

A Monitoring Program to Determine the Effect of Global Change on Alpine Plant Communities in the San Juan Mountains, SW Colorado

A New Site in the Global Observation Research Initiative in Alpine Environments (GLORIA) Program

Mountain Studies Institute (MSI)
Principle Investigator: Dr. Koren Nydick

Update: Installation of the GLORIA target region in the San Juan Mountains is complete. Data entry and analysis are underway.

What is GLORIA and Why in the San Juan Mountains?

GLORIA is a long-term, global observation network for the comparative study of climate change impacts on mountain biodiversity, especially plants. There are more than 30 GLORIA target regions worldwide, but only four are located in North

America.

Ecosystems of the alpine life zone are considered to be particularly sensitive to global warming because they are adapted to low temperature conditions. Alpine communities are also limited to the extent that they can migrate to higher

altitudes or latitudes due to the island nature of mountain tops. Alpine environments contain relatively high number of endemic species (i.e., species that occur only locally) that are at risk of extinction.

A site in the San Juan Mountains will be extremely useful to understand alpine flora biodiversity, community patterns, and impacts of climate change, increasing air pollution, and spread of exotic plant species at a mid-latitude continental mountain range. In some areas of the San Juan Mountains, such as Silverton, temperatures have risen over one degree Celsius in the summer and four degrees Celsius in the winter since about 1970. It is crucial to understand how these increasing temperatures affect alpine tundra and treeline vegetation in this region.



Un-named summits near Lake City used as part of the GLORIA in the San Juan Mountains project.



Peggy Lyons of the Colorado Natural Heritage Program reads a frequency grid on the SJM GLORIA project. Dr. Michael Kelrick from Truman State University takes notes.

What are the Benefits of the San Juan Mountain GLORIA Program?

- Establishment of a long-term observation system that can detect early warning signs of climate change and other stresses such as air pollution and exotic species invasions.
- Data on alpine plant communities that will aid in understanding changes to alpine biodiversity and spatial patterns in the San Juan Mountains and will allow comparison to mountain ranges throughout the world.
- Stewardship of alpine ecosystems.
- Education of undergraduate and graduate students.



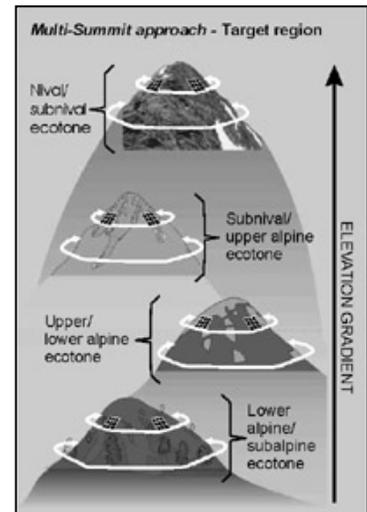
Julie Crawford, a graduate student with the University of Pavia, Italy and a plant ecologist with the U.S. National Park Service reads a frequency grid. Lindsey Lennek, a student at Fort Lewis College, takes notes.

What Does the Work Entail?

GLORIA uses a multi-summit approach and standardized low-impact monitoring methodology that allows study of alpine plant communities and climate change impacts both within and among regions.

Monitoring plots were installed from July 29 to August 9, 2006 on four mountain summits on BLM public land near Lake City, Colorado. The summit elevations range from 12,195 to 13,800 ft.

MSI began planning the project more than a year prior to field work and several candidate locations were considered before picking the Lake City area. The project requires four summits along an elevation gradient beginning from just above treeline. The mountain tops have to be as conically-shaped as possible so that plots can be located on all four sides. Furthermore, geology and climate have to be very similar and peaks have to be as accessible as possible while avoiding areas impacted by recreation or mining.



GLORIA multi-summit approach.



3 x 3 m² plot showing a 1 m² gridded quadrat in the far lower corner.

The physical impacts associated with GLORIA projects are very minimal, by design. Each of the four summits is monitored using a specific observation protocol extending no farther than 10m below and 100m horizontal distance from a summit, with four main plots located at a specific distance below the summit in the primary cardinal directions. There are a total of 16 x 1 m² temporary gridded quadrats (i.e., four in each plot). To facilitate repeat studies, small monument stakes (easily removed) or paint markers are installed to mark the summit origin point and the plot corners. The protocol also includes installation of a tiny, self-contained soil temperature monitoring sensor at a shallow depth inside each plot. The multi-summit array is observed at least once every five years with each summit requiring a

team 2-3 full days to complete. Temperature sensors are downloaded every 2-3 years. See the GLORIA website for more information: http://www.gloria.ac.at/res/gloria_home.

Who Did the Work?

Installation of the GLORIA target region was performed by MSI and cooperators, including:

- Dr. Koren Nydick, Ellen Stein & Kyle Skaggs – MSI staff
- Peggy Lyons – Contract botanist, Colorado Natural Heritage Program
- Julie Crawford – Graduate student with the University of Pavia – Italy. Julie's dissertation focuses on analysis of GLORIA data from the San Juan Mountain target region and other North American sites.
- Lindsey Lennek – Student intern from Fort Lewis College, Durango, CO.
- Dr. Michael Kelrick & his "Wilderness Conservation Biology" class from Truman State University.



Dr. Koren Nydick, MSI's Research & Education Director, reads a quadrat on the rocky ledges of a 13,811 ft. peak while Kelrick records observations.

What about Funding?

The cost of the project is over \$23,000 for planning, installation, and collection and analysis of first year data. **These funds come from MSI, San Juan Public Lands: USFS & BLM, The Nature Conservancy, American Alpine Club, Colorado Native Plant Society, and Colorado Mountain Club.**

Who do I contact?

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