Response of *Luzula arctica* and *Luzula confusa* to warming in Barrow and Atqasuk, Alaska

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Introduction:

Higher latitudes are expected to show the earliest and greatest response to global climate change. Air temperature has been increasing in the arctic at much faster rates than the rest of the globe (IPCC 2007). Arctic plants are adapted to the harsh climate of the region, so a small change in the climate could greatly affect the community. Changes in community structure or composition or arctic plants could greatly affect the productivity of the ecosystem. Also, changes in the arctic ecosystem are likely to have global impacts due to linkages to more southern areas (ACIA 2004). The International Tundra Experiment (ITEX) uses experimental warming to study how tundra plants respond to changing temperature. In general, previous studies have shown that arctic plants respond to warming with increased growth and reproductive effort (Hollister et al 2005). In this study, the response of *Luzula arctica* (Figure 1A) and *Luzula confusa* (Figure 1B) to warming was observed in order to determine if closely related species respond similarly. The study was performed in both Barrow and Atqasuk in order to compare the response of the vegetation to warming at each site.

Methods:

Sites were established at Barrow in 1994 and Atqasuk in 1996. Barrow is located about 60 miles north of Atqasuk (Figure 2). Both experience arctic climates, but Atqasuk is generally 4°C warmer than Barrow in the summer. Each dry site contains 24 warmed plots and 24 control plots. Plots of vegetation ($1m^2$) were warmed 1°C to 3°C using open-top fiberglass chambers (Figure 3). Data on *L. confusa* and *L. arctica* was collected in each control and warmed plot containing the species during the 2010 growing season, from mid June to late August (the species were not found in all plots at each site). Growth measures (inflorescence length and leaf length) were taken about every 24 days, while inflorescence counts were performed weekly.

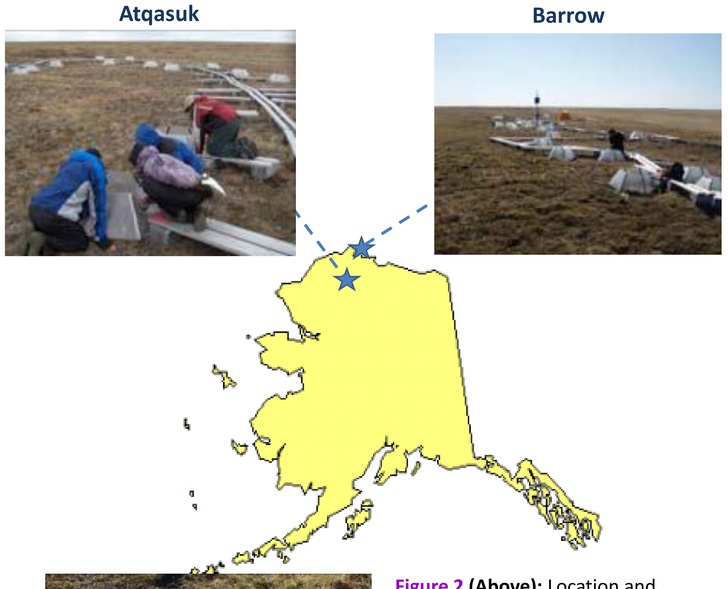

Figure 2 (Above): Location and images of study sites in Barrow and Atqasuk, Alaska.

Figure 3 (Left): Open top chamber (OTC)- fiberglass chamber used to passively warm experimental plots.

Figure 1: Photographs of *L. arctica* (A) and *L. confusa* (B) taken at Barrow, Alaska in summer, 2010

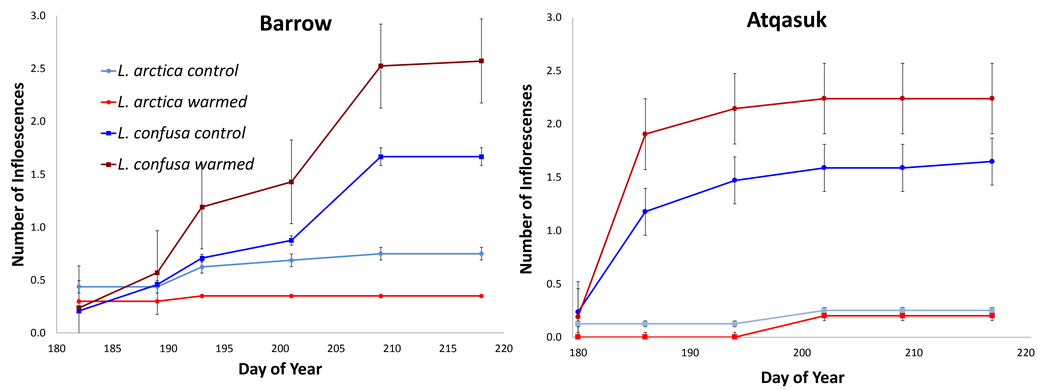

Figure 4: The average number of *L. arctica* and *L. confusa* inflorescences found in a plot on a given day of the year (bars represent standard error of the mean; Barrow n≥17, Atqasuk n≥8).

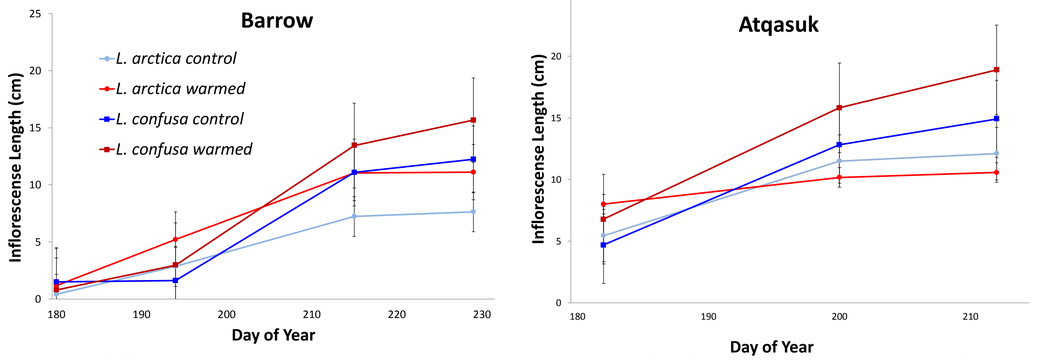

Figure 5: The average inflorescence length (cm) of *L. arctica* and *L. confusa* found in a plot on a given day of the year (bars represent standard error of the mean; Barrow n≥5, Atqasuk n≥6). We included *L. arctica* for comparison even though sample size was too small (n=2).

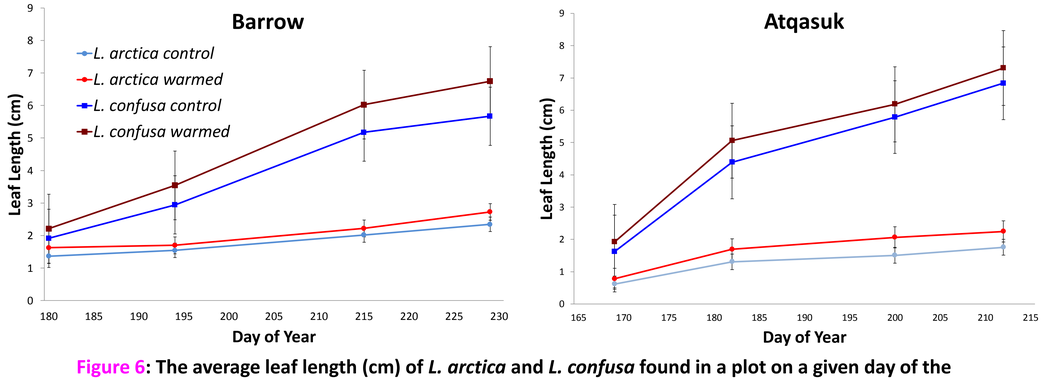

Figure 6: The average leaf length (cm) of *L. arctica* and *L. confusa* found in a plot on a given day of the year (bars represent standard error of the mean; Barrow n≥15, Atqasuk n≥9).

Results

L. confusa produces more inflorescences in response to warming, while *L. arctica* produces less(Figure 4). While the date of peak inflorescence production occurred earlier in Atqasuk than in Barrow, both species produced more inflorescences in Barrow than in Atqasuk. (Figure 4). *L. confusa* produced more inflorescences than *L. arctica* at both sites (Figure 4). *L. arctica* seemed to have a stronger response to warming in Barrow than in Atqasuk in regards to the number of inflorescences produced (Figure 4). In Barrow, both species produced taller inflorescences in the warmed plots while in Atqasuk, *L. arctica* showed a negative response (Figure 5). Inflorescences were taller in Atqasuk than in Barrow for both species, and *L. confusa* produced taller inflorescences than *L. arctica.*(Figure 5) . *L. arctica* showed no significant difference in leaf length with treatment at either site, while *L. confusa* showed a small increase in leaf length in response to warming at Barrow, and no significant change at Atqasuk (Figure 6).

Discussion

The results of this study show that in *L. arctica* and *L. confusa* respond differently to warming. *L. confusa* showed increased reproductive effort when warmed, while *L. arctica* showed a negative response. Generally, neither species showed a vegetative response in terms of leaf length. Previous studies have shown that arctic plants respond to warming with increased growth and reproductive effort, but these results show that this varies by species. Neither showed increased growth effort, and *L. arctica* responded negatively to warming. *L. confusa* produces more inflorescences and taller inflorescences than *L. arctica* at both study sites, and it responds positively to warming. This implies that *L. confusa* may out compete *L. arctica* in the changing environment due to its increased reproductive effort and ability to better adapt to the change in temperature. If this is the case, warming may lead to a change in community structure in which *L. confusa* may become more dominant than *L. arctica.* Changes in community structure and diversity can effect productivity of the ecosystem.

In continuing this study, I hope to compare more characteristics between *L. arctica* and *L. confusa* to observe any other significant differences in their response to warming. I would also like to observe other groups of closely related species in order to determine if they too respond similarly or differently to warming.

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