Conifer Restoration Strategies Along the North Shore of Lake Superior

Michael R. Reichenbach

Extension Professor, University of Minnesota Extension, Cloquet, MN

Abstract

As interest in conservation and ecosystem restoration increases, varying strategies to achieve restoration goals have been implemented. In a landscape-scale project to restore native conifers along the North Shore of Lake Superior, multiple landowners have participated in planting trees on their land using a specific restoration approach. Landowners plant a few acres each year with 10 to 20 trees per acre, each with a fenced exclosure to prevent deer browsing. This low-density planting approach coupled with intense protection measures is to create islands of long-lived conifers that will serve as a seed source for maintaining species diversity and resilience of the North Shore forest. As the program continues forward, the use of seedlings with larger, well-developed root systems may increase future seedling growth and survival. This paper was presented at the Joint Annual Meeting of the Northeast Forest and Conservation Association, the Southern Forest Nursery Association, and the Intertribal Nursery Council (Walker, MN, July 31–August 3, 2017).

Introduction

As a forestry extension educator, one of my goals is to foster successful reforestation, conservation, and ecosystem restoration projects that increase forest health and resilience on family forestlands. My interest in planting trees is based on a desire to help landowners succeed on their terms, matching the seedlings used and practices recommended to the landowners' ability to implement. Many landowners do not have access to planting bars or planting machines, but they do have shovels that are well suited to planting trees of all sizes. The use of high-quality seedlings with the greatest potential to thrive after outplanting may help to get more landowners involved in successful landscape-scale restoration projects.

Interest in conservation and ecosystem restoration is increasing (D'Amato et al. 2018). Harrington (1999) describes ecosystem restoration as projects that improve site function and structure. Function relates to biomass accumulation and nutrient cycling, and structure relates to species composition and complexity. In a review of the science about current approaches to restoration, Stanturf et al. (2014) describe four restoration strategies: rehabilitation, reconstruction, reclamation, and replacement. Rehabilitation involves planting to restore desired species composition. Reconstruction and reclamation restore landscapes to tree cover. Replacement involves the planting of new species to the landscape to replace species that might be lost to climate change. Stanturf et al. (2014: 292) suggest restoration differs from ordinary forestry practices in that "extra-ordinary activities are required in the face of degraded, damaged, or destroyed ecosystems." An example of an extraordinary activity would be shifting from planting 400 or more seedlings per acre to planting as few as 10 or 20 trees per acre.

Corbin and Holl (2012) describe a rehabilitation strategy called applied nucleation; the planting of patches of trees as a means to use natural reproduction as part of the restoration process. The North Shore Project uses a modified form of nucleation, planting seedlings in natural openings within an existing stand, rather than on an open site. This approach allows for natural successional processes to proceed and takes advantage of these process to speed success and reduce costs. The intent is to create islands of seed source, providing a nucleus for future natural regeneration of species that are absent on the sites being restored.

Although planting larger numbers of trees may be required for reforestation purposes, restoration projects involving rehabilitation and replacement may not have the same requirements. Planting fewer trees and investing in protection of those trees is cost effective and attractive for many landowners and, in particular, for owners of small parcels or absentee owners, as the following case study of conifer restoration along the North Shore of Lake Superior describes.

Case Study: Conifer Restoration Along the North Shore of Lake Superior

Restoration of conifers along the North Shore of Lake Superior is an example of a landscape-scale restoration project involving fewer planted trees per acre to meet project goals. Areas in need of restoration often pose challenges to planting survival and growth. Challenges for the North Shore of Lake Superior include shallow soil and south and west facing aspects, resulting in less than ideal growing conditions for seedlings.

Conifers, such as white pine (*Pinus strobus* L.), northern white cedar (*Thuja occidentalis* L.), and white spruce (*Picea glauca* Moench), historically dominated the North Shore of Lake Superior landscape. White pine logging and wildfires after logging in the late 1800s and early 1900s created ideal conditions for the establishment of paper birch (*Betula papyrifera* Marshall). By the early 2000s, the birch trees began dying. Birch on the shallow soils along the North Shore are not long lived, attaining an age of 80 to 100 years (figure 1). Seed sources for northern white cedar and white pine are confined to a few areas, mainly along streams and rivers (figure 2). Because the North Shore is a wintering area for deer, seedlings of all species are severely browsed with few seedlings living to maturity (Myers 2014).

The North Shore conifer restoration project area, known as Minnesota's Lost Forest, is a 154-mile strip of land 1 to 3 miles wide stretching along Highway 61 from the St. Louis-Lake County line near the Knife

Figure 1. Dying Birch along the North Shore of Lake Superior. (Photo by Mike Lynch, 2012)

Figure 2. Northern white cedar along the Temperance River, MN. (Photo by Mike Lynch, 2011)

River to the Canadian border. This narrow strip contains 24,000 parcels of land (personal communication with county assessors). About 75 percent of these lands are in private ownership. Most parcels are less than 20 ac in size, and absentee landowners own most. From interviews with landowners who participated in past restoration projects of the North Shore, much has been learned about what makes a successful program. Participants in the North Shore restoration program have deep connections to the forests and waters of the North Shore. Understanding the landowners' connection to the land provides a starting place from which to develop educational and assistance programs. Landowners' personal connections include a sense of their properties as a private retreat that must be cared for to protect the natural values. One landowner asked, "Why do I want to care for the forest?" and answered by stating, "Aesthetics, spirituality and financial stability. A property without a forest would be worthless" (Reichenbach 2012: 1). North Shore landowners may have only a few days each year to devote to planting; therefore, they are interested in small projects that will be successful.

Dave Ingebritsen (wildlife biologist, Minnesota Department of Natural Resources, retired) developed a planting prescription for the North Shore conifer restoration project (Cook 2018). The prescription is to plant 10 to 15 white pine or northern white cedar seedlings per acre and use an exclosure fence around each tree (figure 3). Further, plantings do not occur on every acre, rather a small number of acres may be planted annually. The exclosure fence, made of welded wire (6 ft high and 3 to 4 ft in diameter) is necessary for seedling survival, as the North Shore is a wintering area for deer. The cost of planting and fencing 1 acre with 15 trees is $180

Figure 3. Single-tree exclosures made of 6-ft tall welded wire fencing are used to protect trees on the North Shore of Lake Superior from deer browse. (Photo by Dave Ingebrigtsen, 2014)

to $225. Exclosures designed to protect multiple trees are not encouraged because of the risk of falling limbs compromising the exclosure. One limb falling across a multitree exclosure risks many trees to browse, but the same limb across a single-tree exclosure risks only one seedling.

Seedlings are planted under the canopy of the declining paper birch–balsam fir (*Abies balsamea* L.) stand (figure 4). The plantings are scattered rather than clustered. The purpose of this rehabilitation planting is to create islands of long-lived conifers that will serve as a seed source for maintaining species diversity and resilience of the North Shore forest. Landowners plant a few acres each year, as time and resources are available. The number of trees planted by each landowner varies based on existing forest conditions and available time and resources. Although this example focuses on coniferous species, the method described has also been proposed as a means to restore oak (*Quercus* spp.) in the central Midwest (Reichenbach 2015). Illinois Forestry Association President Mike McMahan stated the method inspired members to think about planting fewer seedlings for oak restoration projects and investing more in protection (McMahan 2015).

Sugarloaf: The North Shore Stewardship Association, collaborated with the University of Minnesota Extension to develop an educational program for private landowners to restore long-lived conifers to the North Shore of Lake Superior. Other organizations, including the U.S. Department of Agriculture (USDA) Forest Service, the USDA Natural Resources Conservation Service, and the Minnesota Department of Natural Resources joined in the efforts and formed the North Shore Forest Collaborative in 2011 (https://northshoreforest.org).

In 2005, 2010, 2015, and 2017, classes providing 80 hours of instruction about woodlands and their restoration were held. More than 60 landowners attended these classes. In 2016, the North Shore Forest Collaborative initiated sales of reduced-cost exclosure fencing. In 2016 and 2017, as a result of the North Shore Forest Collaborative efforts, 135 landowners planted 18,366 seedlings, of which 6,787 were fenced. As a result of these actions, landowners created islands of new, long-lived conifers that will produce seed on more than 180 acres. Although survival has not been tracked, landowners have told project coordinators that they are replacing trees that die. The availability of planting stock with large, well-developed root systems might reduce mortality rates and save landowners time and expense, thus increasing the overall success of this program.

Future Strategic Focus: Large, Well-Developed Root Systems

Seedlings with large, well-developed root systems may be difficult or impossible to plant with a machine, planting bar, or hoedad (figure 5). Using a shovel to plant large numbers of large seedlings slows production and is not practical when planting for timber production at common planting densities of 400 or more trees per acre. Nonetheless, these seedlings may be well suited for conservation or ecosystem restoration projects. Seedlings with large, well-developed root systems offer advantages to landowners, especially those who have an interest in maintaining and restoring woodlands. Seedlings with well-developed root systems, i.e., large root volume, have good survival and grow quicker than trees with smaller root volume (Davis and Jacobs 2005, Jacobs et al. 2013, Rose et al. 1997, Schultz and Thompson 1990).

Figure 4. Declining birch stands are common along the North Shore of Lake Superior and are suitable sites for underplanting. (Photo by Dave Ingebrigtsen, 2013)

Figure 5. Bur oak (*Quercus macrocarpa* L.) 2–0 seedling produced by Minnesota Department of Natural Resources with a large well-developed root system. (Photo by Mike Reichenbach, 2013)

Schultz and Thompson (1990: 83) reported on the nursery practices required to produce hardwood seedlings and stated, "for a seedling to be successful in the field, it must have both a well developed root and a well developed shoot system." Based on research in the Midwest, these researchers summarized cultural practices for producing quality root systems on two hardwood species: northern red oak (*Quercus rubra* L.) and black walnut (*Juglans nigra* L.). Schultz and Thompson (1990) defined well-developed root systems as having "more than six permanent first-order lateral roots." Seedlings with this type of root system thrived after being planted in the field in the late 1980s, even during some of the worst drought years recorded in the Midwest (Changnon et al. 2007).

Address correspondence to—

Mike Reichenbach, University of Minnesota, 179 University Road, Cloquet, MN 55720; email: reich027@umn.edu; phone: 218–726–6470.

Acknowledgments

This project is possible only through the leadership of Molly Thompson (Director of Sugarloaf: The North Shore Stewardship Association) and the work of North Shore Forest Collaborative members.

REFERENCES

Changnon, S.A.; Kunkel, K.E.; Changnon, D. 2007. Impacts of recent climate anomalies: losers and winners. Champaign, IL: Illinois State Water Survey. http://www.isws.illinois.edu/pubdoc/DCS/ISWSDCS2007-01.pdf. (May 2018).

Cook, S. 2018. Ingebrigtsen retires from DNR wildlife position in Grand Marais. Duluth News Tribune. February 4. https://www.duluthnewstribune.com/sports/outdoors/4398085-ingebrigtsen-retires-dnr-wildlife-position-grand-marais. (May 2018).

Corbin, J.D.; Holl, K.D. 2012. Applied nucleation as a forest restoration strategy. Forest Ecology and Management. 265(2012): 37–46.

D'Amato, A.W.; Jokela, E.J.; O'Hara, K.L.; Long, J.N. 2018. Silviculture in the United States: an amazing period of change over the past 30 years. Journal of Forestry. 116(1): 55–67.

Davis, A.S.; Jacobs, D.F. 2005. Quantifying root system quality of nursery seedlings and relationship to outplanting performance. New Forests. 30(2–3): 295–311.

Harrington, C. 1999. Forests planted for ecosystem restoration or conservation. New Forests. 17(1): 175–190.

Jacobs, D.F.; Salifu, K.F.; Seifert, J.R. 2013. Relative contribution of initial root and shoot morphology in predicting field performance of hardwood seedlings. New Forests. 30(2–3): 235–251.

Lawler, J.J.; Ackerly, D.D.; Albano, C.M.; Anderson, M.G.; Dobrowski, S.Z.; Gill, J.L.; Heller, N.E.; Pressey, R.L.; Sanderson, E.W.; Weiss, S.B. 2015. The theory behind, and the challenges of, conserving nature's stage in a time of rapid change. Conservation Biology. 29(3): 618–629.

McMahan, M. 2015. Personal communication. President, Illinois Forestry Association, P.O. Box 224, Chatham, IL 62629.

Myers, J. 2014. New vision for the north shore. Minnesota Conservation Volunteer. 77(455): 8–17.

Reichenbach, M.R. 2012. Lost forest qualitative evaluation report. 4 p. Unpublished document. On file with University of Minnesota Extension, Cloquet Regional Extension Office, 179 University Road, Cloquet, MN.

Reichenbach, M.R. 2015. Landscape scale forest restoration: forest restoration and charismatic megafauna. In: Illinois Forestry Association Annual Meeting keynote presentation, September 25. Effingham, IL.

Rose, R.; Haase, D.L.; Kroiher, F.; Sabin T. 1997. Root volume and growth of ponderosa pine and Douglas-fir seedlings: a summary of eight growing seasons. Western Journal of Applied Forestry. 12(3): 69–73.

Schultz, R.C.; Thompson, J.R. 1990. Nursery practices that improve hardwood seedling root morphology. Tree Planters' Notes. 41(3): 21–32.

Stanturf, J.A.; Palik, B.J.; Dumroese, R.K. 2014. Contemporary forest restoration: a review emphasizing function. Forest Ecology and Management. 331: 292–323.