Changes in Arctic Vegetation: Using GIS to Visualize Change Across a Diverse Landscape

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Introduction:

Arctic vegetation has been shown to be affected by climate change, particularly warming (Kaplan and New, 2006). These changes in arctic vegetation may result in numerous ecosystem consequences (Gornall et al, 2007). Graminoids constitute a substantial portion of arctic vegetation, and therefore, understanding graminoid change over time is of great importance.

This project provides visual representations of not only changes in frequency, but also the distribution of graminoids across a large grid in the tundra of Barrow, Alaska.

Methods:

- Convert Excel data of plant species and abundance with latitude and longitude coordinates to a comma delimited file.
- Bring data from 2010 and 2013 into ArcMap as .csv files.
- Display the data spatially using the fields Latitude and Longitude as well as WGS 1984 as the coordinate system.
- Use the interpolation method spline to rasterize *Dupontia fisheri*, *Carex aquatilis*, and Graminoids shapefiles from the 2010 layer as well as the 2013 layer.
- Use Raster Calculator to find the difference in species abundance between 2013 and 2010 for *Dupontia fisheri*, *Carex aquatilis*, and Graminoids.
- For each of these six layers, change the symbology to classified to then represent the correct color ramp.

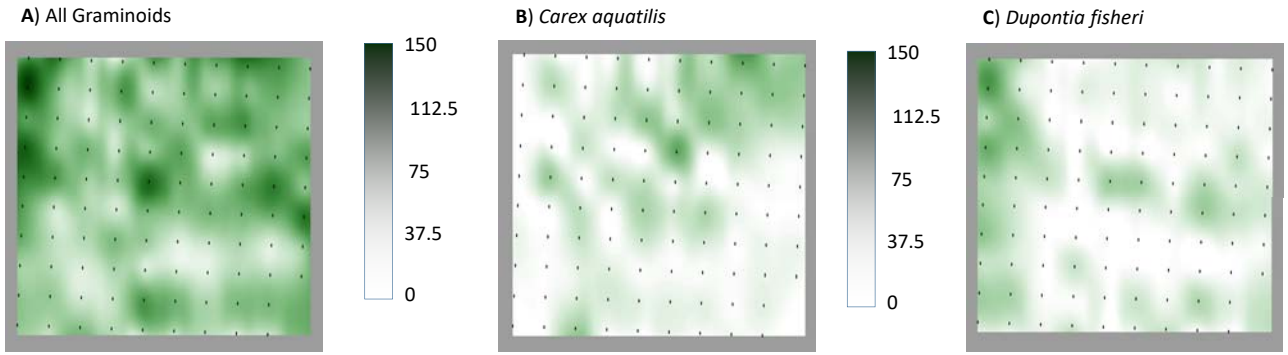

FIG 1. Distribution of Graminoids (**A**), *Carex aquatilis* (**B**), and *Dupontia fisheri* (**C**) in 2010 across the 10,000 m² grid in Barrow, Alaska. Values along the color ramp indicate the estimated number of "hits" of each species within a 1 m² plot.

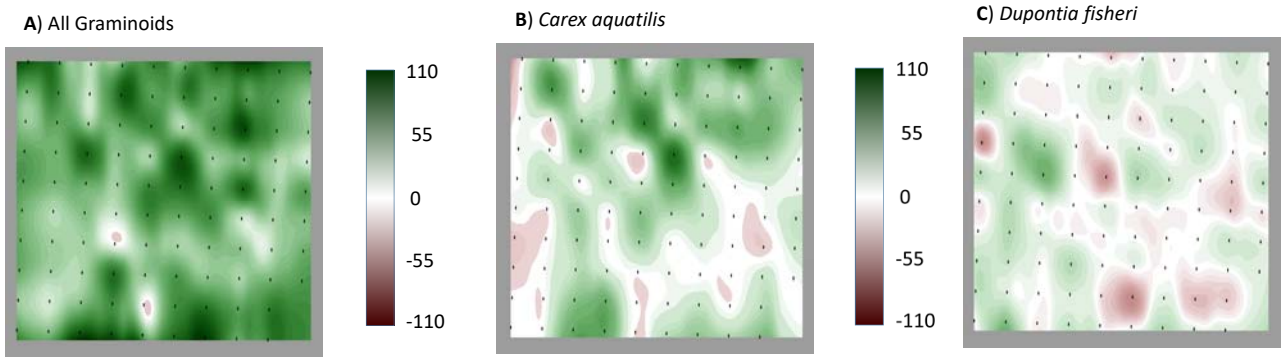

FIG 2. Change in Graminoids (**A**), *Carex aquatilis* (**B**), and *Dupontia fisheri* (**C**) abundance from 2010-2013 across the 10,000 m² grid in Barrow, Alaska. Values along the color ramp indicate the estimated change in "hits" of each species within a 1 m² plot.

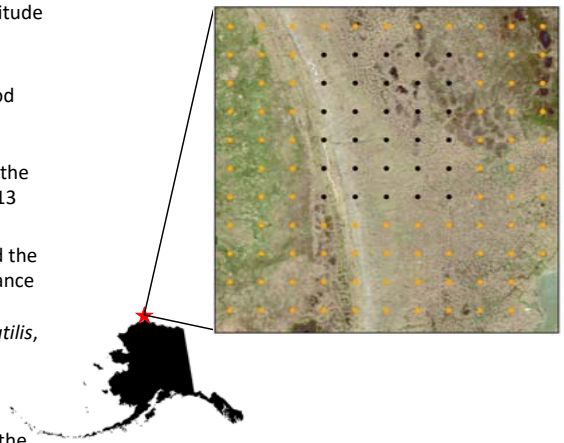

FIG 3. The location of grid in respect to Alaska. Dots represent plots. The black dots constitute the sub-plot in which the data for Figure 4 and Figure 5 was collected.

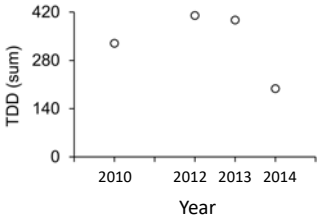

FIG 4. Thawing degree days from 2010-2014 in Barrow, Alaska

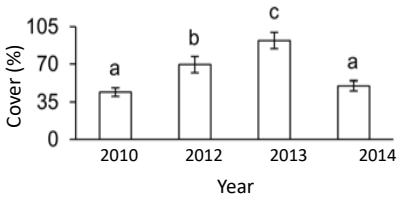

FIG 5. Mean cover of graminoids for the sub-plot of the grid. Different letters indicate statistical significance between individual years.

Results:

- Graminoids showed a significant increase in Abundance from 2010 to 2013 with many areas increasing by almost 110 counts.
- *Carex aquatilis* predominately increased throughout the entire grid with a few areas showing no change and a slight decrease.
- *Dupontia fisheri* shows slightly more areas with increased abundance. However, approximately one fourth of the area on the grid shows a fair amount of decrease.

Discussion:

The hypothesis that graminoid distributions would shift and abundance increase from 2010-2013 was correct. Graminoids as a whole (**FIG 2 A**) showed abundant growth while the two most common graminoids, *Carex aquatilis* (**FIG 2 B**) and *Dupontia fisheri* (**Fig 2 C**), show evidence of shifting distributions as well as an overall increase in frequency. A likely explanation for these results is the warmer temperatures recorded in Barrow in the years 2012 and 2013 as compared to 2010 (**FIG 4**). A previous study, also done in Barrow, Alaska, has already found a correlation between warmer temperatures and increased graminoid ground cover (**FIG 5** & FIG 6) (Botting, 2015). Further research must be performed over a longer period of time so as to better understand the extent to which warming and a changing climate affect arctic vegetation distributions and compositions.

References:

Botting, Timothy. 2015. "Documenting Annual Differences in Vegetation Cover, Height and Diversity near Barrow, Alaska".

Gornall JL, Jonditтor IS, Woodin SJ et al. 2007. "Arctic mosses govern below-ground Environment and ecosystem processes". *Oecologicia*. 153 (4): 937-944.

Kaplan, Jed O., and Mark New. 2006. "Arctic climate change with a 2 ◦C global warming: Timing, climate patterns and vegetation change". *Climatic Change* 79 (3): 213-41.

Acknowledgements:

Funding for this project provided by National Science Foundation, and logistics in Alaska provided by UIC Science. Thanks to Rob Slider, Ashley Brecken, Sheila Wald, and Kelsey Mannard for their help in this project