



Alpine Vegetation Composition, Structure, and Soils

Introduction

Alpine communities are extremely sensitive to climate due to extreme environmental conditions (e.g., wind, temperature, snow and ice, solar radiation, thin atmosphere) and the adaptation of species to these conditions (e.g., low stature, determinant growth, leaf morphology). In addition to climate change, alpine communities are threatened by atmospheric deposition and human use. The Rocky Mountain Network (ROMN) selected alpine communities as a key resource for monitoring because they are significant to visitor experiences and are threatened. The Alpine Vegetation Composition, Structure, and Soils (VCSS) protocol addresses two ROMN high priority vital signs: Vegetation Composition, Structure, and Soils and Invasive/Exotic Plants.

Objectives

The goal of the ROMN Alpine VCSS protocol is to monitor changes in alpine vegetation and develop reference conditions for appropriate ROMN parks. The core monitoring objective is to:

Determine status and trends in species richness, species composition, and vegetation and ground cover (including snow) in appropriate ROMN parks (Glacier National Park, Great Sand Dunes National Park and Preserve, Rocky Mountain National Park).



Donna Shorrock, ROMN Ecologist, documents the high point of a GLORIA peak in Rocky Mountain NP, 2008.

LONG-TERM MONITORING PROJECT SUMMARY



Isabel Ashton, ROMN Ecologist, lays out a GLORIA plot at Great Sand Dunes NP and Pr, 2008.

Protocol Development and Status

The ROMN will adapt the Alpine VCSS protocol from Global Observation Research Initiative in Alpine Environments (GLORIA), an international monitoring network established in 2001 to assess and predict biodiversity and temperature changes in fragile alpine communities in response to broad drivers such as climate. The goals of the GLORIA program include providing a global baseline for vegetation monitoring in alpine environments and assessing the risks of biodiversity loss and ecosystem instability from climate change. GLORIA aims to collect baseline and monitoring data by using an array of plots to measure vegetation across sets of four neighboring peaks. This methodology is extended by cooperators, such as the ROMN, to create a long-term monitoring network at the global scale. Other National Park Service networks are planning sites in parks, including North Cascades National Park. The University of Colorado Mountain Research Station established a site outside of Rocky Mountain in 2007.

Selected peaks vary in elevation from the natural tree line to the uppermost vegetation zone. ROMN staff and cooperators

Network park units with ongoing Alpine VCSS monitoring

Glacier NP (USGS sponsored) Great Sand Dunes NP and Pr
Rocky Mountain NP

NP = National Park; Pr = Preserve

arrange plots in each cardinal direction 5 m (16 ft) and 10 m (33 ft) below the highest point of each peak. Site selection is non-random and equivalent to a sentinel design in other ROMN protocols. ROMN staff measure vegetation composition and species diversity in plots and peak areas, take photographic records of all peaks, and install data loggers in the soil to measure daily and annual trends in temperature. Staff should visit the plots at least every five years to conduct vegetation surveys. However, annual visits are preferable for understanding the variability and speed of changes.

The ROMN will draft an Alpine VCSS protocol adapted from the GLORIA methods in early 2009 and complete a final protocol in the fall. During the 2009 field season, staff will establish plots and collect vegetation data in Rocky Mountain and Great Sand Dunes.

Preliminary Results

The U.S. Geological Survey Northern Rocky Mountain Science Center established a GLORIA site in Glacier in 2003. The Glacier plots were established east of the Continental Divide with the highest peak, Seward Mountain, at 2,717 m (8,914 ft) and the lowest peak, Dancing Lady Mountain, at 2,245 m (7,365 ft). Between 51 and 82 vascular plants were documented on each peak. Results included only one exotic species and a high degree of variability in species diversity and percent cover on each summit correlated to aspect.

In summer 2008, the ROMN network began establishing GLORIA sites in Rocky Mountain and Great Sand Dunes. The ROMN collaborated with park personnel to select and establish peaks, including Phyllis Bovin at Great Sand Dunes and Paul McLaughlin and John Spence (on assignment) at Rocky Mountain. After identifying potential sites from maps and photographs, staff visited and assessed peaks for monitoring suitability based on GLORIA criteria including accessibility, limited human visitation, elevation, climate region, and geological substrate. Peak selection proved difficult due to terrain,



Phyllis Bovin, biologist at Great Sand Dunes NP and Pr, lays out GLORIA vegetation monitoring plots in the park, 2008.



Paul McLaughlin, biologist with Rocky Mountain NP, lays out a GLORIA vegetation monitoring plot on Jackstraw Mountain in the park, 2008.

climate, and limited access, but four peaks in both Great Sand Dunes (just north of Mount Herard) and Rocky Mountain (between Jackstraw Mountain and Mount Ida) met all criteria and were selected. In Great Sand Dunes, staff implemented a pilot plot layout on two peaks, photographed the summit areas, and installed a data logger to test instruments and evaluate the quality and variance in temperature data. In Rocky Mountain staff also selected peaks, photographed the summit areas, marked the summit plots, installed 16 temperature loggers on four peaks, and created an initial plant species list. In 2008, ROMN also registered the Great Sand Dunes and Rocky Mountain summits in the GLORIA network.

Future Plans

The final Alpine VCSS protocol draft will be submitted for peer-review in fall 2009. In addition, the ROMN will draft park-specific standard operating procedures. Staff will begin efforts to coordinate data collection with other GLORIA sites and evaluate the need to incorporate other soil, vegetation, and climate measures into the existing protocol. In summer 2009, staff will begin to collect data in Great Sand Dunes and Rocky Mountain. This work will include placing long-term plot markers on all eight summits, collecting vegetation composition and structure data, and installing data loggers on all peaks. Staff will download temperature data from Rocky Mountain for comparison with existing park climate data to assess the performance of data loggers. Following the 2009 pilot season, the ROMN aims to measure vegetation composition annually for five years at both sites.

Contacts

Isabel Ashton, ROMN protocol lead and Ecologist,
 isabel_ashton@nps.gov
 Mike Britten, ROMN Program Manager,
 mike_britten@nps.gov
 For Glacier monitoring: Dan Fagre, USGS Research
 Ecologist, dan_fagre@usgs.gov