Reproductive changes in the sedge *Carex aquatilis* in northern Alaska in response to experimental and climatic warming

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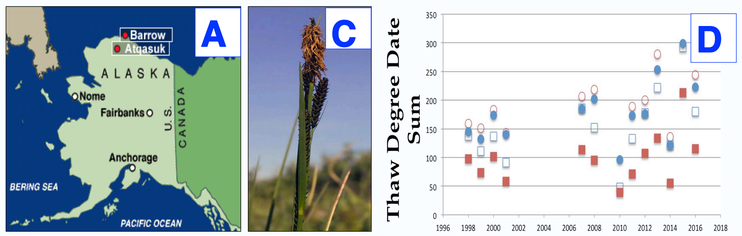
Introduction and Background

The Arctic is warming and it is expected to continue to warm as a result of climate change (Kattsov et al., 2005). An earlier snowmelt, and a longer growing season have ben shown to contribute to vegetation change in the tundra (Schuur et al.; Walther et al., 2002). We focused on the effects of temperature on the sedge *Carex aquatilis* because it is a dominant plant species in Northern Alaska and is important in many Arctic communities.

To predict how *Carex* will respond to climate change, we examined differences in flowering over time and in response to experimental warming at sites in Atqasuk and Barrow, Alaska.



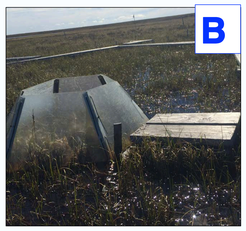
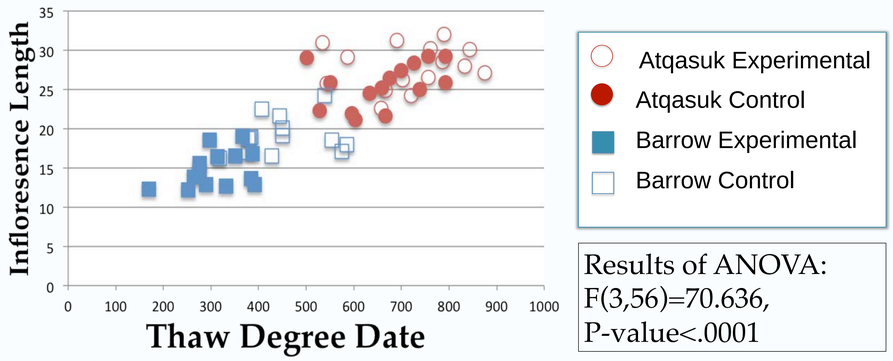


Fig 1. A Map of Alaska showing Barrow and Ataqasuk. **B** An experimental warming chamber in Atqasuk wet site. **C** The sedge *Carex aquatilis* showing the flowering stalk (infloresence). **D** Graph displaying the sum of thawed growing days each summer (this is a representation of the warmth of the summer calculated by adding the average daily temperature consecutively).

Methods

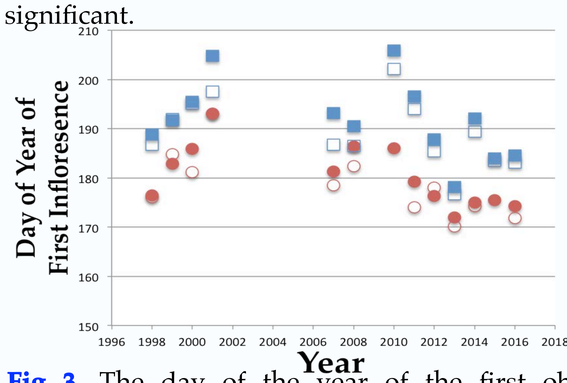
Research sites were located in Barrow and Atqasuk, Alaska **(Fig 1A)**. Each site contained wet meadow tundra and dry heath tundra vegetation. Here we focus on the wet communities. The plots were established in the 1990s. Observations have been made every subsequent summer except 2001-2005 and 2009. Each of the four sites were subdivided into 48 plots. Half of these plots received the open-top warming chambers **(Fig 1B)** (Hollister and Webber, 2000). Observations made on *Carex aquatilis* throughout the summer included recordings of phenological developmental dates, inflorescence counts and measurements, and leaf growth measurements **(Fig 1C)**. Specific plants were marked within each chamber to allow continued observation of the life cycle. We also measured abiotic climate factors via an automated weather station at each site **(Fig 1D)**.

Results and Figures



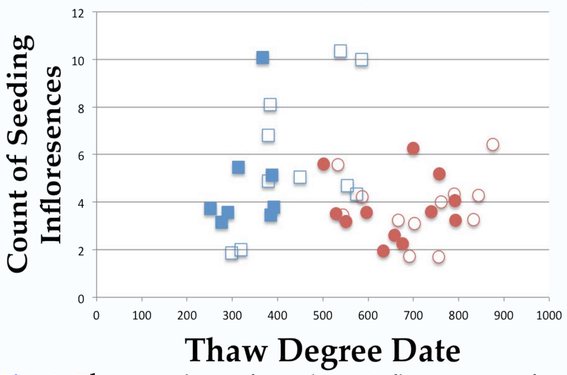
Results of ANOVA: $F(3,56)=70.636$, P-value<.0001

Fig 2. The length of the infloresence increased with temperature. The infloresence of *Carex* was measured weekly in all four plots over time. Atqasuk and experimental plots were consistently taller than Barrow. A one-way ANOVA test was conducted, the analysis of variance was significant.



Results of ANOVA: $F(3,52)=12.917$, P-value<.0001

Fig 3. The day of the year of the first observed infloresence is consistently earlier in warmer plots. The date of the first infloresence for *Carex* was recorded every year, in both Barrow and Atqasuk, warmed and controlled plots. A one-way ANOVA test was conducted, the analysis of variance was significant.



Results of Linear Regression: $R^2=-.005$ P-value=.383

Fig 4. The number of seeding infloresences for *Carex* in each plot did not increase with the temperature of the current year. A simple linear regression was conducted. The results were not significant.

Discussion

We found that the infloresence height increased as the temperature increased; inflorescences were taller at Atqasuk than at Barrow and taller in warmed plots than in the controls **(Fig 2)**. We also found that the date of the first flower (results not shown) and first infloresence was consistently earlier in Atqasuk than in Barrow, and earlier in warmed plots than in controls **(Fig 3)**. We did not find differences in the number of infloresences that produced seeds to be linked with the temperature of the summer in which they were measured **(Fig 4)**.

The response of *Carex* to warming in the tundra is indicative of the changing ecology of this biome. A changed ecology has the potential to affect the entire ecosystem, causing shifts in the larger region, which could have important consequences on the people and animals that live there (Klanderud et al., 2005).

Acknowledgments

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Literature Cited

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