The Effects of Climate Change on *Eriophorum triste*; An Arctic Graminoid Species

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Introduction

Nearly all climate change scenarios predict that the greatest warming resulting from climate change will be in the Arctic. Low temperature is one of the greatest limiting factors to plant growth and reproduction in Arctic regions, so a rise in temperature could greatly impact plant community structure. The International Tundra Experiment (ITEX) uses experimental warming through open-top chambers to study how tundra plants respond to an increase in temperature. Previous studies have shown that, in general, arctic plants respond to warming with increased growth and reproductive effort as well as earlier phenological development (Hollister et al. 2005, Oberbauer 2013). This suggests that graminoid plant species may perform more favorably in response to climate change. This study takes a closer look at a dominant species in arctic wet meadow habitats, *Eriophorum triste* (Fig 1B). The objective of this study was to determine if *Eriophorum* follows the general trends mentioned above. Wet meadow tundra is an important community type in Arctic Alaska, so it is important to understand how individual species may respond to an increase in temperature and thus affect the overall community structure.

Methods

The research site was established in 1995 in Barrow, Alaska (Fig 1A). The site is located within a wet meadow community and contains 24 control plots and 24 experimentally warmed plots (each 1m^2). Experimental plots were fitted with fiberglass open-top chambers (OTCs) that raised the ambient temperature 1°C to 3°C (Fig 1C). Phenology (day of first: green leaf and inflorescence) and growth (length of: leaf and inflorescence) measurements were collected weekly for *E. triste* from mid June to late August (Fig 2A).

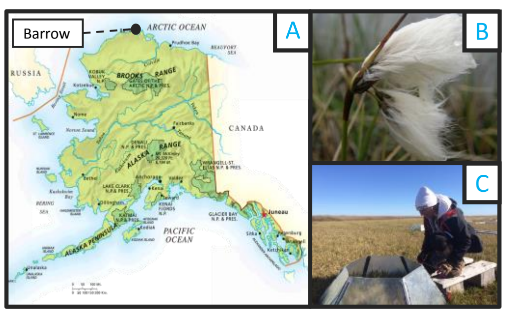
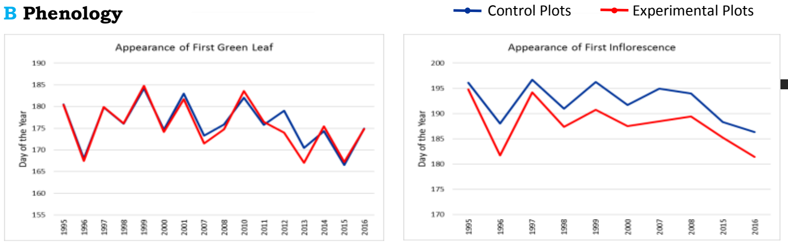


Fig 1A: Location of study site in Barrow, Alaska. **B:** *Eriophorum triste* at the Barrow wet meadow study site. **C:** Working at the Barrow wet meadow study site over an OTC.

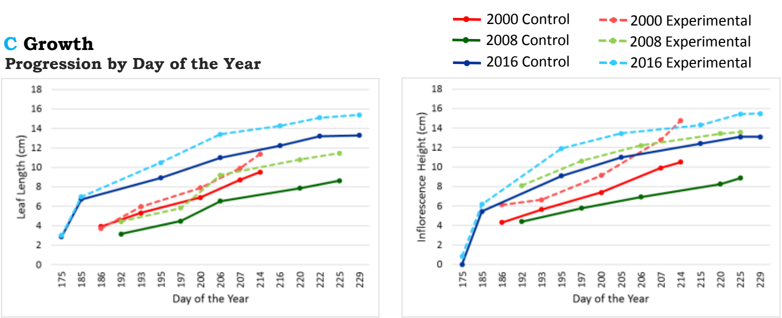
A Growth Diagrams

B Phenology



C Growth

Progression by Day of the Year



Progression by TDD

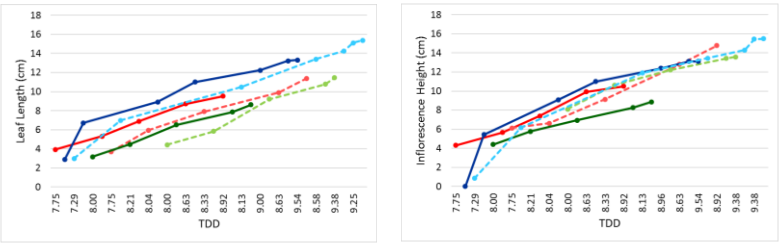


Fig 2A: Leaf length and inflorescence height measurements for *E. triste*. **B:** Phenology collected for *E. triste.* First green leaf (*left*) and first inflorescence (*right*) are expressed by day of the year for each year where measurements were made in control (*blue*) and experimental (*red*) plots. **C:** Growth progression collected for *E. triste.* Leaf length (*left*) and inflorescence height (*right*) is shown by day of the year (*top*) and thawing degree days (TDD; *bottom*). Each line represents the progression of growth in a year (*color*) and treatment (*line style*).

Results

Only certain phenological traits show consistent trends with warming (Fig 2B). The appearance of an inflorescence was significantly earlier for *E. triste*, but the appearance of the first green leaf did not display an obvious trend.

Increased temperature results in longer leaf lengths and taller inflorescence heights for *Eriophorum triste* (Fig 2C). Warming seemed to have a greater impact on inflorescence heights as they grew significantly faster and taller in experimental plots. This trend is consistent across most years.

Discussion

Generally, growth and phenological development is enhanced in response to warming. Discrepancies in certain phenotypical traits also suggest that *E. triste* has a more individualistic response to climate change. Previous findings show that additional factors such as alteration of light and nutrients exhibit different responses in different plant species (Chapin and Shaver 1985, Hollister et al. 2005, Wahren et al. 2005). Each species partitions environmental resources and often requires them at different times or locations (Chapin and Shaver 1985). In some cases temperature may be subordinate to other fluctuating factors in influencing growth and reproductive effort. This may result in a lag in the rate of vegetation change depending on the magnitude of fluctuations (Hollister et al. 2005). To understand plant community changes in the tundra, then, it is important to understand these individualistic responses as well as the relationship between temperature and other fluctuating factors affected by warming.

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