A *Superior* Research Reader

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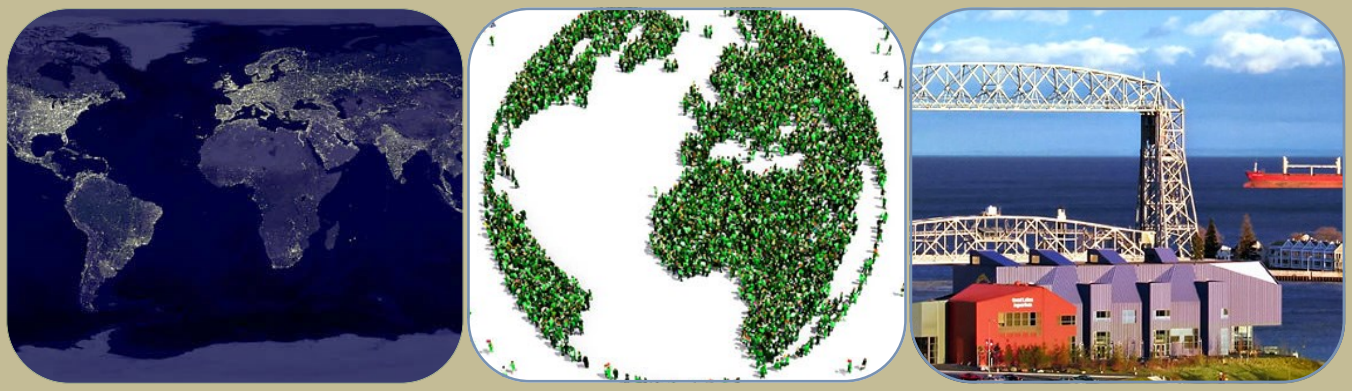

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Greetings and welcome to A *Superio*r Research Reader, a monthly reader on what we believe is current and relevant research to science and resource management on the Superior.

This Month's Edition: The Anthropocene

After the recent Climate Change Education sessions that occurred on the Forest, many of you may be thinking about the impacts of humans on our natural resources and how we can manage for that change. That's why we would like to dedicate this issue of the Reader to the Anthropocene: a proposed epoch that begins when human activities started to have a significant global impact on Earth's geology and ecosystems. Below you'll find a variety of articles that discuss natural resource management in the Anthropocene, from identifying measured impacts to proposing adaptation strategies. And check out this link to the Smithsonian's zoomable maps that reveal the scope of humanity's influence on the Earth and the innovations aiming to create a more sustainable future. Sometimes discussions about the human footprint can be all doom and gloom but let's use the tools we have already identified through our NEPA planning and climate change education to be proactive in managing for change. We hope the articles in this month's edition offer practical and inspiring ways to be innovative in your work during the Anthropocene. Enjoy!

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1. New tools developed in northern MN suggest diverse forests are more resistant to climate change and that "climate suitable planting" may enhance resilience.

2. New research in the context of the Anthropocene proposes that ecological responses be evaluated at landscape scales using risk-based approaches and goals for management based on Achievable Future Conditions.

3. In a conference specific to forest conservation and management in the Anthropocene, adaptation approaches for conserving biodiversity on the landscape were identified. Check them out here.

4. A new study finds that temperate coniferous forests experienced the largest percent loss of interior forest between 2000 and 2012. The author explains, "As forest area is lost and the remainder becomes more fragmented, the remaining forest may no longer function as interior forest. Sustaining forest interior is arguably as important as sustaining forest itself."

Measuring and managing resistance and resilience under climate change in northern Great Lake forests (USA).
Duveneck and Scheller 2015. Landscape Ecology.

ABSTRACT: Climate change will have diverse and interacting effects on forests over the next century. One of the most pronounced effects may be a decline in resistance to chronic change and resilience to acute disturbances. We assessed the interactions of climate change, resistance, resilience, diversity, and alternative management of northern Great Lake forests. We simulated two landscapes (northern Minnesota and northern lower Michigan), three climate futures (current climate, low emissions and high emissions), and four management regimes [business as usual, expanded forest reserves, modified silviculture, and climate suitable planting (CSP)]. We simulated each scenario with a forest landscape simulation model. We assessed resistance as the change in species composition over time. We assessed resilience and calculated an index of resilience that incorporated both recovery of pre-fire tree species composition and aboveground biomass within simulated burned areas. Results indicate a positive relationship between diversity and resistance within low diversity areas. Simulations of the high emission climate future resulted in a decline in both resistance and resilience. Of the management regimes, the CSP regime resulted in some of the greatest resilience under climate change although our results suggest that differences in forest management are largely outweighed by the effects of climate change. Our results provide a framework for assessing resistance and resilience relevant and valuable to a broad array of ecological systems.

Achievable future conditions as a framework for guiding forest conservation and management
Golladay et al. 2016. Forest Ecology and Management.

ABSTRACT: We contend that traditional approaches to forest conservation and management will be inadequate given the predicted scale of social-economic and biophysical changes in the 21st century. We propose that ecological responses be evaluated at landscape or regional scales using risk-based approaches to incorporate uncertainty into forest management efforts with subsequent goals for management based on Achievable Future Conditions (AFC). Robust monitoring programs of forest management actions are also crucial to address uncertainty regarding species distributions and ecosystem processes. Development of regional indicators of response will also be essential to evaluate outcomes of management strategies. Our conceptual framework provides a starting point to move toward AFCs for forest management, illustrated with examples from fire and water management in the Southeastern United States. Our model is adaptive, incorporating evaluation and modification as new information becomes available and as social–ecological dynamics change. It expands on established principles of ecosystem management and best management practices (BMPs) and incorporates scenarios of future conditions. In an uncertain future of rapid change and abrupt, unforeseen transitions, adjustments in management approaches will be necessary and some actions will fail. However, it is increasingly evident that the greatest risk is posed by continuing to implement strategies inconsistent with current understanding of our novel future.

Adaptation approaches for conserving ecosystems services and biodiversity in dynamic landscapes caused by climate change
Schmitz and Trainor 2014. Conference Proceedings from Forest Conservation and Management in the Anthropocene.

ABSTRACT: Climate change stands to cause animal species to shift their geographic ranges. This will cause ecosystems to become reorganized across landscapes as species migrate into and out of specific locations with attendant impacts on values and services that ecosystems provide to humans. Conservation in an era of climate change needs to ensure that landscapes are resilient by devising adaptation strategies to deal with such dynamism. This requires anticipating the future fate of species and ecosystems as well as implementing spatially explicit adaptation that enables species, ecosystems and their services to persist across vast landscapes. This paper describes a framework that highlights six spatially explicit adaptation approaches that emulate natural ecological resilience in support of landscape-scale adaptation planning. These include understanding and better sustaining concentrations of current biodiversity on landscapes and ecosystems services; anticipating where species will migrate so as not to develop landscapes in ways that impede their movement; and establish landscape connectivity between habitats and geophysical settings to ensure species can reach thermally favorable new environments as they are displaced by climate change. We discuss how to deploy the adaptation approaches in conservation assessments aimed at supporting land use planning for conservation and compatible land uses, highlighting the importance of using multiple approaches to develop coherent plans that address multiple stakeholder interests.

A global evaluation of forest interior area dynamics using tree cover data from 2000 to 2012
Riitters et al. 2015. Landscape Ecology.

ABSTRACT: Published maps of global tree cover derived from Landsat data have indicated substantial changes in forest area from 2000 to 2012. The changes can be arranged in different patterns, with different consequences for forest fragmentation. Thus, the changes in forest area do not necessarily equate to changes in forest sustainability. The objective is to assess global and regional changes in forest fragmentation in relation to the change of forest area from 2000 to 2012. The changes of forest interior area were compared to the changes of total forest area in each of 768 ecological regions. A 3.2 % net loss of global forest area translated to a net loss of 9.9 % of forest interior area. The difference in loss rates was consistent in most of the 768 ecological regions. The indirect component accounted for 2.44 million km2 of the net forest interior change, compared to 1.32 million km2 that was attributable to the direct component. Forest area loss alone from 2000 to 2012 underestimates ecological risks from forest fragmentation. In addition to the direct loss of forest, there was a widespread shift of the remaining global forest to a more fragmented condition.