Project Summary
Rocky Mountains Cooperative Ecosystem Studies Unit

Project Title: Extent and Contributing Factors of Delayed Post-Fire Mortality in Glacier National Park

Discipline: Natural Resources
Type of Project: Research
Funding Agency: National Park Service
Other Partners/Cooperators: University of Colorado at Boulder
Effective Dates: 7/1/2014 – 9/30/2016
Funding Amount: $43,228

Investigators and Agency Representative:
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Project Abstract: Since 1988, approximately 234,000 acres have burned west of the Continental Divide through forest-dominated areas of Glacier National Park (GNP). One year post-fire assessments of fire severity, a measure of tree mortality, and initial field observations suggest that these fires have created a mosaic of different burn severities, with substantial areas of forest surviving in moderate and low severity burn patches. Estimates of burn severity derived from dNBR analysis of all fires > 400 ha in size within western GNP between 1984-2010, provided by the Monitoring Trends in Burn Severity (MTBS) program, indicate that 38%, 34% and 29% of total burned area was of low, moderate and high severity, respectively. However, field observations made in recent field seasons in the park and a preliminary aerial photography analysis of recent fires that we have conducted, suggests that large areas within burn perimeters that were classified as low or moderate severity have experienced significantly higher mortality than expected after several years post-fire.

In our qualitative evaluation using high resolutionaerial photography, it is clear that significant forest mortality is occurring following wildfires beyond the one year timeframe at which dNBR and other remotely sensed fire severity assessments are standardly conducted. In many cases, delayed post-fire mortality is continuing for 3-8 years following wildfires, suggesting mechanisms other than delayed visual detection. Currently, however, the commonness, extent of and mechanisms underlying this delayed mortality are not well understood. Delayed mortality is difficult to quantify using satellite reflectance alone, because post-fire vegetative regrowth of shrubs, grasses and trees can obscure long-term assessment of changes in canopy reflectance. Therefore, in this proposed research we will use a time series of aerial photographs (1999, 2004, 2005, 2009, 2011) to determine temporal changes in post-fire structure.

The goals of this research proposal are to:
1. Determine how widespread and over what timespan delayed post-fire mortality occurs using multiplefires that burned in western Glacier National Park (GNP) between 1999-2003. This analysis will evaluate how consistently delayed mortality is observed between distinct fire years and how much of the area initially classified as low-moderate severity is affected. The 1999-2003 fire years are selected for this analysis because they have the best aerial photography record and comprise much of the area burned since the mid20th century.

2. Identify the most likely causes of delayed post-fire mortality. For this analysis we will evaluate multiple factors which we hypothesize to be the most likely causes of delayed mortality, including: Hypothesis #1: Delayed visual detection of tree mortality; Hypothesis #2: Post fire insect mortality; Hypothesis #3: Post-fire climatic stress; and Hypothesis #4: Pre-fire climatic stress

We treat Hypothesis 1 as a null hypothesis where tree mortality is actually occurring directly as a result of fire, but detection is not evident in one year post-fire assessments due to delayed vegetation necrosis that later becomes visible within 2-3 years post-fire. Hypothesis 2 is based on the known potential for increased insect mortality due to decreased physiological status and beetle preference of fire-damaged trees. Beetle mortality has been shown to occur locally within burn areas without significant mortality occurring in neighboring unburned stands. Hypothesis 3 recognizes that fire-induced damage to surviving trees can increase susceptibility to tree death due to strenuous growing conditions in years subsequent to the fire. Hypothesis 4 is based on the recent recognition (Michaeletz et al. 2012) that ground fire-induced tree death may be more due to heat impairment of xylem function and ultimate hydraulic failure rather than cambium damage. According to this hypothesis, drought in years prior to a fire may predispose trees to greater mortality independent of fire behavior simply because xylem function is already impaired when a

fire occurs, leaving trees that are not directly consumed by the fire with reduced capacity to deal with partial crown, cambium or xylem damage that they might otherwise have survived.

Outcomes with Completion Dates: Final Completion Report – May 30, 2016

Keywords: post-fire mortality, Glacier National Park, University of Colorado at Boulder