Linking ecological and structured decision-making networks to develop restoration strategies for mixed-pine forests of Upper Michigan, USA

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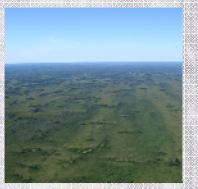
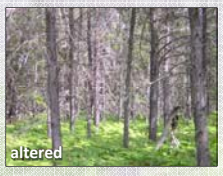
Background and Objectives

Mixed-pine forest ecosystems composed of eastern white pine, red pine, and jack pine once dominated the landscape of the northern Lake States, covering almost 40% of eastern Upper Michigan.



From the land-survey and historical records, it is believed that low-intensity fires occurred every 5-40 years creating small gaps maintaining a relatively open understory, which over time produced mixed-pine stands with uneven-aged structures. Under certain conditions (e.g., low fuel moisture, low humidity, high temperatures, and strong winds), these fires often intensified and became stand-replacing fires that burned not only the mixed-pine forests but also the surrounding forested wetlands and patterned fens. However, the legacy of turn-of-the-century logging and catastrophic wildfires, and subsequent fire suppression have altered forest composition and structure, and dramatically increased fuel loadings.



With support from the Joint Fire Science Program, the U.S. Fish and Wildlife Service (USFWS), the U.S. Forest Service (USFS), The Nature Conservancy (TNC), and The Ohio State University, we are working to:

1) develop a better understanding of the fire-history regimes, fuel loadings, and forest composition and structural characteristics of pre-EuroAmerican settlement and post-EuroAmerican settlement mixed-pine forests;

2) determine the current fire hazard and assess the forest management planning efforts of different federal and state agencies; and

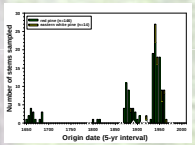
3) develop restoration-based fuel reduction recommendations for mixed-pine forest ecosystems of eastern Upper Michigan.

Fire and Forest Ecosystem Dynamics

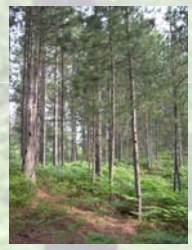
We dendrochronologically reconstructed the fire regime of mixed-pine forest ecosystems at SNWR (Drobyshev *et al.* 2008a). These analyses suggest that large (5,000-10,000 ha) non-stand replacing surface fires were characteristic of the natural fire regime, and following EuroAmerican settlement there was a decrease in overall fire frequency and smaller (<100 ha) fires were more common. In terms of variability, we found that the fire cycle (FC) of stands located in the Seney Wilderness Area was longer and more variable than stands located outside of the Seney Wilderness Area, which were subjected to higher levels of direct human influence (e.g., logging, fire suppression).

Multiple fire scarred red pine from Seney National Wildlife Refuge.

We also quantified the variation in stand composition, structure, and diversity and examined how this variability was related to current fuel loadings, fire history, and harvesting history (Drobyshev *et al.* 2008b). These results suggest that in terms of forest composition and structure, those stands which have experienced long fire-free periods have higher abundances of jack pine and lower structural diversity of the overstory and of the understory vegetation than those stands that experience more frequent fire.



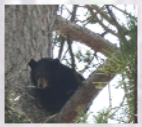
Recruitment in the SNWR Wilderness. Triangles on the x-axis denote major fire years.



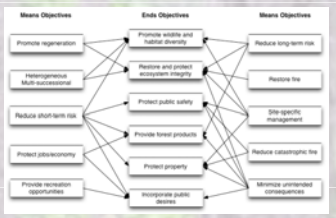
Additionally, we found that multi-cohort stands with old (250–300 years) trees in the overstory experienced more frequent fires, and as a result are more structurally complex than younger stands. Finally, although we observed no significant relationships between total coarse woody debris and fire history, we did find that stands which experienced repeated low-intensity fires showed significantly smaller amounts of fine woody debris and shallower duff depths.

Perceived Benefits and Risks of Using Fire

In order to identify the key management objectives and perceived risks and benefits of restoring mixed-pine forest ecosystems in Upper Michigan, we conducted open-ended interviews with thirteen land managers associated with the U.S. Department of Interior Fish and Wildlife Service, U.S. Department of Agriculture Forest Service, Michigan Department of Natural Resources, and The Nature Conservancy (Wilson *et al.* 2009).



These interviews indicate that where mixed-pine forest ecosystem management and restoration is concerned, ecologically motivated objectives (e.g., wildlife and habitat diversity) take precedence over socio-economically motivated objectives (e.g., providing forest products). The reverse is true for minimizing adverse effects of wildfire, where socio-economic objectives such as protecting property take precedence over ecological objectives like biodiversity.



A simple means-end network separates "ends" objectives from "means" objectives and highlights the causal influences between them.

Despite interest in restoring fire, or using fire as one of many tools to help emulate the outcomes of natural disturbance, managers of all organizations felt limited by uncertainty about the potential risks and benefits to their fundamental management objectives, difficult tradeoffs between short- and long-term objectives, and significant external barriers (e.g., mandates, lack of knowledge). When these difficult tradeoffs are combined with uncertainty about the factors that regulate ecosystem structure such as fire, as well as institutional mandates, the default decision may be to rely on decision short-cuts that result in the avoidance of the perceived "risky" choice (e.g., prescribed fire) and a tendency to work alone rather than as part of an ecological and management network.

Developing a Restoration Network

The diverse land ownership goals and mandates of land management organizations in Upper Michigan makes it unlikely that restoration efforts conducted at local scales will adequately emulate the effects of larger fires, which were critical to the development of mixed-pine forests on the pre-EuroAmerican landscape. Additionally, we also found that institutional barriers may make it difficult for these organizations to coordinate large-scale restoration efforts, including the practical implementation of a wildland fire-use approach or prescribed fire.

We are continuing our efforts to foster the restoration of mixed-pine forest ecosystems through the use of a structured decision-making approach. Our previous work has helped identify the fundamental management objectives and potential management alternatives that may be useful for achieving what is ultimately most important for individual agencies and organizations. These efforts will be incorporated into a fuel treatment guide.

Northern Lake States region of the U.S.

We are also working with the support of the Joint Fire Science Program to develop a fire science delivery network for fire-prone ecosystems of the northern Lake States. This network of fire specialists, resource managers, policymakers, and scientists will work to ensure that the best available scientific or technical data is available in a readily-available and usable format.

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Photos: G. Corace and C. Goebel