

## **Elevation, substrate, & climate effects on alpine & sub-alpine plant distribution in California's high mountains: preliminary data from the California GLORIA Project**

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Plant distribution varies with elevation, substrate, and climate. Documenting plant response to global climate change, in sensitive zones such as the alpine, is a major goal for global change biology. Understanding how plant communities reflect elevation and substrate is critical to analyzing plant response to climate change on regional scales. In California's alpine zone, community composition can change over as little as 25 meters in elevation, and multiple substrates are found in close proximity. Basic information on alpine plant distribution by elevation and substrate provides a basis for anticipating which species may be reduced with a warming climate, which likely to persist, and which could replace those that decline.

The Global Observation Research Initiative in Alpine Environments (GLORIA) is a worldwide effort to document vegetation changes over time in alpine settings using permanent multi-summit plots. Established in North America in 2004, we currently monitor six permanent GLORIA target regions, composed of 21 high summits in California's alpine and subalpine zone. High resolution plant occurrence and cover data from the upper 10 meters of each summit is presented, from 4325 meters in elevation to 3250 meters. The summits span the ranges of eastern-central California, ranging in substrate from dolomite to granite, to argillized acidic volcanics. Additionally, plant frequency and cover are assessed at 25 meter elevation intervals, with 100-meter belt transects on contour, overlapping profiles, extending downward from four summits in the White Mountains.

Species richness varies 10X over our 1000-meter elevation range. Plants from our data can be generally divided into 3 groups: 1. Summit specialists (ex: *Polemonium chartaceum*) only on top of the highest peaks, 2. Alpine plants (ex: *Phlox condensata* and *Astragalus kentrophyta*) predominantly within the alpine zone but sometimes into the upper sub-alpine zone, and 3. Broadly distributed plants (*Elymus elymoides* and *Chrysothamnus viscidiflorus*) from the alpine zone to the valleys. Rock substrate and microsite soil development have a strong effect on plant community composition and species richness (ex. volcanic rocks were found to support 2x more species than dolomite).

Impacts of climate change on plant communities will be assessed by repeating the GLORIA protocol every 5 years and recording soil temperature on all four aspects at each summit. We present the first set of 5-year resurvey and temperature data from 18 summits and 4 down-slope belt transects. We have documented considerable annual variation in species presence/absence at almost all sites. Consistent with the expectation of rising global temperatures, our soil temperature loggers have documented a rise of 1-degree Celsius at most of our sites. This data (2004 through 2012 for different sites) is a baseline dataset for assessing bioclimatic shifts and future plant composition in California's alpine zone.