all live trees.

The field visits were helpful in identifying variables to include in the second stage of this project which will be a statistical analysis describing the change in northern white-cedar crown dieback across its range in the northern US over an approximate ten-year period. These variables include: the FIA measurements of disturbances, treatments, physiographic class, dbh, percent rotten or missing cull, and damages, as well as auxiliary information about temperature and precipitation.

## Literature Referenced

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