MONITORING THE RESPONSE OF TUNDRA VEGETATION TO TEMPERATURE AT BARROW AND ATQASUK, ALASKA

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ABSTRACT

The Arctic has warmed and is expected to continue to warm more than other regions of the world. This study examines the potential effects of observed warming on the vegetation by observing the response of tundra plants to variation in temperature due to natural temperature gradients, interannual variability, and experimental warming at four sites experiencing modest warming in northern Alaska (PART A). The project couples long-term monitoring with experimental warming to determine if the changes observed in the region are due to regional warming or other causes. The four sites span a temperature gradient from warmer Atqasuk to cooler Barrow and moisture gradients from dry heat to the first meadows. At each site 24 warmed and 24 control plots have been periodically monitored since the mid-90’s. The common response to warming observed thus far is earlier phenological development and increased growth of graminoids (PART B); however, the response of a plant species is individualistic and may vary among sites. The trajectories of species composition and cover change where not consistent across sites despite a more uniform response to experimental warming (PART C). This may reflect the influence of driving factors other than temperature or the resistance of the plant community to change. Overall the project is finding that warming is one of many factors likely responsible for the observed vegetation changes occurring in northern Alaska.

PART A.
The Barrow Dry site began in 1994 and the Wet site in 1995. Both Atqasuk sites began in 1996. The project was established under the umbrella of ITEX (International Tundra Experiment; a collaborative network of researchers examining the response of tundra vegetation to warming) and the sites have been included in every major ITEX cross site synthesis. The region has shown a slight warming trend over the course of the project.

PART B.
The plants at Barrow and Atqasuk appear to be responding to regional warming. We say this because the observed changes occurring in the control plots are in many ways similar to the observed response to experimental warming. We have shown previously that the experimental warming is a reasonable analog of regional warming. The timing of flowering appears to be advancing for the region as a whole (FIG 3A) and the response to experimental warming is consistently earlier flowering (FIG 3B). The observed trend for the region has been an increase in the length of graminoid inflorescences and leaves (FIG 4A/4B, leaf data show the same trend but are not presented) and the response to experimental warming is increased graminoid growth (FIG 4B & 4C). Other responses to warming are less consistent across species and are difficult to generalize. Since the response to experimental warming is similar to the observed trends for the region, we believe the underlying causal factor is the same—warming. Thus it appears that the plant species at Barrow and Atqasuk are responding to a the slight warming trend observed for the region with earlier flowering and increased growth of graminoids.

PART C.
Plant community change was monitored by point framing (FIG 5). The response to warming can be generalized as an increase in community stature due to an increase in growth and abundance of shrubs and graminoids at the expense of lichens and bryophytes which overall results in a decrease in species diversity (FIG 6, TABLE 1). These changes are consistent with earlier studies. However the changes that have occurred in the control plots are much less consistent and do not show an obvious similarity to the response to experimental warming. Thus it appears that the factor driving community change is different at each of the sites.

LITERATURE CITED


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