**Materials and Methods**

Study Area

The plants studied in this project included all herbaceous species in Colorado growing at altitudes greater than 3,200 meters. Alpine is generally considered to occur above 3,505 meters in Colorado, and as such this study area included subalpine and alpine plants up to the highest point, the summit of Mt. Elbert at 4,374 meters. The Rocky Mountains and continental divide run north to south through the middle of the state from Latitudes 30°N to 41°N.

Climate Data

Climate data was obtained from the Prism Climate Group (http://www.prism.oregonstate.edu/) and consisted of 2.5 arc-minute (4 KM2) gridded data sets of United States climate. The three climate variables studied included average annual maximum temperatures, average annual minimum temperatures, and average monthly precipitation from 1950 to 2011. Growing Degree Days were calculated from the minimum and maximum temperatures. These climate data were imported into QGIS v. 1.8.0.

Elevation data was obtained from the USGS Core Science Metadata Clearinghouse and consisted of a US Geologic Survey Digital Elevation Model with a pixel size of 90 square meters. Geographic areas with elevations above 3,200 meters in Colorado were extracted from the climate data by creating sample point centroids for each Prism Climate pixel, and using the point sampling tool in QGIS to sample the altitude digital elevation model to determine which centroids had elevations 3,200 meters or greater . 1279 sampling points were extracted using this process.

Finally, the same sampling points were used to sample the climate data from each of the three climate variables for every year from 1950 through 2011. These data were used to determine the average high temperature, average low temperature and average monthly precipitation for each year.

Herbarium Data

Herbarium data was collected from Seinet (<http://swbiodiversity.org/seinet/index.php>) and from the University of Colorado Herbarium (COLO). The University of Colorado Herbarium contains the largest number of herbarium specimens collected in Colorado, but does not participate in the Seinet program. No attempt was made to identify the exact coordinates of the collections because much of the data was collected before the use of precise GPS technology. We relied on the collector’s estimate of the elevation to determine whether the collection fell within our elevation constraints. C The data includes 290 species with 8 to 52 vouchers collected per year. The average time span of collections per species is 23 years while the lowest number of distinct collection years for a species was seven with 279 species containing ten or more distinct years of collected vouchers.

The data was refined as follows:

1. Data were filtered to include only vouchers which had been recorded as “in flower”, “in fruit” or “bulblet”
2. Data were limited to vouchers collected at or above 3,200 meters.
3. Records missing the exact date of collection were removed.
4. In years where there were multiple collections, only the species with the first date of collection was retained in the dataset. All collections with later dates of collection were removed.
5. Data were limited to collections make within the study period of 1950 through 2011.

(NOTE: actually, I don’t think we ever did this. May have been done in R, but I couldn’t find it). The lowest number of distinct years collected for a species was 7. 290 total species were found in the sample. 271 species had ten or more years of collection.

Matching Climate Data with Species Data

Regression analyses were performed in R (R x64 1.13.2) matching each species’ flowering date to the climate data averaged over Colorado locations above 3200 meters per year. Earlist bloom date was compared to the average high and low temperatures, average precipitation, and cumulative growing degree days. Growing Degree Days were calculated as the cumulative difference of the average temperature and a base temperature.