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Introduction:

Global climate change is expected to change atmospheric temperatures from 1-4.5° Celsius throughout the next century with the greatest change occurring in the Arctic. The Arctic plant community is also expected to show more response to global climate change than the rest of the world (IPCC 2001). Being adapted to the harsh Arctic environment, the plant community is easily influenced by slight change in the climate. These changes will provide an early example of global climate change. The International Tundra Experiment (ITEX) is studying the Arctic's response through experimental warming. Previous ITEX studies have shown that the plant community is increasing in cover and reproductive effort (Elmendorf et al 2011)(Arft et al 1999). This study used cover data and inflorescence heights and counts taken from 2012 to determine the response of the sedge genus *Carex* (Figure 1) to warming in Atqasuk and Barrow Alaska. The response of both sites was also compared to determine if either site is experienced more change.

Methods:

The study sites were established at Barrow in 1994 and at Atqasuk in 1996 (Figure 8). Barrow is located about 60 miles north of Atqasuk and is on average 4°C colder than Atqasuk (figure 2). Both towns contain wet meadow sites that consist of 24 control plots and 24 experimental plots. The experimental plots were passively warmed 1-3° Celsius using open top chambers (figure 3). Cover data was collected from each plot containing *Carex* using the point frame method at the peak of the 2012 growing season (figure 4). Every instance in which live *Carex* was encountered was summed per plot to estimate cover. Growth measurements and inflorescence counts were collected in Late August of 2012 at the end of the growing season.



Figure 8: Photo of the Barrow wet meadow (left) and the Atqasuk wet meadow (right).

Results:

Carex showed a significant increase in cover in response to warming at both the Atqasuk and Barrow sites ($P < 0.01$) (figure 5). *Carex* cover was also significantly higher at the Barrow site ($p < 0.01$) (figure 5). There was not a significant difference in the changes between the control and experimental plots between the two sites. Average inflorescence length was significantly larger at Atqasuk ($p < 0.01$) and significantly larger in the experimental plots in both sites ($p < 0.05$) (Figure 6). There was no significant difference between the changes in inflorescence height between the control and experimental plots between the two sites. The trend in average number of inflorescences is opposite of height and cover and decreases in the warmed plots for both sites (Figure 7).

Discussion:

The results of this study show that the responses of the two sites to warming are not significantly different. Although the average cover of *Carex* increased in the experimentally warmed plots, the average number of *Carex* inflorescences are trending towards decreasing in the experimental plots. However, inflorescence height is increasing in warmed plots showing that *Carex* is putting more resources into inflorescence height rather than number. Previous studies have shown that plants respond to warming by increasing reproductive effort, but this study shows that *Carex* increases inflorescence size rather than number.

To continue this study, I would like to examine the response of other sedge species to warming to see if the trends are the same as *Carex*. I would also like to examine the difference in vegetative and non-vegetative reproduction.

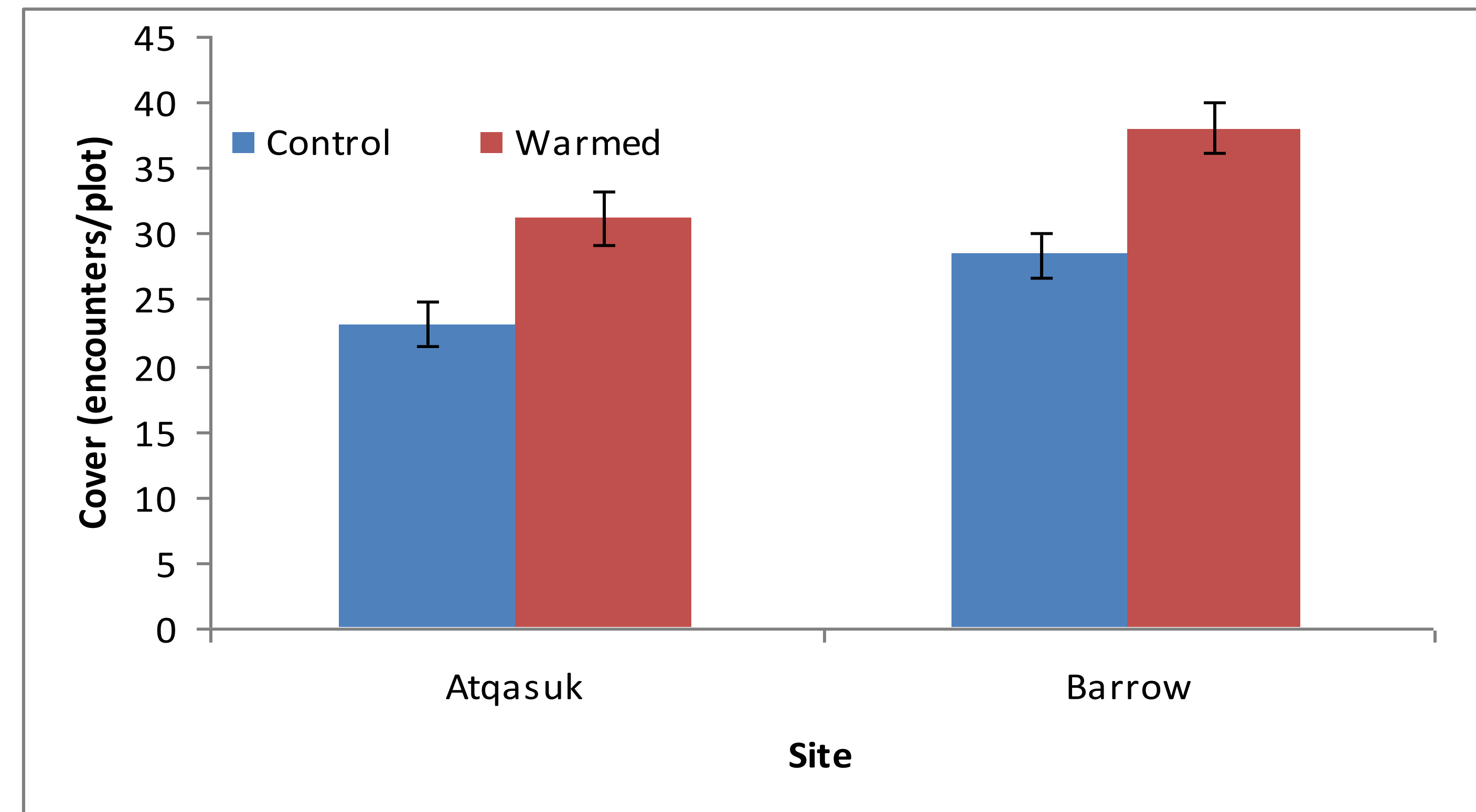


Figure 5: The average cover of *Carex* in the experimental and control plots in each site.

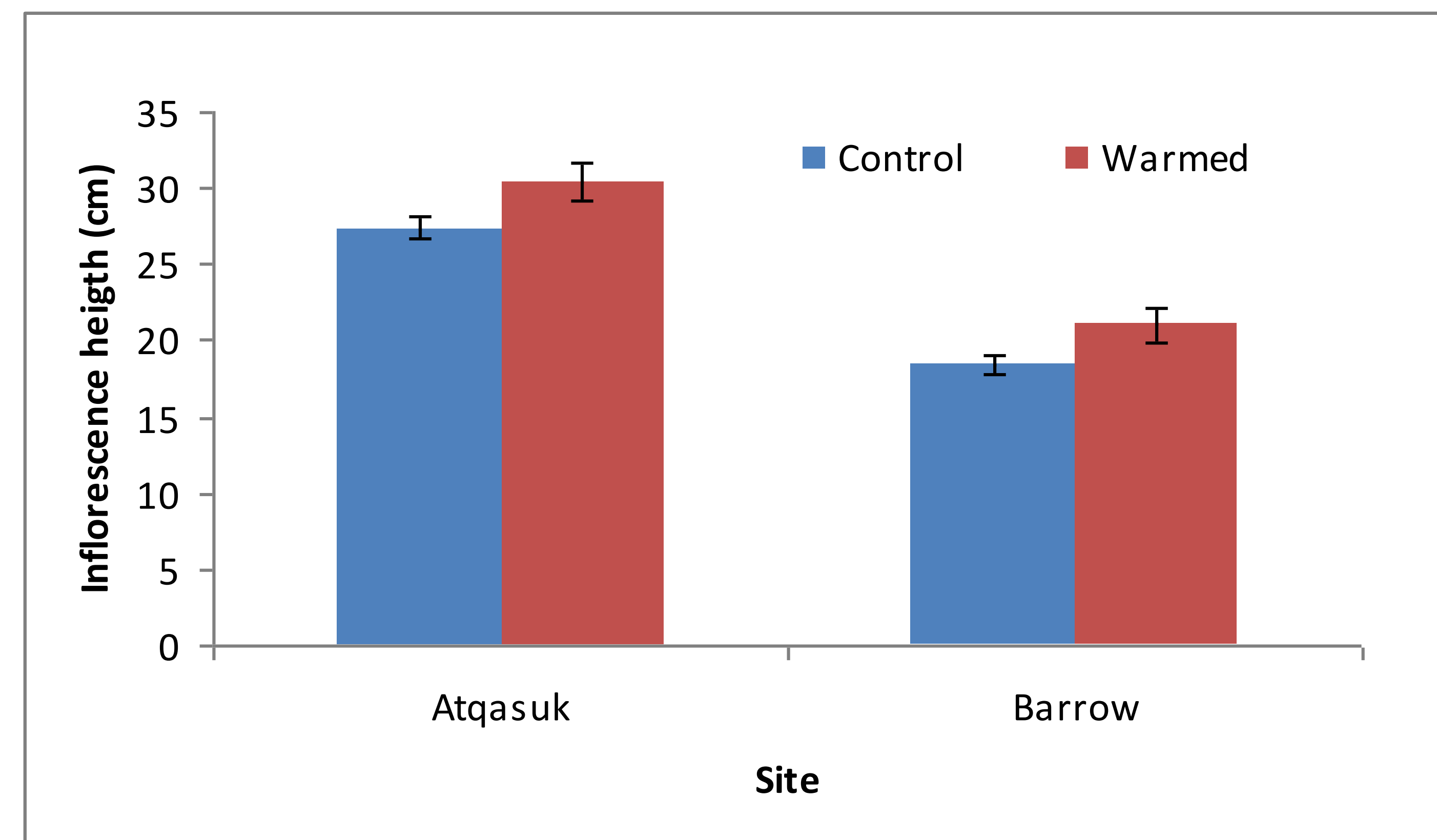


Figure 6: The average inflorescence height of *Carex* in the experimental and control plots in each site.

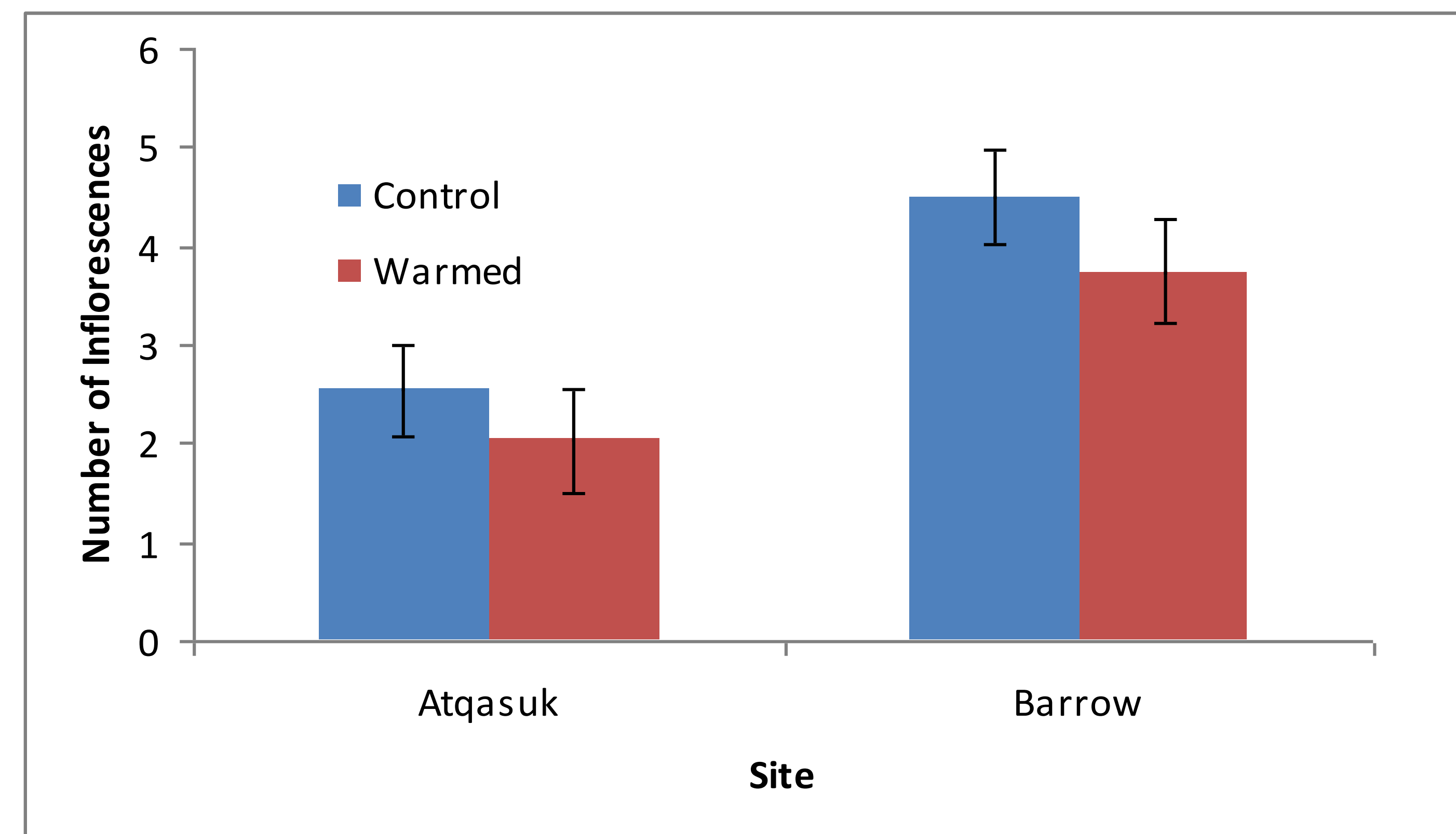


Figure 7: The average number of inflorescences in the experimental and control plots in each site.



Figure 1 (left): *Carex aquatilis-stans* in flower. Each picture shows one inflorescence.



Figure 2: Locations of Barrow and Atqasuk in Alaska's North Slope. Photo from <http://www.echospace.org/assets/287.html>



Figure 3: Fiberglass open top chamber used to warm experimental plots.

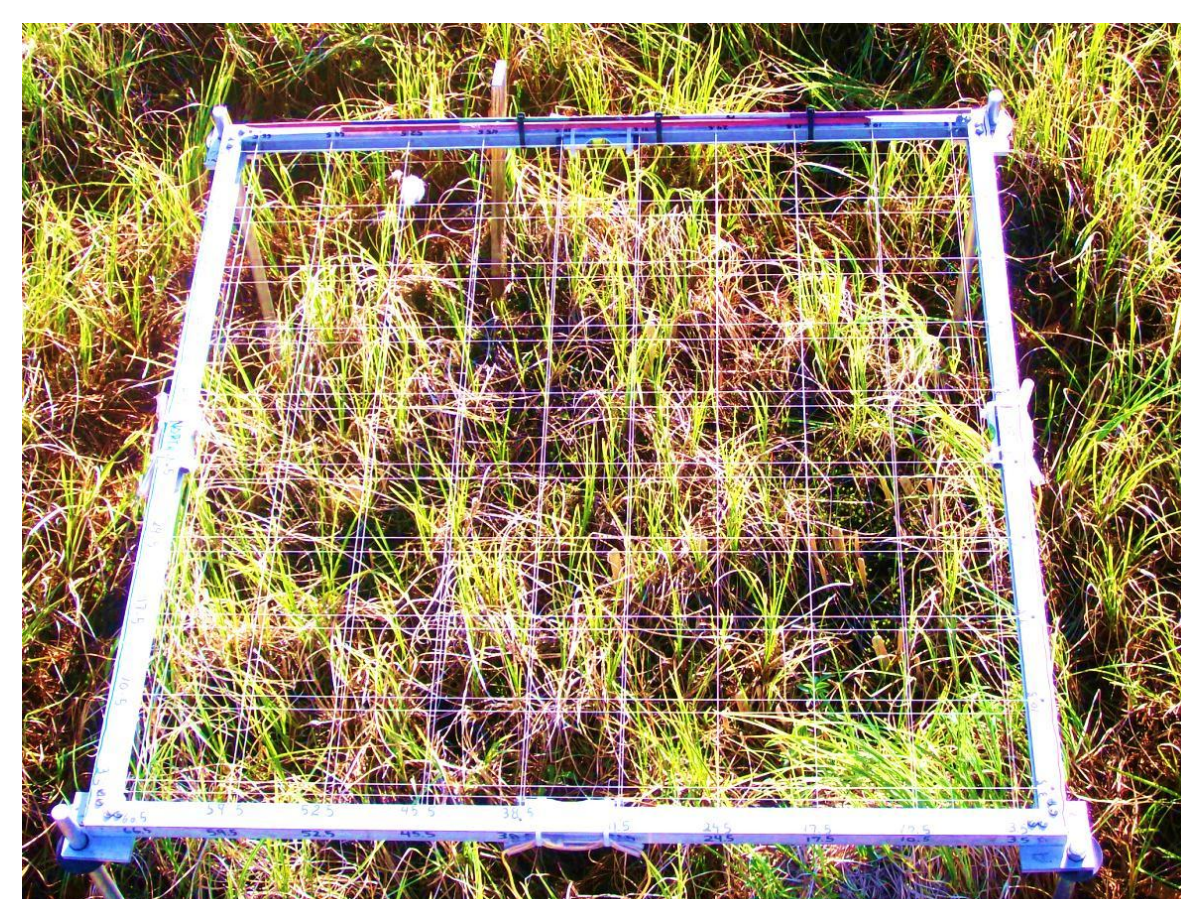
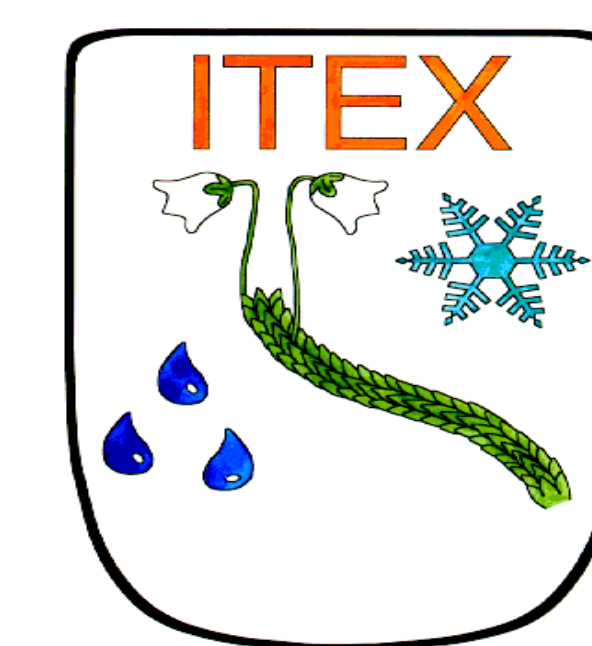


Figure 4: Point frame containing 100 points of intersection. At each point, all species present are identified.



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References

Arft, A. M., M. D. Walker, J. Gurevitch et al. 1999. Responses of tundra plants to experimental warming: meta-analysis of the international tundra experiment. *Ecological Monographs* 64:491-511.

Elmendorf, S. C., G. H. R. Henry, R. D. Hollister et al. 2011. Global assessment of experimental climate warming on tundra vegetation: heterogeneity over space and time. *Ecology Letters*.

IPCC. 2001. *Climate Change 2001: impacts, adaptation, and vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press, Cambridge, UK.