Overall performance of *Cassiope tetragona* in a climate changing environment

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INTRODUCTION

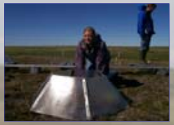
The change that the climate is undergoing is receiving a great deal of attention. Polar species are particularly vulnerable to these changes because they have adapted to harsh conditions, and are expected to change the most (IPCC 2007). To better predict future changes in tundra vegetation, this study, in conjunction with a research network known as the International Tundra Experiment, used warmed 1m² patches of tundra with fiberglass chambers and examined the response of *Cassiope tetragona*. The dwarf evergreen shrub *C. tetragona* (**FIG 1**) is unique in that the length of the annual growth increments (AGIs) has been shown to reflect climatic conditions during the season they were produced (Molau 1997). Therefore, studying *C. tetragona* can help to determine climate changes, and the effects of them, over many years. We examined the response of flowering and growth of this species at dry heath sites at Barrow and Atqasuk, Alaska.

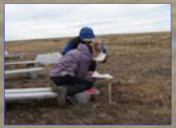
FIG 1. *Cassiope tetragona*, a circumarctic, ericaceous evergreen dwarf shrub present at both Barrow and Atqasuk, Alaska.

METHODS

There are 24 warmed chambers and 24 control plots at each of the dry sites. Cooler Barrow is located 340 miles north of the Arctic Circle (71°18'N 156°40'W), and warmer Atqasuk is located 280 miles north of the Arctic Circle (70°29'N 157°25'W).

Data on *C. tetragona* were taken from each plot (both control and warmed) at both sites during the growing season of 2007 (June to August). The response variables examined are grouped into two categories, phenological and quantitative. Phenological data, recorded as day numbers, include first green leaf, first bud, first open flower, first seed, and first seed dispersal. Quantitative data include total number of flowers per plot, and length of annual growth increments (Molau & Edlund 1996).





RESULTS

The results show no difference in the length of annual growth increments between the control and warmed plots at each site, whereas at Atqasuk they are larger than at Barrow (**FIG 2**). There was no difference in the number of flowers between the control plots at Atqasuk and Barrow (**FIG 3**). At Barrow, the number of flowers was higher in the warmed plots than the control plots, while at Atqasuk there were fewer flowers in the warmed plots than the control plots. On average, flower opening, withering, and seed production occurred significantly later at Barrow (**FIG 4**). There were no significant differences between treatments, but events were on average earlier in the warmed plots than the control at Barrow. This is especially true when examining change in the number of flowers throughout the season (**FIG 3**).

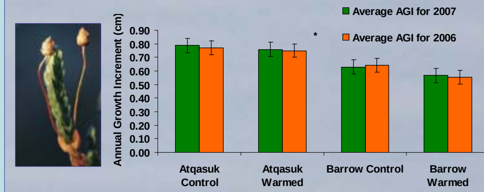


FIG 2. Left: Shoot of *C. tetragona* showing annual growth increments (AGIs). Right: AGIs at the Barrow and Atqasuk sites in 2006 and 2007. Error bars represent standard error of the mean. *significant (p<.05)

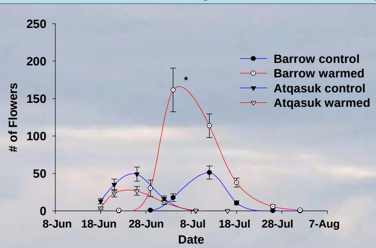


FIG 3. Average number of flowers for control and warmed plots at Barrow and Atqasuk in 2007. Error bars represent standard error of the mean. * significant (p< .05)

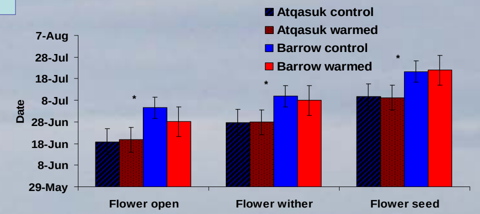


FIG 4. Phenology of *C. tetragona* between Atqasuk and Barrow, which include the average date of open flower, withered flower, and seed. Error bars represent standard error of the mean. *significant (p< .05)

DISCUSSION

These results are consistent with the findings of Hollister et al. (2005) in which the number of inflorescences of *C. tetragona* at Barrow was greater in the warmed plots than the control plots, while at Atqasuk there was little effect of warming, which could be due to water stress. The average annual growth was consistent with the findings of Havstrom (1995) in that growth was greater at Atqasuk than Barrow. However the small amount of warming was not enough to cause an increase in the growth at each site. The lack of growth shows that *C. tetragona* displays conservative growth strategies at these sites (Hollister et al. 2005).

These results suggest that with changing climate conditions, *C. tetragona* varies in the amount of effort put into reproduction at both locations, while keeping growth constant. With continuing warming of the Arctic due to climate change, we expect that *C. tetragona* will flower more and may disperse more rapidly at the northern end of its range, while maintaining relatively consistent growth. These changes will likely result in changes in community composition.

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