

# Fluctuation in plant growth and in reindeer populations in Svalbard

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## *Expanded abstract:*

### **Introduction**

The rate of increase of populations of reindeer in Svalbard fluctuates greatly between years. Snow and ice conditions in winter are widely believed to be the principal proximal factors responsible for declines. Recent analysis of climate records and mortality data, however, shows that rates of death from starvation in late winter are correlated with climate in the preceding summer. We suggest that plant production in summer has an important influence in the abundance of winter forage and, consequently, on reindeers' survival. This prompts two questions: first, does plant growth vary significantly between years in Svalbard? and second, what factors affect growth?

### **Methods**

Between year variation in plant productivity was measured in *Cassiope tetragona* collected from Adventdalen, Spitsbergen in July 1987. This species, which is not eaten by reindeer, can be used as phytometer, in a way similar to

dendrochronology, because annual increments of growth can be identified on the shoots. Annual growth was assessed by measuring the number and length of leaves in strict sequence along individual shoots. An historical record of growth over the last 20 years was established by this means.

### **Results**

Plant growth in Adventdalen varied considerably between years. Two sorts of variation were apparent in *C. tetragona*: first, variation in the number of leaves per year (range = 4 - 20 leaves) and second, variation in the size of those leaves (range = 1 - 8 mm). Annual leaf performance was positively correlated with both mean July temperature and precipitation in May. Interestingly, however, the total length of a given year's complement of expanded leaves, corrected to remove developmental trends, also correlated with the number of leaves produced in the preceding year. Furthermore, correla-

tions between leaf performance in a given year and weather conditions in the preceding year were also often significant.

## Discussion

Positive correlation between growth of *C. tetragona* and precipitation in May, which normally falls as snow in Svalbard, suggests that snow cover is important in protecting sensitive shoot apices from late frosts.

Correlation between leaf performance in successive pairs of years indicates that leaves are pre-formed in the year before they expand. It may reflect an important mechanism to buffer production against vagaries of weather during the short growing season in the high arctic (Callaghan, Carlsson and Tyler, 1989). This may also occur in some forage species.

## Conclusions

Retrospective analysis of the past growth of long-lived plants is a good tool for investigating relationships between plant performance and environmental factors such as weather. It is likely to be particularly useful in areas where, therefore, traditional techniques (e.g. clipping quadrats) are impractical over long periods.

In many parts of Svalbard, reindeer eat mainly vascular plants and mosses, not lichens, in winter. Substantial variation in plant production between years, as demonstrated here, together with variation in the availability of forage, is therefore potentially likely to have an important influence on the potential abundance of forage in winter and, hence, survival in reindeer. This aspect of the ecology of Svalbard reindeer has hitherto been largely ignored.

Correlation analysis of plant growth and climate is in progress and trends of plant productivity will be related to patterns of reindeer mortality.

## Reference

- Callaghan, T.V., Carlson, B. and Tyler, N.J.C.  
1989. Historical records of climate-related growth in *Cassiope tetragona* from the high arctic.  
- *Journal of Ecology* 77:823-837