Knots, Rotten Hearts, and Seams: UW-Stevens Point Student Research Unveils the Extent of Hardwood Defects

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Partners involved in the red oak defect project gathered at the UW-Stevens Point College of Natural Resources student research symposium in April 2024. Pictured from left are Mike Demchik, forestry professor; Megan Espe, WFC associate director; intern Alice Maas; Paul Bailey, Tigerton Lumber Co.; intern Hannah Kovalaske; Tom Kazik, Stockbridge-Munsee Community Forestry Dept.; intern Eric Alfredson; Les Werner, forestry professor and WFC director; Ben Knaack, Tigerton Lumber Co., and Paul Koll, Stockbridge-Munsee Community Forestry Dept. The interns are holding personalized signs created from the red oak milled as part of the project.

This past year the Wisconsin Forestry Center (WFC) at the University of Wisconsin-Stevens Point initiated phase two of the Photographic Guide to Defects in Hardwoods series. The defect series aims to demonstrate the range of responses to wounds in important hardwood species. The northern red oak guide, to be released later this year, is a follow-up to the hard maple defect guide published in 2023.

The guides are intended to serve as a training tool for foresters and loggers making decisions regarding trees with defects such as tearouts and seams. These defects reduce the length of clear cuts that can be taken from boards and can limit the range of product outlets. The next species in the series will be red maple. These three species are the highest volume of quality hardwoods in Wisconsin and represent a wound response continuum.

Trees' Response to Wounds

Trees respond to wounding with a three-step process: contain, separate, and close (Figure 1). The first step contains the spread of decay resulting from the wound within the tissues that were present in the tree at the time of wounding. This is known as compartmentalization of defect in trees (CODIT). Compartmentalization occurs in all three dimensions of the tree including longitudinal, tangential, and radial. In the second step, new growth after wounding is separated from the tissues affected by the wound and represents what is known as the "fourth wall." The new wood is often free of discoloration. In the final step, trees attempt to close the wound by forming wound wood. Wound wood restores mechanical stability and reduces exposure to decay-causing organisms. Of the species in the defect series, hard maple is extraordinary at compartmentalizing, northern red oak is more moderate, and red maple is significantly worse.

Research Methods

For the red oak project, in September 2023 we selected trees with external defects including seams, tearouts, epicormic sprouts, suppressed growth, butt injury, and codominant stems. In October, the trees were felled,

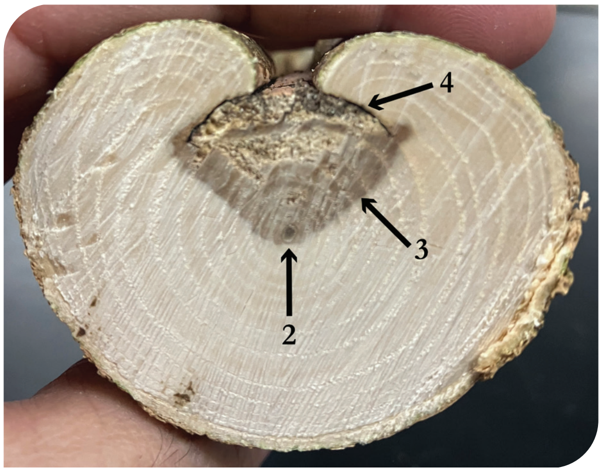

Figure 1. Cross-sectional view showing the locations of compartmentalization of defect. Wall 1 (not visible in image) resists the spread of defect vertically in the tree and is present at the time of wounding. Walls 2 and 3 are also present at the time of wounding and stop the spread of the defect tangentially and radially in the tree. Wall 4 forms after wounding, separating injured tissues from the new wood. This wood is generally free of defect.

merchandized into 8-foot logs, and transported to the UW-Stevens Point College of Natural Resources (CNR) wood lab. Logs were milled with the defect up and centered. While logs typically would be milled to minimize the defect in resulting boards, we milled the logs to allow visualization of how the internal defect developed.

The logs were cut into 1-inch-thick boards and photographed (Figure 2). We measured the amount of defect as a percentage of the total board area.

Results

During the spring semester our focus shifted to preparing research presentations for the Jim and Katie Krause College of Natural Resources Student Research Symposium. In our presentations (recording available at youtu.be/dA4O4x2QYQE) we shared that seam defects vary with severity and depend on the straightness, depth, length, and total number. A single straight seam can have minimal impact on sawn product by placing the log on the edge of a face when milling. This arrangement allows the impact of the seam to be merchandized out when the board is edged or clear cuts are taken. However, a spiral seam can't as easily be merchandized and usually reduces the length of clear cuts. Tearout defects typically worsen over time, meaning that the longer a tree with a tearout is left standing, the higher the potential for widespread decay. Epicormic sprouts create branch knots in wood, significantly lowering lumber grades for product depending on the density of the knots. In some cases, logs will be made into railroad ties where these branch knots are not considered defects.

Lessons Learned

Alice Maas: Being a part of this research project with the WFC helped me grow personally and professionally by gaining experience with operating a portable sawmill, assessing defect impact, learning about tree wound response, and researching seams for my symposium presentation. I also gained confidence in conducting research and hope to do more in the future. I look forward to using what I have learned in my coming classes and career.

Hannah Kovalaske: I serve on the committee that organizes the Jim and Katie Krause CNR Student Research Symposium. Because of this involvement, I was eager to get my hands on an active research project, so when the opportunity to work with the WFC came along, I jumped on it. Since then, I've gained both hard and soft skills as I've moved through the research process, from operating a portable sawmill and assessing defect impact, to applying research skills like data collection and management, as well as organizing the photos we took of our boards. I gained the ability to look at a defect on a tree and understand what that might look like internally, resulting in stronger field skills when it comes to managing timber.

Figure 2. Boards were milled from Log F1, which was selected for a butt injury and a seam. Note the decay present in the first half of the boards.

Eric Alfredson: Prior to this project, I had experience doing forest inventory and experience in a finished products sawmill, but I was lacking knowledge of the process in between those steps that turns logs into boards. Although we did not mill our logs like one normally would, I gained hands-on experience in that process. One of the biggest takeaways from this project has been a better knowledge of subtle external defects, such as epicormic sprouts, as well as a greater understanding of the biology of the defects. In addition, this project helped me as a young inexperienced forester to visualize the internal implications of external defects. I found this project to be very helpful when it comes to management decisions and deciding whether to cut a tree with regards to economics. This project also improved my understanding of log and lumber grading.

Acknowledgments

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For more information: For more information about the *Photographic Guide to Defects in Hardwoods* series, including an online order form for the hard maple defect publication, visit ***https://bit.ly/DefectGuides***

Figure 3. Research assistant interns milled red oak logs in fall 2023 on the UW-Stevens Point campus. They were trained by Les Werner, forestry professor and director of the Wisconsin Forestry Center.