Mortality Trends for Red Oak Species

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Division of Forestry
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WISCONSIN DEPT. OF NATURAL RESOURCES

Trends in mortality and crown health

The ratio of mortality to gross growth has been increasing for black oak and northern pin oak since 1996 and has gradually decreased for northern red oak (Chart 1). Since 2004, this ratio has doubled for black oak and tripled for northern pin oak.

Descriptors of crown health, such as dieback and transparency also mirror the mortality ratio (Chart 2). The percentage of crown dieback increased significantly for black and northern pin oak between 2004 and 2009 while the percentage of dieback decreased for northern red oak.

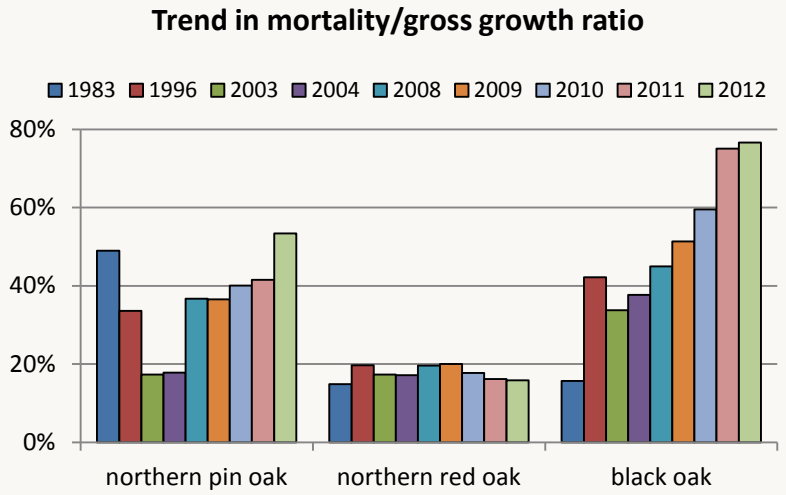

Chart 1. Mortality ratio (average annual mortality / annual net growth + annual mortality) from 1983 to 2012 (based on Forest Inventory and Analysis data).

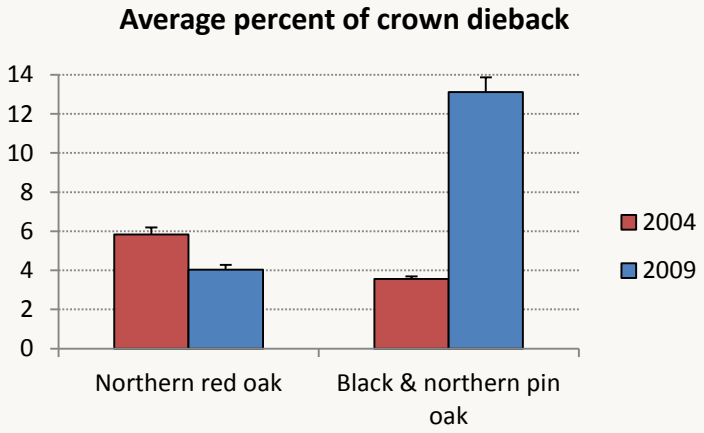

Chart 2. Average percentage of crown dieback (based on 2004 and 2009 Forest Inventory and Analysis data).

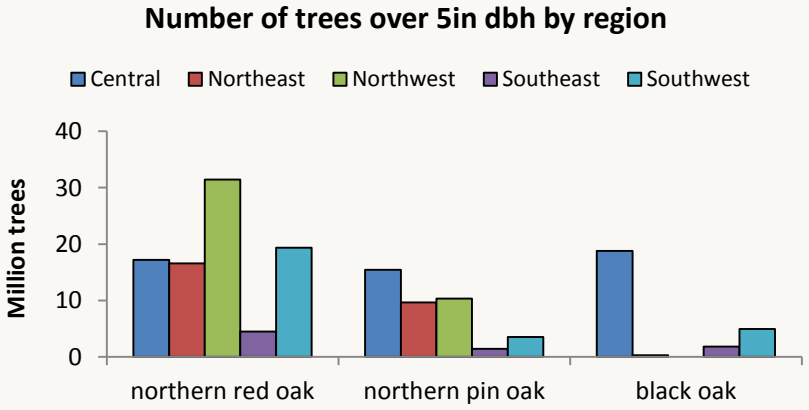

Chart 3. Number of all live trees over 5 inches dbh on timberland (based on 2012 Forest Inventory and Analysis data).

Mortality trends by region

Over half of all black and northern pin oak trees are located in central Wisconsin whereas over half of northern red oak is found in northern Wisconsin (Chart 3). These two regions of the state have seen the most dramatic increases in the mortality ratio for black oak and northern pin oak, but mortality has decreased for northern red oak in both regions (Chart 4). The greatest volume of mortality and the highest mortality ratio for northern red oak occurs in southwest and west central Wisconsin (Figure 1).

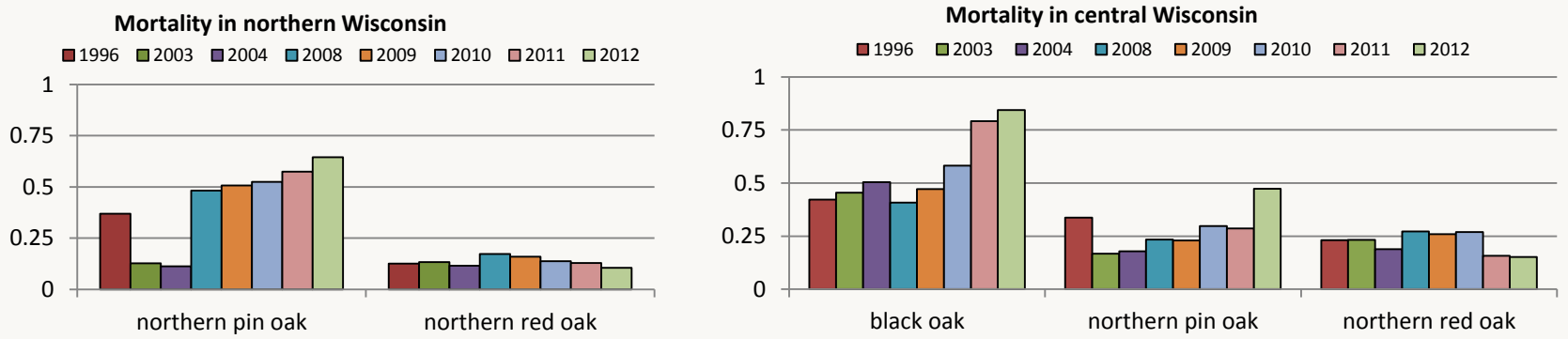

Chart 4. Trends in mortality ratio for northern Wisconsin (left) and central Wisconsin (right) from 1996 to 2012 (based on Forest Inventory and Analysis data).

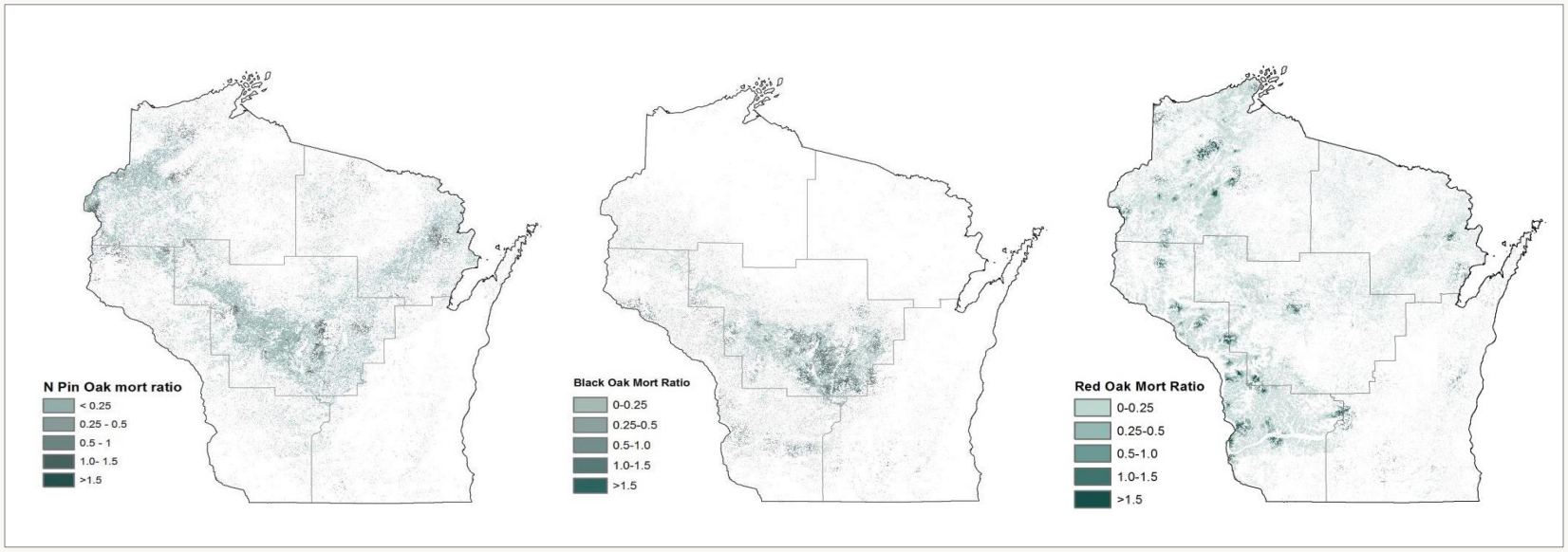

Figure 1. Distribution of mortality ratio for northern pin oak, black oak and northern red oak on forested land in Wisconsin (based on interpolation of 2012 FIA plot data).

Trends by size class

The mortality ratio for northern pin oak poles has increased by five fold since 2004 and has quadrupled for sawtimber. The ratio has quadrupled also for black oak sawtimer-sized trees (Chart 5). For large (>16 inch dbh) black oak sawtimber, the mortality ratio has increased six fold since 2004.

The mortality ratio for northern red oak poles has fallen but remained unchanged for sawtimber. Mortality is generally much lower for red oak.

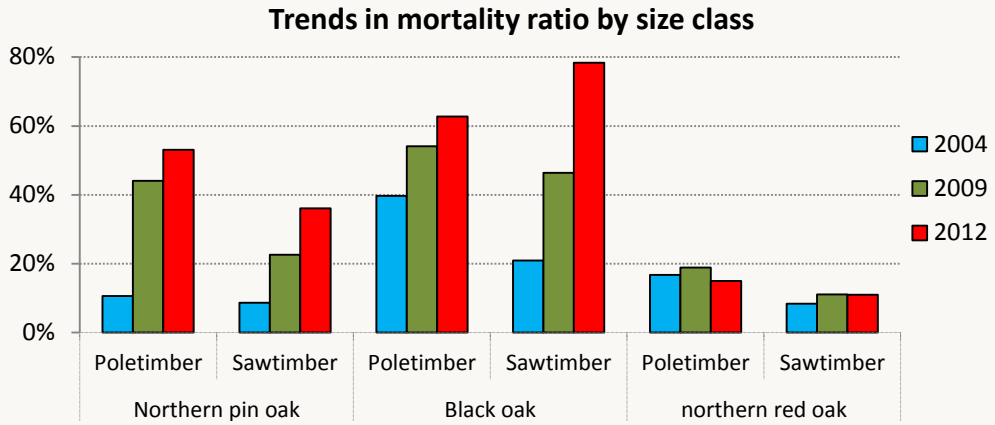

Chart 5. Mortality ratio by size class (poletimber: 5-11 inches dbh, sawtimber: 11+inches dbh (based on Forest Inventory and Analysis data).

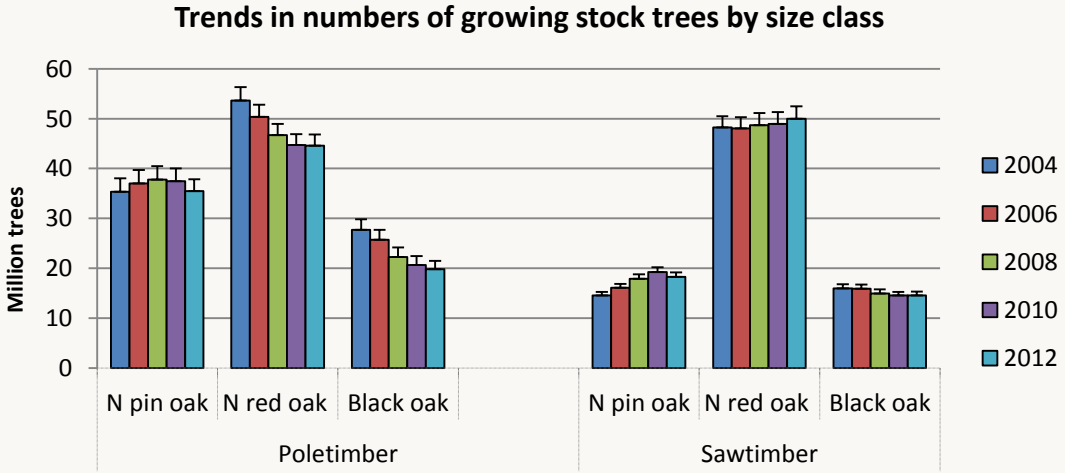

Chart 6. Number of growing stock trees by size class (poletimber: 5-11 inches dbh, sawtimber: 11+inches dbh (based on Forest Inventory and Analysis data).

The future looks brighter for northern pin oak than for black oak or northern red oak. The number of northern pin oak saplings has almost doubled since 2004 but remained unchanged for the other two species .

The number of sawtimber-sized trees has increased significantly for northern pin oak (by 26%) but remained unchanged for northern red oak and black oak (Chart 6). For poletimber, however, we see significant decreases for northern red oak and black oak (by 28%).

The volume of northern red oak has increased steadily since 2004 mainly as large trees mature whereas volumes of black oak have decreased .

Mortality trends by habitat type

Mortality of northern pin oak and black oak occurs disproportionately on very dry to dry habitat types (Chart 7). Figure 2 indicates that these dry sites occur mostly in central, northwest and some parts of the northeast.

Mortality for northern pin oak, is elevated on these dry sites in both central and northeastern Wisconsin. For black oak, this elevated morality is limited to central Wisconsin which is where the vast majority of this species is found (Figure 1).

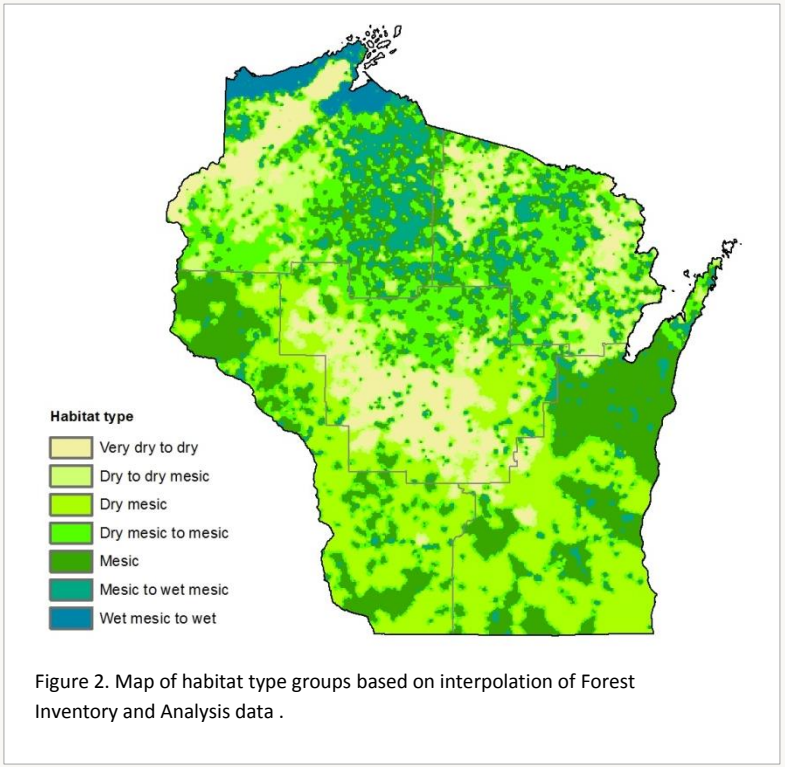

Figure 2. Map of habitat type groups based on interpolation of Forest Inventory and Analysis data .

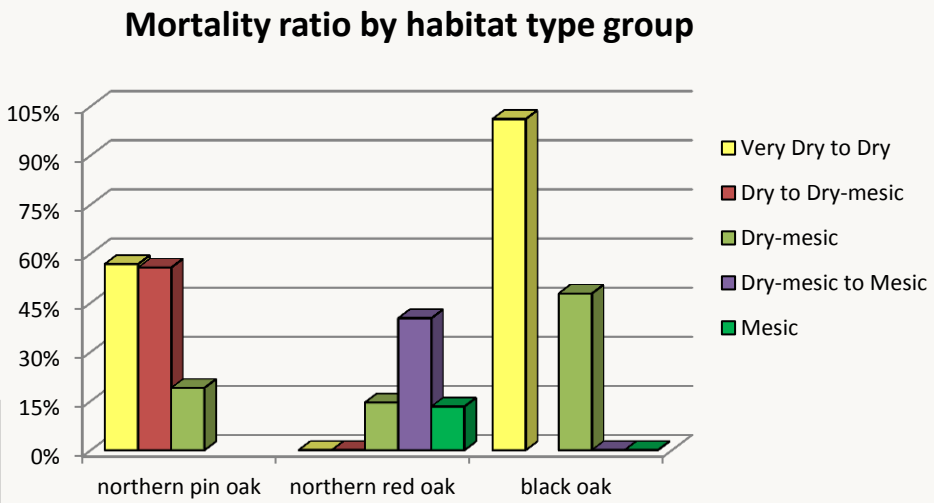

Chart 7. Mortality ratio by habitat type (based on 2012 Forest inventory and Analysis data).

Mortality of northern red oak, though low compared to the other red oak species, is higher on dry mesic to mesic sites and in southwest Wisconsin compared to other habitat types and compared to the rest of the state. Northern red oak does not generally occur on very dry sites.

Drought and oak mortality

Drought is a major contributing factor to oak mortality especially if combined with defoliation. The last decade has seen major late summer droughts in six out of eight years (Figure 3). In several of these years, drought conditions were accompanied by above average temperatures for most of the summer through fall. Extreme drought, which is normally very unusual, has occurred in each of these years.

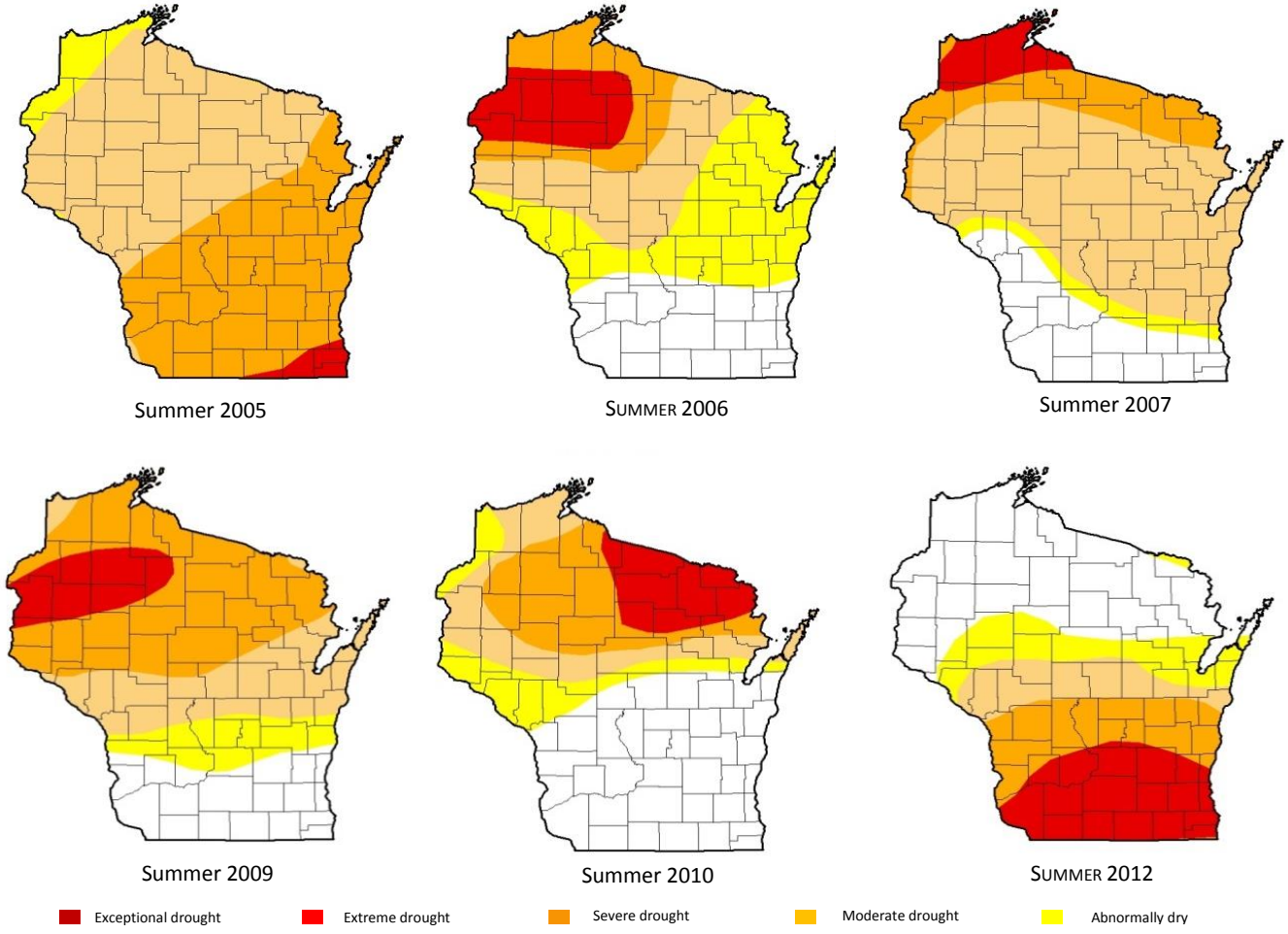

Figure 3. Areas of drought in Wisconsin in late summer (http://droughtmonitor.unl.edu/).

Pests and diseases that kill oaks

Major defoliators of oak in Wisconsin (Figure 4) include the forest tent caterpillar (*Malacosoma disstria*), gypsy moth (*Lymantria dispar*), elm spanworm (*Ennomos subsignarius*), and the fall cankerworm (*Alsophila pometaria*).

Several of these pests can defoliate oaks year after year sometimes with populations building to outbreak levels. This type of repeated defoliation can lead to mortality either directly or by predisposing trees to infestations by other pests.

A wood-borer that often attacks drought-stressed red oaks is the twolined chestnut borer (*Agrilus bilineatus*). This insect can kill oaks, especially after two or three years of defoliation and especially when defoliation is accompanied by drought conditions.

Figure 4. Upper left: forest tent caterpillar. Upper right: Gypsy moth. Lower left: Twolined chestnut borer. Lower right: Elm spanworm.

Figure 5. Circles of dead oaks can rapidly expand especially in sandy soils.

Oak wilt (Figure 5) may be a prominent cause of oak mortality especially in central and southwest Wisconsin. This disease was first recognized in Wisconsin in 1942 and has increased dramatically since then. It now occurs in 58 of the 72 counties. Oak wilt has been present for a long time in southern and central Wisconsin.

Oak wilt is often more severe on well-drained soils as root systems need to expand further for water and are more easily grafted to neighboring trees. Since wilt spreads through grafted root systems, this can exacerbate the disease on very dry habitat types.