Mapping fire severity scenarios across Southern Appalachian forests: A risk-based approach for planning, restoration and monitoring

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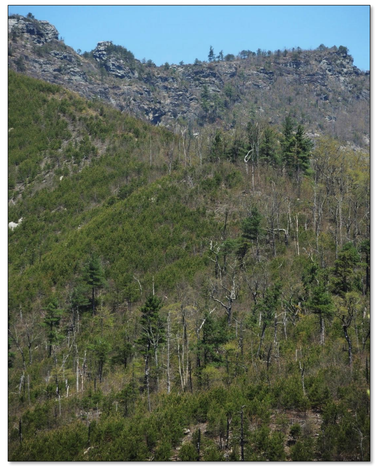
INTRODUCTION

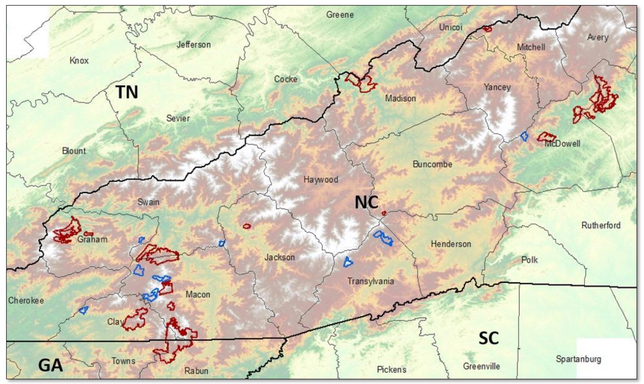
Agency planners seek to know the effects of wildland fire on the successional status of the forests that they manage. At the stand level, the effects of wild and prescribed fire are known to differ, with wildfires often being associated with more mortality and fuel consumption due to the weather conditions when they occur. But do differences extend to the landscape and regional scale among types of fires and do effects vary over time? This project addresses these broad scale fire impacts over recent decades within the Pisgah and Nantahala National Forests of NC.



(Above) Mixed severity after the 2013 Table Rock wildfire in Pisgah National Forest's Linville Gorge Wilderness. Such fine scale severity patchiness emerges from this 10-30m resolution analysis. (Photo: SPN, 2021).

METHODS

Limited by available fire perimeters and remote sensing, we selected 22 representative wildfires and 12 prescribed fires from the National Forests that burned between 1999 and 2019 (see map below). Using remote sensing, we generated fire severity maps from Sentinel 2 (10m) or Landsat 5 or 8 (30m) imagery using sequential growing season change in NDVI using Google Earth Engine. A high severity threshold was calibrated with sub-meter aerial imagery. We then calculated the conditional chance of lethal severity with combinations of topographic moisture and potential vegetation.



RESULTS AND DISCUSSION

Across wild and prescribed fires, high severity was consistently greater toward more xeric sites and vegetation types, but prescribed fire nearly always resulted in lower growing season severity than wildfire, consistent with expectations from the field. Wildfires burning in summer and drought were especially likely to result in a more extreme outcome, with implications for climate change and how prescribed fire can ease restoration toward desired outcomes.

TOPOGRAPHIC MOISTURE

		% Severe
Mesic	Rx Fire:	0
	Wildfire:	4
Mod.	Rx Fire:	1
	Wildfire:	10
Xeric	Rx Fire:	4
	Wildfire:	15

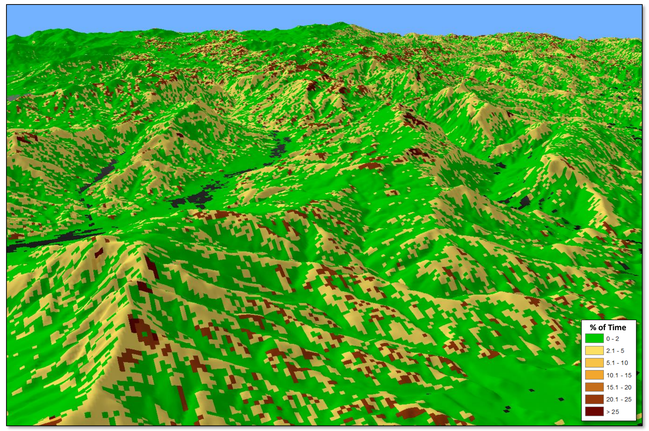
SELECT POTENTIAL VEGETATION TYPES

		% Severe
Rich Cove	Rx Fire:	0
	Wildfire:	1
Acidic Cove	Rx Fire:	1
	Wildfire:	4
Mesic Oak	Rx Fire:	0
	Wildfire:	5
Dry-Mesic Oak	Rx Fire:	1
	Wildfire:	13
Dry-Oak	Rx Fire:	9
	Wildfire:	12
Pine-Oak Heath	Rx Fire:	3
	Wildfire:	25

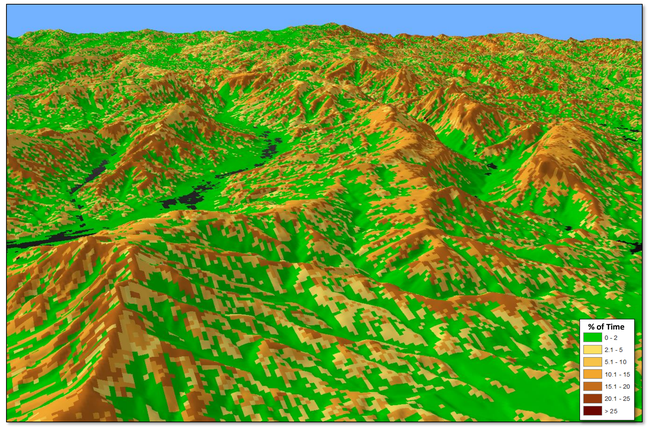
USE OF CHANCE AND SCENARIOS IN PLANNING

With caveats, the observed patterns of lethal severity associated with combinations of topographic moisture and potential vegetation can be extrapolated to the broader landscape. The maps below show lethal severity when fire is prescribed (top), like the fall 2016 wildfires (middle), or like all sampled wildfires since 1999 (bottom). These different predicted outcomes can be useful for landscape restoration and burn prioritization, evaluating risks to communities, and forecasting where the region's forest is headed as fires become more common.

Chance of lethal severity with prescribed fire



Chance of lethal severity with fall 2016-like fire



Chance of lethal severity with all 1999-2019-like wildfire