Chapter 12. Assessment of Black Ash (*Fraxinus nigra*) Decline in Minnesota

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Introduction

Black ash (*Fraxinus nigra*) is present throughout the upper Midwest and Northeastern United States and is often found in lowland hardwood forests. Black ash seed is an important food for birds and small mammals, and its twigs and foliage are used by ungulates. Black ash wood is valued for paneling and furniture as well as for Native American basketry. In recent years, the availability of quality trees used to make baskets has diminished because of black ash decline.

Black ash decline has been observed throughout the range of its host (Croxton 1966, Livingston and others 1995, U.S. Department of Agriculture Forest Service 2004). In Minnesota, 2004 surveys showed over 27,000 acres of dieback occurring on black ash (U.S. Department of Agriculture Forest Service, Northeastern Area State and Private Forestry 2005). The cause of ash decline is unknown, but has been related to drought (Livingston and others 1995), subfreezing temperatures with little snow cover, or late spring frosts (U.S. Department of Agriculture Forest Service 2004). Black ash is a shallow-rooted species susceptible to varying water levels and winter freeze-thaw injury.

Our objectives in this study were to use Forest Inventory and Analysis (FIA) and Forest Health Monitoring (FHM) data to assess the pattern and extent of black ash decline in Minnesota and to relate this to mapped climatic, physiographic, and edaphic data (see Ward and others 2009).

Methods

Aerial survey data collected in Minnesota during 2004 were obtained from the FHM aerial survey results viewer (U.S. Department of Agriculture Forest Service, Northeastern Area State and Private Forestry 2005). Dieback and decline polygons in the black ash cover type were joined to three Minnesota Department of Transportation roads layers—major interstates and trunk highways, county and State roads, and city streets—to examine relationships between distance to road and decline symptoms. In addition, data collected in Minnesota from 1,605 black ash trees measured in the 1990-era inventory and remeasured in the 2003 inventory, were accessed from the FIA Spatial Data Services Center. The data included true plot coordinates which were spatially joined with several ancillary datasets: county boundaries, ecological subsections, temperature and precipitation, State Soil Geographic (STATSGO)

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soils data (U.S. Department of Agriculture Natural Resources Conservation Service, Soil Survey Staff 2007), the National Wetlands Inventory (http://www.fws.gov/nwi/index.html), and the National Hydrography Dataset (http://nhd.usgs.gov/index.html). Spatial relationships of black ash growth and mortality among State climate divisions, ecological subsections, and counties were analyzed using contingency tables. Linear regression was used to determine relationships between growth and mortality and the dependent variables mean temperature, mean precipitation, and STATSGO soil characteristics.

Results and Discussion

Black ash dieback/decline polygons were significantly closer to city streets ($P = 0.030$) and to county and State roads ($P < 0.001$) than were random black ash points. Distance to highways was not significantly different between dieback/decline polygons and random points ($P = 0.341$). Several factors could contribute to the relationship between dieback/decline and distance to city, county, and State roads. Construction of city, county, and State roads can alter the natural hydrologic flow through black ash stands and result in stagnant, standing water, which can adversely impact tree growth and survival. Other factors can include high levels of road deicing salt spray and runoff on land adjacent to roads in the winter. Road salt spray causes bud death and twig dieback in deciduous trees, and high levels of soil salt can damage leaves and reduce tree growth and vigor. In addition, road salt can decrease the cold hardiness of plants. However, direct salt spray related decline should be restricted to near roadside distances. Vegetation near roadways can also be exposed to damaging pollutants from car and truck emissions.

Recorded black ash mortality at the time of sampling increased by 18 percent between the 1990 and 2003 inventories, and levels of mortality were spatially concentrated. The increase in mortality between the two time periods differed among 16 counties ($P < 0.001$) (fig. 12.1), being greatest in Mahnomen County (56 percent) and least in Crow Wing and Mille Lacs Counties (6 and 7 percent, respectively). Mortality also differed among five Minnesota climate divisions in 1990 ($P \leq 0.001$), but was not significantly different among divisions in 2003 ($P = 0.176$). Mortality between 1990 and 2003 was highest in the central (24 percent higher), northwest (23 percent), and north central (15 percent) divisions. In 1990, significant differences in black ash mortality ($P = 0.02$) existed among 20 ecological

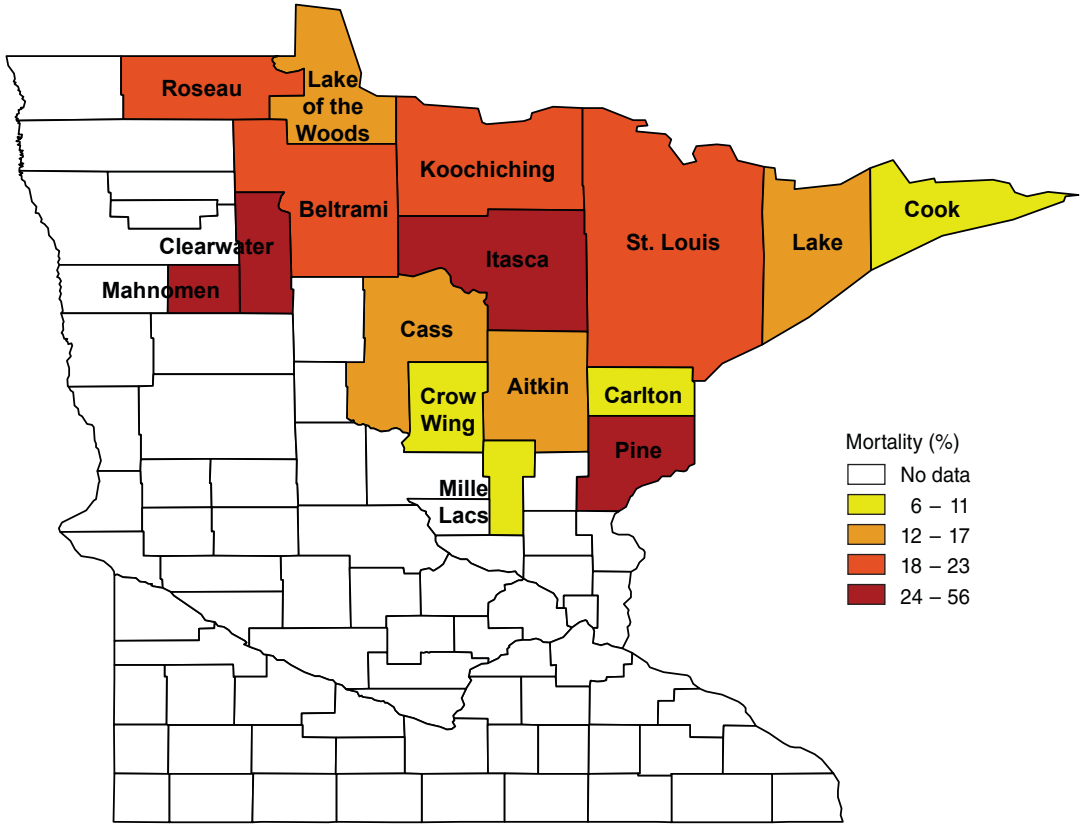

Figure 12.1—Changes in recorded levels of black ash tree mortality among Minnesota counties between the 1990 and 2003 inventories. (Data source: Forest Service, Forest Inventory and Analysis Program)

subsections (*sensu* Cleland and others 1997), with the greatest mortality occurring in the Mille Lacs Uplands subsection (212kb) (note: the Mille Lacs subsection encompasses but is much larger than Mille Lacs County). Mortality was not significantly different among ecological subsections (P = 0.540) in 2003. Little variation in tree mortality was explained by STATSGO soil variables in the 1990 cycle ($R^2 = 0.10$) or the 2003 cycle ($R^2 = 0.02$).

In summary, FIA growth and mortality data proved valuable for determining spatial variation in black ash decline across the study region, and for relating decline to broad regional ecological factors. No FIA variables were found to separate declining trees from nondeclining trees. The results suggest that incidence of mortality is increasing in the region, but that it is spatially variable as to occurrence. Continued mortality could severely impact the sustainability of the black ash resource in the region.

Based on this study we are now examining field plots across northern Minnesota to investigate the influence of finer scale site (soil moisture drainage), tree age, and road influences on incidence and severity of decline.

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