Changes in Plant Canopy Structure in Response to Warming

Jeremy May & Robert Hollister
Biology Department
Grand Valley State University
Climate Change and the Arctic

Climate change affects entire globe
Most pronounced at high latitudes
Warming in the arctic
Documented since the 1800’s
More rapidly since the mid 20th century

(IPCC 2007)
Effects of Warming on Tundra Plants

Even small variations in the environment effect community function
Reproductive effort, growth rates, and nutrient cycling
(Chapin and Shaver, 1985)

Responses to warming are often within one growing season
Graminoids and Shrubs often show the most increased growth
(Arft et al, 1999; Hobie and Chapin, 1998)

Increased growth of these taller strata shifts competitive advantage

Bryophytes and lichens become light deficient and decline in abundance
(Epstein et al, 2004; Wahren et al 2004)
Hypotheses

1. Increase in overall canopy heights for each site with warming

2. All individual functional groups would increase in height with warming

3. Community dynamics will shift to a more closed canopy

- Shrubs
- Forbs
- Graminoids

Nonvascular plants were not compared
Site Locations
Site Setup and Warming

24 Warmed and 24 Control plots
All plots are 1m²
Open-Top Chambers (OTC)
Light enters and traps heat in
Established between 1994-96
International Tundra Experiment (ITEX)
Point Frame Method

Summers of 2007-08
Same 2 weeks each year

Point Frame Grid
- 75cm by 75cm
- 100 points

Measurements
- At each point

Species
Live/Dead Status
Height

(Hollister et al, 2005)
No change in the Atqasuk Dry Site  \( p=0.540 \)

Taller canopy for all other sites  All \( p<0.0001 \)

Wet sites increased the most
Shrub Height

No change in Dry Sites  Both $p > 0.28$

Taller Shrubs in the Atqasuk Wet Site  $p = 0.011$
Forbs were taller in Atqasuk Wet Site $p=0.011$

Other sites had an increasing trends All $p>0.141$
Graminoids were taller All $p<0.02$

Graminoids most influential driving Canopy Height (shown before)
No change in Atqasuk Dry Site

Other sites had more closed canopies

Barrow sites changed the most
Atqasuk Dry canopy opened due to a loss of graminoids

Other sites canopies closed due to spread of graminoids and shrubs
Conclusion

Warming caused:

Overall increase in canopy height
Most growth forms were taller
Overall closing of canopies

- Shrubs: 9% increase
- Forbs: 10% decrease
- Graminoids: Average 28% increase
- Total increase: 11%
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References


Questions?