Project Summary
Rocky Mountains Cooperative Ecosystem Studies Unit

Project Title: Spatial and Temporal Trends in Snowpack Dynamics in Rocky Mountain National Park

Discipline: Natural
Type of Project: Research
Funding Agency: National Park Service
Other Partners/Cooperators: Colorado State University
Effective Dates: 9/1/2012 – 4/1/2014
Funding Amount: $7,832

Investigators and Agency Representative:
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Project Abstract: Rocky Mountain National Park, like most locations in the mountains of the western U.S., receives most of its annual precipitation in the form of snow (Bales et al, 2006). The seasonal snowpack that typically blankets the higher elevations from October through June serves several important functions for both humans and ecosystems. Primary among these is snowmelt runoff, which is the main source of streamflow and groundwater recharge year-round (Barnett et al, 2008). The amount and timing of snow accumulation and melt determine the magnitude and timing of these important water fluxes, which are critical for aquatic and riparian habitat and for downstream water supply (Hauer et al, 1997). Another important function of the snowpack is to provide winter habitat and cover for subnivean animals such as mice, shrews, voles, and other rodents, and to protect low-growing plants from exposure to dessicating winds and frigid temperatures. Changes in snowpack dynamics can influence the survival of the animals and plants that depend on the snowpack for protection, and may influence the frequency of intense wildfires (Westerling, 2006). Changes in snowpack dynamics are also likely to influence surface albedo, providing a positive feedback mechanism for additional warming (Flanner et al, 2011). Given the importance of the seasonal snowpack and of the magnitude and timing of its accumulation and melt, it is also important to determine spatial and temporal patterns in these parameters. Fortunately Rocky Mountain National Park has two types of records available to provide data for such determinations. The first type is the automated Natural Resource Conservation Service Snowpack Telemetry (SnoTel) station.

Fourteen snow courses are located within the Park, and five additional courses are located within 5 miles of the park . The snow courses provide monthly readings of snow depth and SWE. While the time increment of data collection is much longer than for SnoTels, the length of the record is also much longer—generally back into the 1940s. Eight of the snow courses are collocated with SnoTel stations.

Previous studies have demonstrated significant inter-annual variability in the magnitude and timing of accumulation and loss of SWE in the region encompassing Rocky Mountain National Park. For example, Pedersen et al (2011) analyzed snow course data from the Upper Colorado River Watershed and the Upper South Platte-Arkansas Watersheds in order to correlate snow course data with tree-ring data, to estimate snowpack dynamics as far back as 1,600 years ago. The pattern of variability they found was consistent from one side of the Continental Divide to the other, but quite variable from year to year.

In another recent study based solely on SnoTel data, Clow (2010) found a declining temporal trend in April 1 SWE in the vicinity of Rocky Mountain National Park, averaging about 2 cm/decade from the 1978-2007.

The purpose of the proposed study is to use records both from SnoTel stations and from snow courses to evaluate spatial and temporal patterns in accumulation and melt of snow water equivalent in Rocky Mountain National Park during the period 1936-2012.

Outcomes with Completion Dates:
A final report, in both hard and electronic form, will be submitted by October 15, 2013. The report will include the problem statement, background, literature review, scope, methods, all data used, results of statistical tests, maps, figures, conclusions, and references.

Keywords: Colorado State University, Rocky Mountain National Park, climate change, snowpack, water resources, spatial patterns, temporal patterns