Visualizing Impact of Climate Change on Peak Flowers

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Problem

Design new methods of visualizing the seasonal timing of flowering (i.e. wildflower phenology) in the high mountain meadows of Mt.Rainier to help phenologists understand the biological impacts of climate change. Data was collected by volunteers for 10 plant species (see Figure 1) at 9 locations over a large gradient in elevation from 2013 to 2015. The nine sites are located along the east branch of the Lakes Trail (see map in Figure 2).

Figure 1: Flower species from left to right, top to bottom: American Bistort, Bracted Lousewort, Subalpine Lupine, Western Anemone, Avalanche Lily, Gary's Lovage, Magenta Paintbrush, Mountain Daisy, North Microseris, Sitka Valerian.

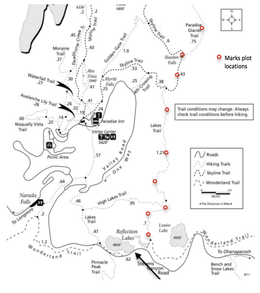

Figure 2: Map for nine observing sites.

Motivation

About MeadoWatch Project:
We collaborate with Janneke Hille Ris Lambers from Department of Biology, who is interested in forecasting the impacts of climate change on phenology of wild flowers. The timing of seasonal wildflower displays is strongly linked to snow, and will thus be strongly influenced by climate change. As a result, plant and animals relying on wildflower displays may be affected, as will the management of these natural resources. To address these issues, the citizen science program MeadoWatch was established.

Initial Visualization:
Their initial visualization includes drawing unimodal curve for the probability of flowering by fitting statistical models to the phenology data and making static summary scatter plots. We would like to develop an interactive visualization that could display the dynamic change of snow disappearance date (SDD) and the timing of flowering for each plant species and plot over the summer season for each year. The challenging part would be how to make users gain an insight from our visualization in a straightforward manner that the wildflower phenology was linked with snowmelt date that was influenced by climate change.

Approach

We design an animated narrative visualization for the phenology data to tell the story of how climate change makes impact on peak flowers. The visualization consists of two parts: the focal flowers in corresponding sites represented by bands and circles; and the histograms documenting the total number of wildflower species observed flowering (i.e. the wildflower season). We use animation to display the yearly trends of snowmelt and the flowering of each species in each locations (on different latitude) over time.

Results

Figure 3: Both mountains and histograms are arranged in small multiples for each year, which allows for direct comparison between years at any given date. As time progresses when user hits play, bands turn from light blue to dark green when snow melts from plots, dots turn colored when flowers are observed in plots, and the heights of the bars in the histogram (bottom panel) document the total number of wildflower species observed flowering (i.e. the wildflower season). The histograms show up gradually along the time axis as the animation plays. Every change in the process of animation will be marked in such histograms, which will eventually become a static visualization summarizing the information provided in the animation. Users can also type in the start date of the animation.

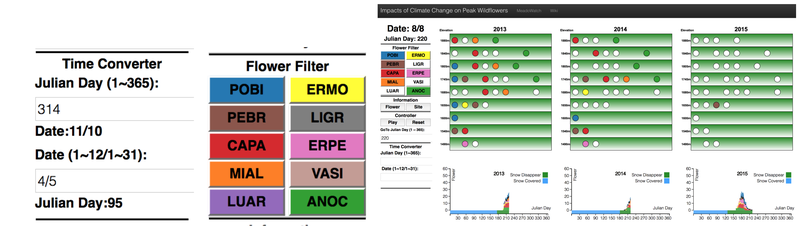

Figure 4: The left panel shows the time converter between Julian day and date. The middle panel shows the color legend for the 10 species, which were chosen to be similar to the actual color of most species. This legend could also functions as a filter on flower species so that people can choose certain types of flowers they are interested in, which is illustrated by the right panel. Upon selecting on the species, the focal flowers in corresponding sites and the histograms will change accordingly.

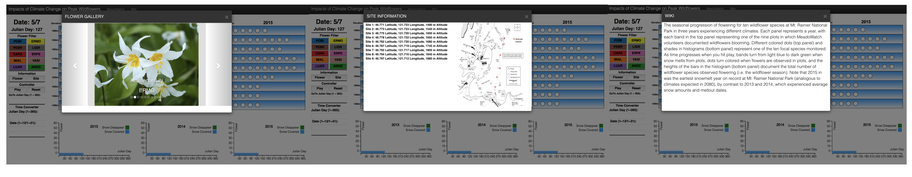

Figure 5: The left panel shows the flower gallery. The middle panel shows the site information. The right panel shows the information box for the narrative legend.

Future Work

As more data is collected in the meadowatch project, we can generalize this visualization to phenology data of more than three years. Users can select years among which that they are interested in comparing, thus having easy access to the historical phenology record for each focal species and locations.