Chippewa County Forest Regeneration 2020 CDAC Report

Wisconsin Department of Natural Resources - Forestry Division

March 19, 2021

Summary - Forest Regeneration

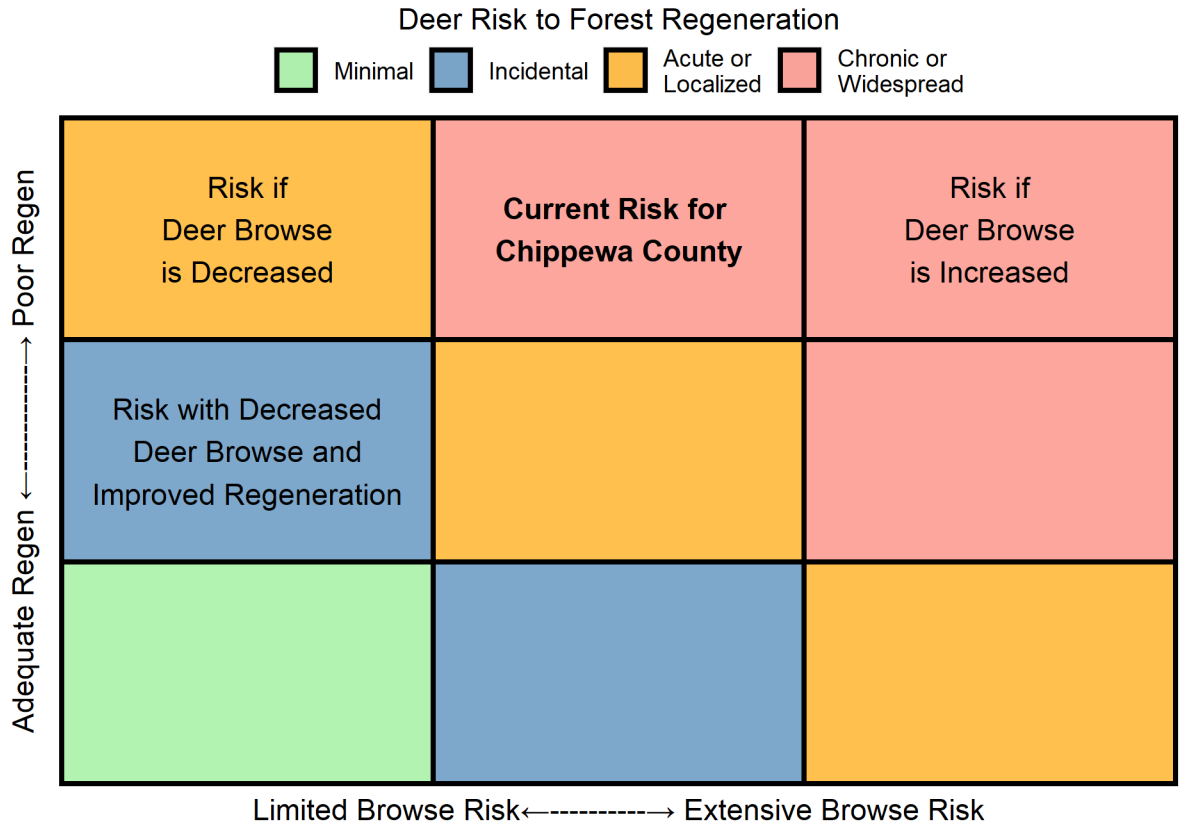
In Wisconsin, forest management relies on natural tree reproduction or regeneration to ensure the benefits of sustained outdoor recreation, wildlife habitat, and timber production. Natural regeneration is the process by which new tree seedlings become established through natural seeding, sprouting, suckering, or layering after trees are harvested or die from other causes. Successful regeneration is critical to sustainable forest management.

There are many factors that can affect forest regeneration such as the weather, interfering plant species, and forest management practices. Animal browse can also pose a significant impediment to forest regeneration, and in Wisconsin, white-tailed deer are the most common large animal that regularly eats tree leaves and stems. Research has regularly shown that high deer density often leads to increased browse impacts on forest regeneration.

Risk to Forest Regeneration in Chippewa County

Forest regeneration analysis conducted by the WDNR Forestry Division indicates that whitetail deer browse currently popses a **widespread or chronic** risk to forest regeneration in Chippewa County. This result is derived from observations of significant regeneration difficulties and average deer browse.

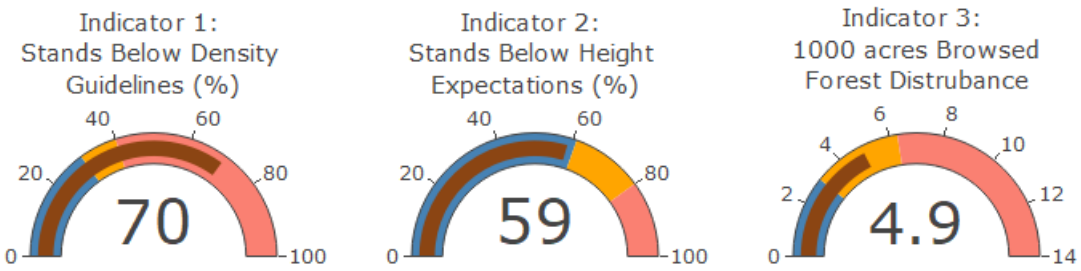
The WDNR Forestry Division concludes that reducing the deer population in Chippewa County will likely reduce this risk and the severity of current regeneration impacts. Likewise, increasing the deer population will likely increase current risk and intensify current regeneration impacts.



This risk table indicates the current risk that deer pose to forest regeneration in Chippewa County. It also demonstrates the likely consequences of increasing and/or decreasing deer browse. For example, an increase in deer browse will move the current risk right whereas a decrease will move it left, unless already at the upper or lower limit. Over time, it is likely that an increase in deer browse will worsen regeneration moving risk up, where a decrease in browse will improve regeneration moving risk down. Descriptions of the four risk categories can be found in Appendix C at the end of this report.

Forest Risk Metrics for Chippewa County

The WDNR Division of Forestry reports three metrics to identify risks to forest regeneration. These metrics contribute to our understanding of whether forest stands are meeting seedling and sapling density guidelines, whether seedling and sapling heights are meeting growth rate expectations, and whether observed browse and disturbance acreage is at level where regeneration impacts are more likely. The total number of indicators in the red or orange determine the current risk to deer regeneration.



The dark brown dial line and number represent Chippewa County's performance on each indicator. For Indicator 1, the color shaded areas reflect the stocking standards from the Wisconsin Silviculture Handbook. For indicators 2 and 3, the color shaded areas represent the 33rd, 66th and 100th percentiles for that value.

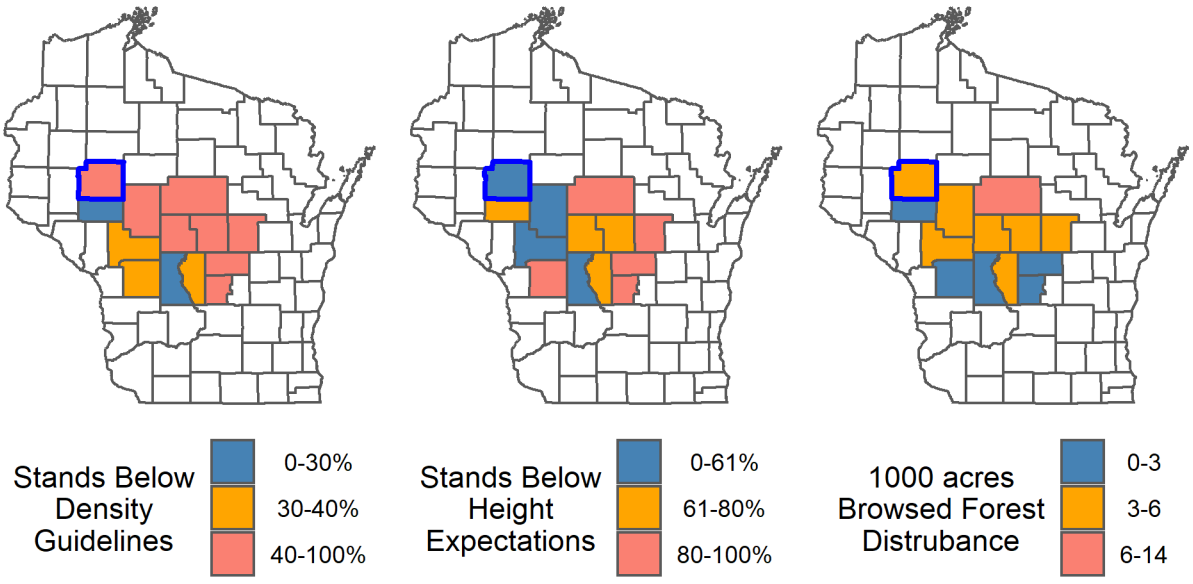
Indicator 1 - Forest regeneration monitoring from 2018-2020 indicates that **70**% of the observed recently harvested stands in Chippewa County are failing to meet regeneration guidelines. If a significant percentage of stands are failing to meet guidelines, this indicates that deer could be a factor impeding the overall regeneration of seedlings and saplings in Chippewa County.

Indicator 2 - Forest regeneration monitoring from 2018-2020 indicates that **59%** of recently harvested stands in Chippewa are not meeting regeneration height expectations. When a forest stand is not progressing to maturity as quickly as expected, it indicates that deer browse may be restricting seedling and saplings growth so they do not mature as expected. This impact can impede regeneration of forest stands even when minimum density guidelines are being met.

Indicator 3 - Forest regeneration monitoring from 2018-2020 recorded deer browse on **100%** of stands in Chippewa County. To estimate the overall risk that deer browse poses to regenerating forests, the percentage of stands with observed browse is scaled by the annual average **4.9** thousand acres of forest disturbance in Chippewa County. Forest disturbance includes forest acres harvested or damaged by fire, wind, or flooding. In total there are **4.9** thousand acres of browsed forest disturbance in Chippewa County. For this metric, a higher number indicates greater overall risk to forest regeneration, while a lower number indicates lower risk.

Taken alone, none of these indicators tell us for certain that deer browse is, or is not, having an impact on forest regeneration. When taken together, these indicators show the relative likelihood that deer browse is impacting forest regeneration and the ecological and economic risk it may pose to forests in Chippewa.

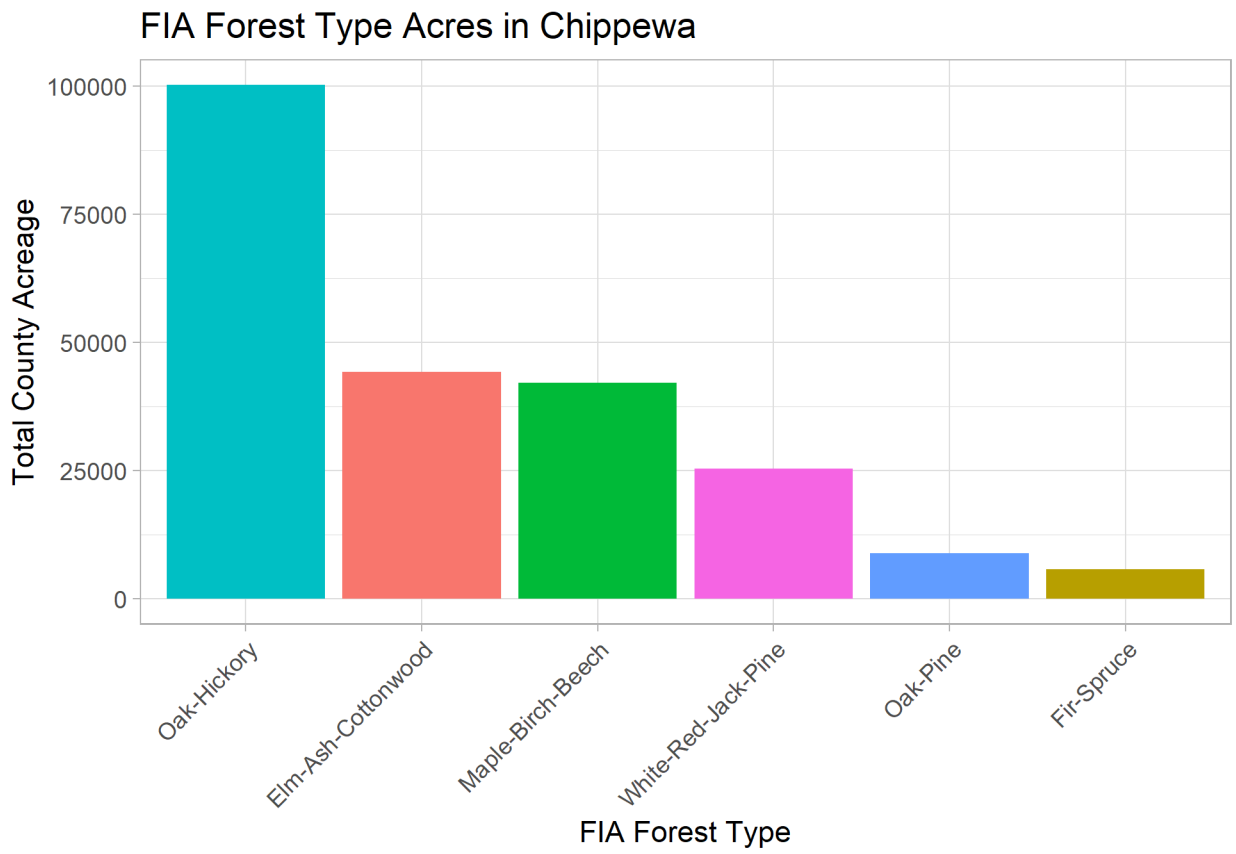
The following maps show the regeneration metric status for counties in the FIA Central Region which share similiar forest and land cover features.



Report Detail for Chippewa County

County Overview

Chippewa County has a total of 666,050.5 acres of which 273,877 are forested. In terms of forested land cover, Chippewa County ranks #36 in Wisconsin at 41% forested. Forestry in Chippewa yields approximately 18.96 million dollars per year in economic output.



Note - FIA Forest types are slightly different from the WDNR Forest Cover Types discussed in the remainder of this analysis.

Since forest regeneration monitoring began in Chippewa County, stands with plots were surveyed in 2018, 13 stands with 67 plots were surveyed in 2019, and 14 stands with 84 plots were surveyed in 2020.

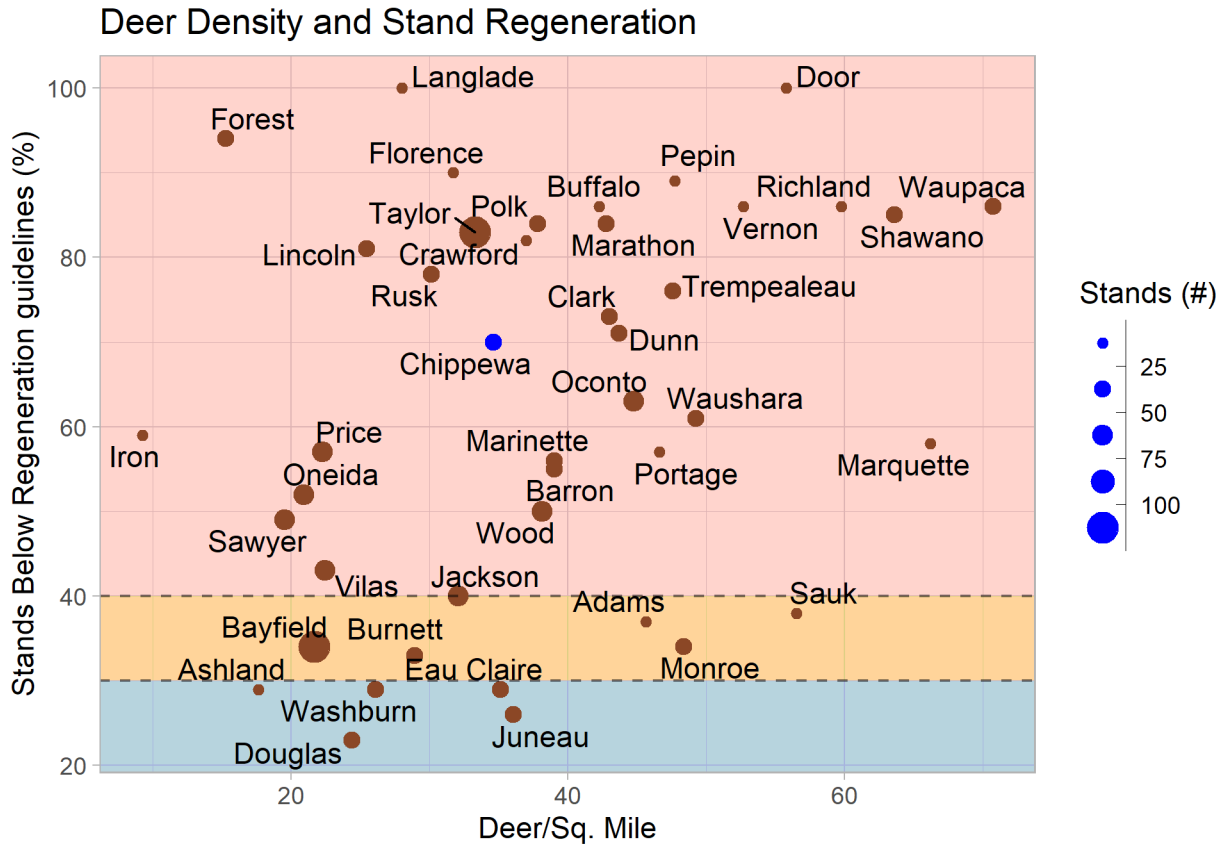
Deer Browse and Forest Disturbance in Chippewa County

Following a disturbance, such as timber harvest, fire, flood, or blow-down, tree seedlings that will eventually recruit into the forest canopy are established or released. It is in these

the early stages of regeneration that young seedlings and saplings are the most vulnerable to deer browse which can slow or prevent the forest from reaching a stage of maturity where it can provide ecological and economic benefits to wildlife habitat, outdoor recreation, and timber production. Furthermore, regeneration problems associated with deer will have a relatively larger impact in areas where more acreage is disturbed, even when deer browse is less common. By comparison, where deer browse is very common but disturbances are not widespread, deer browse poses a smaller total risk to future ecological and economic health of forests. In these areas, deer browse still presents a significant risk to the few stands that are disturbed, but in absolute terms, the net effect of these impacts will be less than in areas where disturbance is more common.

Regeneration Minimum Density Guidelines in Chippewa County

Statewide, there is a strong linear relationship between deer densities and the likelihood that recently harvested forest stands are meeting tree count guidelines for regeneration. This graph compares the deer population in each county (x axis) to the percentage of forest stands that are below minimum density guidelines (y axis). A deer density increase of 2 deer per square mile is related to about a 1% increase in the likelihood that forest stands in that county will not meet regeneration minimum density guidelines. On the graph, an increase in deer densities would be expected to move the county up and to the right. Conversely, a decrease in deer densities would be expected to move the county down and to the left.



This graph compares the deer population in each county (x axis) to the percentage of forest stands that are below minimum density guidelines (y axis). The blue point represents Chippewa County. The brown points represent the other counties in Wisconsin with FRM monitoring. The size of each point is proportional to the total number of monitored stands in that county.

The Wisconsin Silviculture Handbook indicates that all forest cover types are fully stocked if 70% of sample plots are meeting regeneration guidelines and are inadequately stocked if fewer than 60% are meeting guidlines. These 60% and 70% thresholds are used here as a rough guide to identify counties that are systematically not meeting minimum density quidelines.

Forest regeneration monitoring indicates that recently harvested stands in Chippewa County are not meeting seedling and sapling regeneration guidelines on **70**% of the observed stands. In addition, DNR Wildlife staff estimate that there **35** deer per square mile of deer range in Chippewa County.

Minimum Density Guidelines by Forest Cover Type in Chippewa County

Different forest types regenerate differently in response to deer browsing preference and seedling and sapling growth patterns. In some cases, deer browse may prevent seedlings

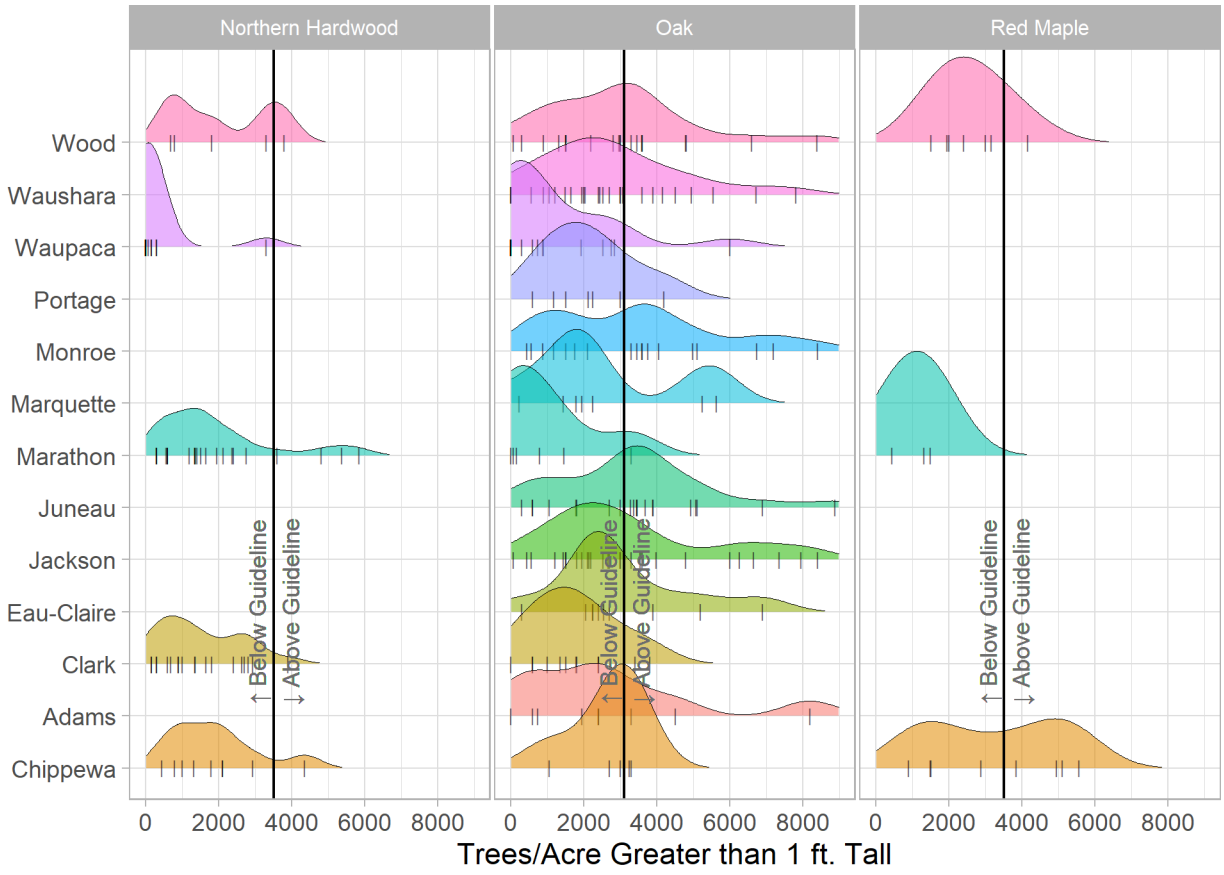
and saplings from reaching the minimum density needed for that forest ecosystem to develop into a mature, self-sustaining forest with marketable timber. This analysis is capable of determining the proportion of stands that are not meeting these minimum seedling and sapling counts. Statewide, regeneration of pine (Red, White, and Jack) is doing well in most counties. By comparison, a larger proportion of hardwood stands such as oak and maple are falling short of the regeneration guidelines in most counties.

There are 3 forest types in Chippewa County that have been surveyed more than three times since forest regeneration monitoring began. The below table compares regeneration between Chippewa County and the regional average for these forest types.

Table 1: Forest Regeneration in Chippewa by Forest Cover Type Compared to Region (types with less than 3 stands excluded)

	County				Region			
Forest Type	Total Stands	Seedlings/Acre	Stands Browsed (%)	Below Guideline (%)	Total Stands	Seedlings/Acre	Stands Browsed (%)	Below Guideline (%)
Northern Hardwood	9	1867	100	100	76	1871	84	87
Oak	5	2656	100	60	197	3217	92	53
Red Maple	8	3275	100	75	25	2671	88	82

The plot compares the seedlings and saplings per acre greater than 1 foot tall observed for different forest cover types in counties within the FIA region.



On the above plot, each shaded area represents the tree densities on monitored stands for each county. The vertical line represents the regeneration guideline for that forest cover type. The more shaded area there is to the right of the line, the more stands are meeting regeneration guidelines.

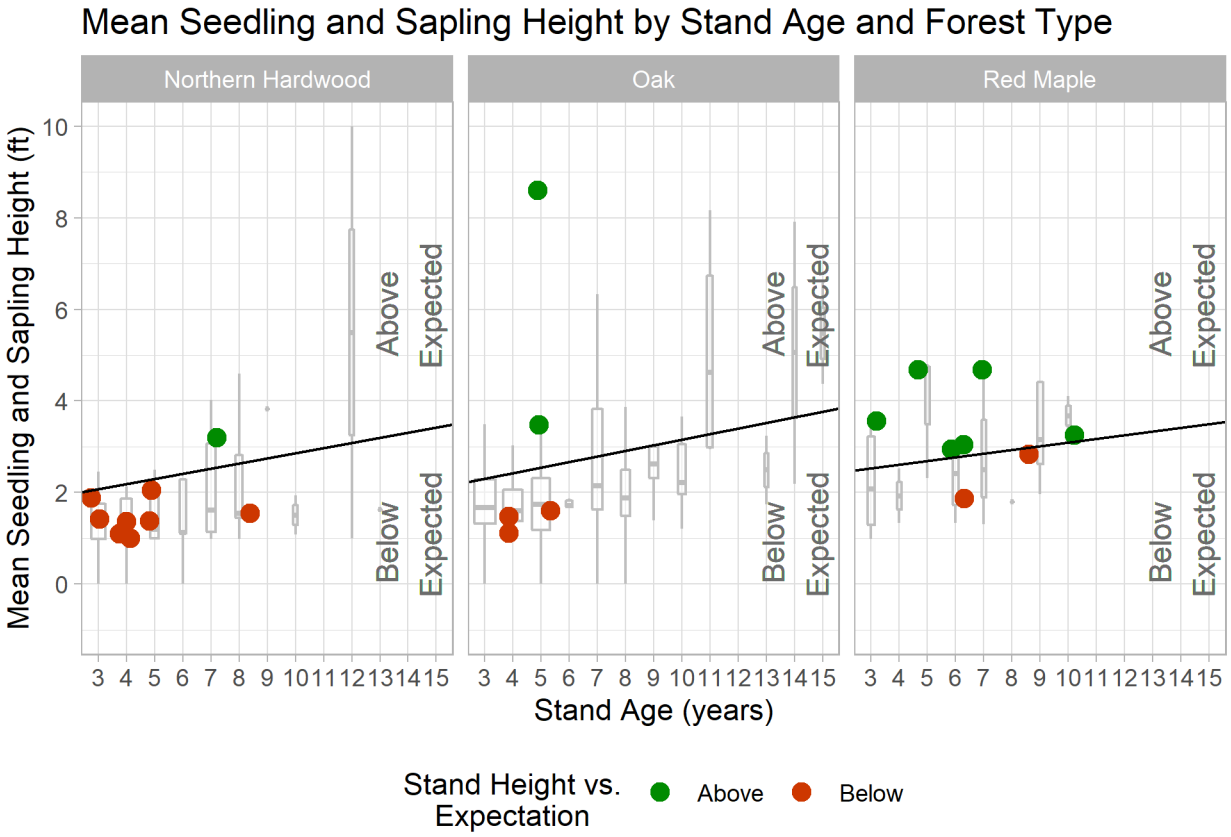
The small vertical tick marks are the observed tree density values for individual stands. The more tick marks there are, the more accurate the shaded area can be taken to be. If a county does not have a shaded area for that cover type, it indicates that no monitoring was done for that forest type in that county.

Regeneration Height Expectations in Chippewa County

In addition to affecting the total amount of trees per acre, deer browse can also affect the height distribution of a regenerating forest. For example, deer may repeatedly browse on seedlings and saplings in a manner that does not kill them but slows or stalls their growth. In this case, the minimum density guideline may be met according to the total seedling and sapling count, but over time the seedlings and saplings may never become established trees.

Forest regeneration monitoring began in 2018 and revisits stands every three years. Therefore, this analysis cannot at this time identify individual stands that are failing to mature.

However, some forest cover types (Northern Hardwood, Oak, Red Maple, Central Hardwood, and Pine) can be compared to a modeled expected growth rate using statewide data for each forest type. Compared to the expected mean height for the stand's age, forest regeneration monitoring indicates that recently harvested stands **59**% of stands in Chippewa are below growth rate expectations.



The above graph shows each stand in the county as a point representing average seedling and sapling heights relative to expectations for different forest cover types. The x-axis represents the age of the stand in the number of years since its last harvest. The y-axis is the mean height of seedlings and saplings in that stand. The black line represents expected mean height at that age (black line). Stands above the black line (green points) are above expectations at that age. Stands below the expected growth rate (red points) may be failing to adequately develop into mature forest stands. Boxplots of the regional distribution are shown behind the points to reference Chippewa County against other counties in the Central FIA region.

Note that this metric is only used as a rough guide to determine growth rate expectation. Closer investigation of the data for individual stands is needed to assess that stand's actual progression as would be expected for its age and harvest type.

Appendices

Appendix A - Forest Regeneration Monitoring Methods

Forest regeneration monitoring on recently harvested stands began in 2018 in Wisconsin. This effort is limited to the 45 (out of 72) counties with more than 30% forest cover. The goal of this monitoring is to determine if forest stands are regenerating at a rate that will support ecological purposes such as wildlife habitat and future economic benefits such as timber harvest. In addition, this monitoring attempts to identify factors that might be preventing or slowing regeneration of the forest. This is done by recording the count, height, species of all seedlings and saplings that have not grown large enough where they are free to grow without interference from other plants or animals browsing on them. In addition, other measures are recorded such as visible deer browse, canopy coverage, ground cover, and the type of recent harvest that was conducted.

The forest regeneration monitoring program will attempt to revisit most stand every three years. With repeated measurement, WDNR Forestry staff will be able to identify specific stands that are not progressing toward maturity and determine what factors are impacting its growth. However, since the monitoring program is only three years old, no stands have been revisited yet and this analysis will not be possible for several years. For now, WDNR Forestry staff have compiled indicators based on statewide statistical analysis to identify potential problems. These indicators are not capable of definitively connecting deer browse to impacts on forest regeneration, but instead indicate the level of risk deer pose to forest regeneration in a county.

The first forest regeneration indicator identifies the percentage of stands in a county meeting regeneration guidelines. When regeneration monitoring measurements are completed on a stand, WDNR staff calculate the number of desirable seedlings and saplings per acre taller than one foot and compare them to regeneration guidelines for that forest type as defined in the Wisconsin Silviculture Handbook. If the tree density is above the minimum density in the handbook, the stand is considered to be meeting the regeneration standard. If the tree density is below the minimum density in the handbook, the stand is considered not meeting the standard. This calculation is done when the forest is in the regeneration period for its forest cover type. These periods are 1-2 years after harvest for aspen and birch and 3+ years for all other forests. Eventually, WDNR Forestry staff will be able to use regeneration monitoring to refine the current guidelines.

The second forest regeneration indicator identifies the percentage of stands that are meeting expected growth rates. Expected growth rate curves were determined from the forest regeneration monitoring dataset by calculating the mean seedling and sapling height for each forest cover type at each year post harvest. Linear regression models were then used to calculate the annual expected growth for the forest cover types had a statistically significant relationship between year and height. Notably, this modeling likely includes forest stands that have substantial regeneration problems. Therefore, the growth rate curves are likely too low for what would be expected from a healthy stand. At this time there is little to no research that prescribes a target growth rate for different forest cover types.

However, WDNR Forestry staff will use forest regeneration monitoring data to calculate growth rate curves that can be used by forestry staff, the timber industry, and landowners to assess the health of their stands as they regenerate after harvest.

Appendix B - Risk Category Assignments

Risk categories were assigned to each county based on the number of regeneration metric indicators it has. For each indicator, a value of 1 was assigned if the county was in the 25th percentile, a value of 2 was assigned if it was in the 25-50th percentile, and a value of 3 was assigned if the county was in the 50-100th percentile. Deer indicators were placed on the x-axis of the risk matrix. The two regeneration metrics were summed and placed on the y-axis. A result of this is that a county could be assigned to the category of poor regeneration if it had one regeneration indicator in the 50-100th percentile or two in the 25-50th percentile.

A limitation of this current approach is that the indicator assignments are based on how a county compares to all other counties in Wisconsin. It would be preferable to compare each county to a static performace standard. Although, those static standards do not yet exist, further research and continued analysis of this these data will be used to eventually create these static standards.

Appendix C - Risk Category Descriptions

Widespread or Chronic Risk - Widespread or chronic risk is the most severe risk category. It indicates that there are currently multiple and/or severe regeneration problems coupled with moderate to high deer browse by disturbance. There are likely to be county-wide impacts from deer browse and/or severe impacts where deer browse is the highest. Reducing deer browse county-wide will likely decrease risk and improve forest regeneration in the long-term.

Acute or Localized Risk - Acute or localized risk indicates either a) severe or multiple regeneration problems have been identified in the county or b) that deer browse is high enough to represent a potential risk to forest regeneration. This risk may be focused on specific tree species, specific forest cover types, and/or specific parts of the county where deer browse is highest. Reducing deer browse, especially where browse is the highest would likely reduce this risk.

Incidental Risk - Incidental risk indicates that either a) some regeneration problems have been observed but that deer browse is low enough that do not pose a widespread risk, or b) regeneration is adequate but deer browse is high enough that they represent an

increased risk. It is likely that deer will still periodically impact forest regeneration to some degree, particularly in areas with the densest population. Reducing deer browse will likely have limited impact on reducing risk, whereas increased deer browse could dramatically increase the risk to forest regeneration.

Minimal Risk - Minimal risk is the lowest risk category and indicates that deer browse is low and few if any regeneration problems have been observed. Reduction of deer browse is unlikely to reduce risk significantly whereas an increase might increase risk, especially in the long-term.