Changes along an altitudinal vegetation gradient in Southern Norway during 70 years

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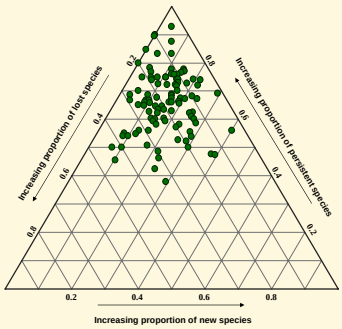
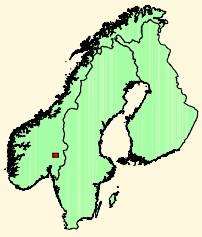
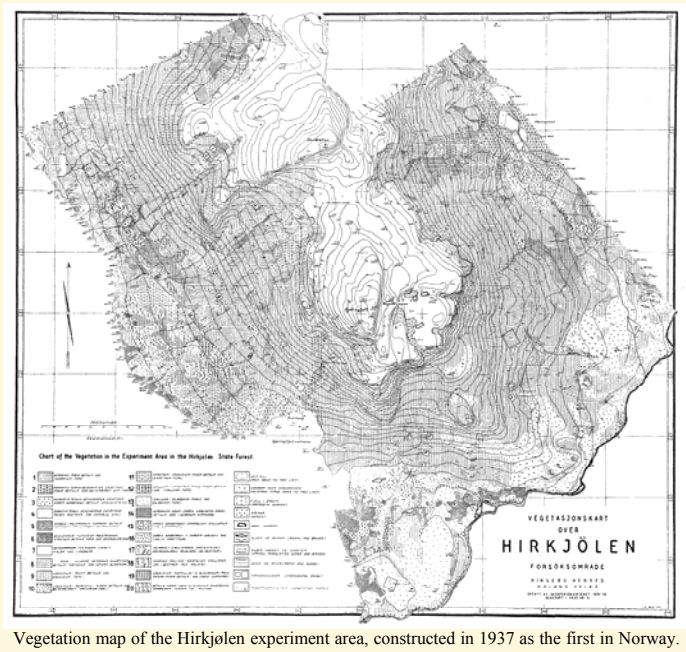
North boreal forests cover a large proportion of the Norwegian land surface. The predicted anthropogenic climate changes are supposed to influence these areas. In order to evaluate whether such processes already may occur, consistent historical data has high relevance. In this project we want to repeat a botanical investigation from the 1930's to identify vegetation changes and their relation to climatic factors.



Only small changes in α-diversity were observed. The mean number of species recorded per plot was 37.3 in the 1930's, compared to 35.7 in 2005. However, the species turnover was rather high (on average 19%, see diagram above), reflecting the dynamics in species composition.

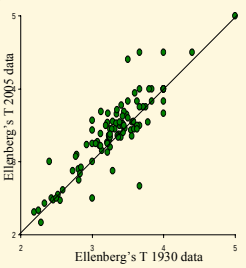


The Hirkjølen experiment area is located in the central part of South Norway, ca. 200 km north of Oslo (62° N). The experiment area comprises 1153 ha of mountain forest and 273 ha of mountain heath, ranging from 740 to 1160 m asl. The research area was established in 1930, and a thorough survey of vegetation, soil and timberline was established. Within the area a lot of silvicultural experiments and local metorological measurements have been carried out.



Vegetation map of the Hirkjølen experiment area, constructed in 1937 as the first in Norway. In the 1930's 347 plots of 100 m2 were systematically distributed for every 200 meters. Within these plots vegetation analyses and tree measurements were performed in 1932/1933. Our project is based on repeating these analyses 70 years later. So far 100 of the plots have been reanalyzed.

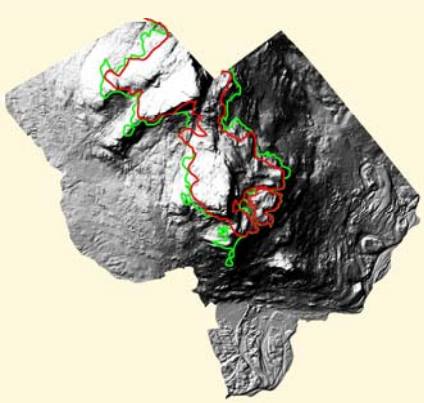
The map also shows the tree line and the forest limit. We have georeferenced the map in order to record potential changes in their position.



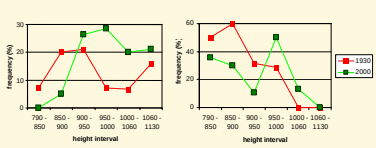
Preliminary analyses based on Ellenberg's indicator values reveal that temperature and light are the main causes for changes in species composition.

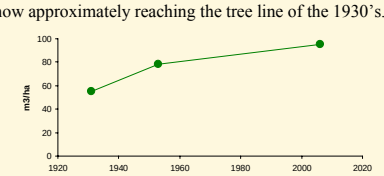
Temperature has been recorded from June to September at several local meteorological stations at different altitudes (800 and 1060 m a.s.l.) over periods from 35 to 25 years between 1932 and 1966. Two of these stations with long term observations have been re-established in order to reconstruct the microclimatic time series up to the present. We will relate these measurements to the elevation model as a tool for better understanding of changes in forest limit, tree line and vegetation dynamics.

The alpine meteorological station (1060 m asl, established in 1930); photo from 1960 (above) and 2006 (below). The pictures clearly demonstrate that the mountain birch forest has expanded upwards.



Section of orthophoto from 2004, with the forest limit (white line), the tree line (green line) and some of the permanent plots (dots) which were mapped in the 1930's. Preliminary results, based on field work and image analysis, indicate that the forest has expanded upwards, now approximately reaching the tree line of the 1930's.





The standing volume of trees in the plots have increased during the period.

The mountain forest vegetation varies from dry, lichen-dominated types to herb-rich mesophilous types.

- The species composition have remained relatively constant during the period of 70 years
- The observed changes in species distribution show relation to climate (as shown by Ellenberg's T and the tendency for several species to "climb upwards"). However, other factors (e.g. reduced grazing, forestry and natural dynamics) probably also cause vegetation changes, and it is hard to separate the climatic effects from these.
- The climatic effects may hopefully be better understood as more plots have been analysed, and as the local meteorological data set is included in the analysis.

This poster was presented at the 49th Annual Conference of the International Association for Vegetation Science, arranged in Palmerston North, New Zealand 12 - 16 February 2007. This project is financed by the Norwegian Research Council (CRIBE, grant no. 165035/S30)and the Norwegian Institute for Forest and Landscape. Photographs by Kristian Bjor, Bjørn Tveite and the authors. Thanks to Bjørn Tveite, Per Arild Aarrestad, Ingvald Røsberg, Bernt Håvard Øyen and other cooperators in the project. The Hirkjølen Eksperimental Area is included in the European Network for long-term Forest Ecosystem and Landscape Research (ENFORS).

Project homepage: http://www.hirkjolen.no/cribe
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