Project Summary
Rocky Mountains Cooperative Ecosystem Studies Unit

Project Title: How Does Disturbance Interact with Climate to Shape Vegetation Patterns in Rocky Mountain National Park?

Discipline: Natural
Type of Project: Research
Funding Agency: National Park Service
Other Partners/Cooperators: Colorado State University
Effective Dates: 7/1/2012 – 12/31/2014
Funding Amount: $12,000

Investigators and Agency Representative:
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Project Abstract: The Rocky Mountain region has experienced significant changes in temperature and precipitation regimes throughout the past century (Stohlgren *et al.* 2007), and has also been affected by an increase in climate-driven disturbances (Westerling *et al.* 2006; Raffa *et al.* 2008). The mountain pine beetle epidemic affecting much of the western U.S. and Canada in recent years is unusually severe, and was likely exacerbated by warm winters and drought (Raffa *et al.* 2008). Climate change can alter vegetation patterns directly through shifts in temperature and precipitation, but disturbance events such as the recent beetle outbreak may have a more dramatic and immediate effect on vegetation patterns. Disturbances can also accelerate climate-driven shifts in forest composition by creating recruitment opportunities that allow plant species to become established or gain dominance in areas beyond their current range.

Rocky Mountain National Park (ROMO) is home to several species that may be particularly vulnerable to the dual effects of climate change and disturbance. Limber pine, a high-elevation tree species that may face increased competition as temperatures rise, is susceptible to both mountain pine beetle and the introduced white pine blister rust. Recent aspen declines throughout the west may be caused in part by climate change (Rehfeldt *et al.* 2009), and though aspen could potentially benefit from canopy gaps cause by beetle outbreak, previous research conducted by the Rocca lab indicates that intense browse pressure from elk is limiting aspen recruitment in ROMO (Nelson 2009; Renwick & Rocca 2011). As these examples demonstrate, multiple interacting factors can contribute to shifts in forest composition and should be considered when assessing potential climate change impacts.

Future vegetation patterns will be determined by the interaction between climate, disturbance, and the underlying physical template. The mountain pine beetle outbreak is already affecting the structure and composition of forests in ROMO (Diskin *et al.* 2011), and climate-driven shifts in species distributions may occur where trees killed by the mountain pine beetle are replaced by other species. To accurately predict how forests may change in the future, it is critical that we first understand how disturbances such as the recent mountain pine beetle outbreak may mediate response to climate change (Overpeck *et al.* 1990).

Our research has two primary objectives:
1) Enhance our understanding of how disturbance events interact with climate and the abiotic environment to alter vegetation patterns.
2) Use this knowledge to model potential shifts in forest composition at a scale relevant to land management and planning.

Outcomes with Completion Dates: December 31, 2014

Keywords: climate, disturbance, vegetation patterns, Rocky Mountain National Park, Colorado State University