A *Superior* Research Reader

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Greetings and welcome to A *Superio*r Research Reader, a monthly reader on what we believe is current and relevant research to science and resource management on the Superior.

This Month's Edition: FIRE

It's fire season and every year at this time we like to share some of the latest fire research that has caught our eye. This month's issue focuses on findings from studies of both wildfires and prescribed burns. In the wildfire realm, familiar faces Lee Frelich and Randy Kolka bring back Bud Heinselman's classic work in a contemporary perspective on wildland fire as a baseline and study how Pagami Creek Fire severity influenced forest floor emissions, respectively.

As for prescribed burning, this edition's highlights should be useful for the NEPA work that occurs on the forest. One review found that prescribed fire and thinning create different stand conditions and thus, should not be considered surrogates in local management. Another study completed by colleagues at the MN DNR, UMN and NRS shows how both fire severity and harvesting practices have different effects on our lowland black spruce and tamarack forests.

As an added bonus, we'd also like to highlight new fire research published by SNF Ranger Gus Smith from his former days on the west coast!

Enjoy the latest,

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1. Lee Frelich's most recent publication summarizes how wildfires create resilient mosaics on the landscape and how they can be affected by edge effects and climate change. Email kfrerker@fs.fed.us for a copy of the pdf!

2. This comprehensive review finds that thinning is not an equivalent substitute for prescribed burning in order to accomplish certain ecological objectives.

3. Local researchers find that Minnesota's black spruce and tamarack lowlands respond differently to both fire severity and harvesting disturbance.

4. A study completed after the Pagami Creek Fire relates fire severity to carbon, nitrogen and mercury emissions.

Wildland Fire: Understanding and Maintaining an Ecological Baseline
Frelich 2017. Current Forestry Reports.

ABSTRACT: Wildland fires play an important role in maintenance of ecological function and biodiversity, even on landscapes where fire is considered to be rare. At time scales of centuries, fires in large wilderness areas maintain a balance among successional stages, and although early and late-successional stages are rarely absent, their occurrences change in space and time, possibly leading to metapopulation dynamics for species that depend on certain successional stages. Over thousands of years, fires influence the trajectory of ecosystem retrogression, and in cold climates, fires can prevent ecosystem acidification that reduces forest productivity. Fire regimes within large wildlands are subject to change caused by fragmentation effects at large spatial extents; this can result in increased or reduced fire frequencies (disturbance dilution effect) within wildlands. Wildland managers need to think about how changes in the surrounding landscape influence the integrity of the natural disturbance baseline, while forest managers need to think about how harvesting compares to the baseline with respect to maintenance of productivity and biodiversity.

The effects of thinning and burning on understory vegetation in North America: A meta-analysis
Willms et al. 2017. Forest Ecology and Management.

ABSTRACT: Management in fire-prone ecosystems relies widely upon application of prescribed fire and/or fire-surrogate (e.g., forest thinning) treatments to maintain biodiversity and ecosystem function. The literature suggests fire and mechanical treatments are more variable in their effects on understory vegetation as compared to their effects on stand structure. We conducted a meta-analysis to determine if there were consistent responses of understory vegetation to these treatments in North American forests that historically experienced frequent surface fire regimes. The most consistent effect of the treatments was the increase in non-native species following mechanical thinning and reduction in shrub cover following a burn. These differences suggest the two treatments may not be surrogates in the short-term (< 5 years). Increase of non-native species due to disturbance is well established but it is not clear if burning and thinning consistently have differential impacts. Response of non-native plants to disturbance is likely a complex function of a variety of site and landscape factors that cannot be evaluated by the current literature. We conclude that prescribed fire and thinning treatments can be used successfully to restore understory species richness and cover, but they can create different conditions and these potentially different outcomes need to be considered in the planning of a fuels reduction treatment.

Early response of ground layer plant communities to wildfire and harvesting disturbance in forested peatland ecosystems in northern Minnesota, USA
Rowe et al. 2017. Forest Ecology and Management.

ABSTRACT: A rare, stand-replacing fire in northern Minnesota, USA provided the opportunity to compare the effects of wildfire and timber harvesting in two peatland forest communities, nutrient-poor black spruce bogs (BSB) and nutrient-rich tamarack swamps (RTS). Fire had a positive influence on black spruce regeneration within BSB sites, particularly areas experiencing lower levels of fire severity, with seedling densities significantly higher than harvest and control areas. Our results also suggest that ecosystem recovery will be rapid after low-severity fire in these areas. In contrast, tamarack regeneration was only documented in harvested RTS sites. Light to moderate burning created suitable black spruce seedbeds by reducing cover of *Sphagnum* moss and dominant ericaceous shrubs, and increasing the cover of pioneering mosses. In RTS sites, fire typically consumed the entire upper peat surface, resulting in homogenization of community composition and retrogression towards marsh-like conditions dominated by cattails. These findings underscore the importance of accounting for post-fire microsite heterogeneity when developing silvicultural systems for emulating natural disturbance processes in conifer forests with a naturally accumulated surface peat layer. In addition, the state shifts observed in areas experiencing high severity fire suggest that increases in fire frequency and severity may create significant challenges to maintaining forested conditions, particularly in RTS.

Emissions of forest floor and mineral soil carbon, nitrogen and mercury pools and relationships with fire severity for the Pagami Creek Fire in the Boreal Forest of northern Minnesota
Kolka et al. 2017. International Journal of Wildland Fire.

ABSTRACT: Forest fires cause large emissions of C (carbon), N (nitrogen) and Hg (mercury) to the atmosphere and thus have important implications for global warming, anthropogenic fertilization of natural ecosystems, and bioaccumulation of harmful metals in aquatic and terrestrial systems. Research indicates that fires are becoming more severe over much of North America, thus increasing element emissions. However, there has been little research relating forest floor and mineral soil losses of C, N and Hg to on-the-ground indices of fire severity that enable scaling up those losses for larger-scale accounting of fire-level emissions. We investigated the relationships between forest floor and mineral soil elemental pools across a range of soil-level fire severities following the 2011 Pagami Creek wildfire. We were able to statistically differentiate losses of forest floor C, N and Hg among a five-class soil-level fire severity classification system. We estimate that 468 000 Mg C, 11 000 Mg of N and over 122 g of Hg were emitted from the forest floor during the burning of the 28 310 ha upland area of the Pagami Creek fire.