Is there a correlation between human induced fires and gradual changes in vegetation and forest decline at Lygra, Hordaland?

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By using two proxies, soil macrofossil charcoal and pollen, estimations of how regular burnings of heathland has influenced vegetation types and forest line through time can be made. Our findings indicate that these burnings might have made an impact, and that a human-inflicted change in vegetation might be real.

ABSTRACT

By taking samples using a Russian corer, traces of burnings of heathland can be observed. These burnings have been done quite regularly as a controlled way to adjust the vegetation for better grazing, presumably for sheep. Pollen analysis indicates that there has been changes in vegetation in the mire where samples were taken, which might be a result of regular burnings of heathland. Research was done to see whether the burnings also could have caused a change in forest line.

The results show that after the burnings started at a depth of 263-264 cm, there were slight changes in vegetation, but not to the degree that was expected, and without a clear transition from forest to mire.

Figure 1: Measurements are being made before samples are taken with a Russian corer.

INTRODUCTION

There have been burnings of heathland in Western Norway for about 5000 years (IFFN, 2009). Burnings helped clear the land for grazing, and controlled the successions of *Calluna vulgari* This caused the *C. vulgaris* to stay in a pioneer phase, and this way the plant would be available for sheep. Since this clearing opened the forest, the land would also increase in humidity caused by less trees for absorption of water, and a mire could form.

To understand how gradual vegetational changes have occurred through ages, methods like pollen analysis and mapping of proxies like soil macrofossil charcoal to identify burnings is of good use, and can contribute to shed light on how these changes appear. By understanding these changes, predictions can be made for the future, which enables us to understand more of how agriculture can influence the vegetation and turn it into cultural landscapes.

Our intentions for this analysis is to see whether or not we will be able to use our two proxies to identify a vegetational change at Lygra, Hordaland, Norway. The change we are looking for, is the transition from forest to mire, and can be observed by pollen from *Sphagnum spp., Betula* and *Alnus* (Prøsch-Danielsen & Simonsen, 2000).

Some of these transitions could be observed in our core samples, but not to the extent we were aiming for. Charcoal layers from burning of heathland was identified at several depths, and these layers did to a small degree correlate with the vegetational transitions we were looking for.

REFERENCES

Krahulec, F., Skálová, H., Herben, T., Hadincová, V., Wildová, R., & Pecháčková, S. (2001). Vegetation Changes Following Sheep Grazing in Abandoned Mountain Meadows. *Applied Vegetation Science* [Internet] *4*(1), 97-102. Available from http://www.jstor.org/stable/1479041 [Downloaded 05/10/2016].

Kvamme, M. & Kaland, P.E. (2009) Prescribed Burning of Coastal Heathlands in Western Norway: History and Present Day Experiences. *International Forest Fire News* [Internet] 2009 (38). 35-50. Available from <http://www.fire.uni-freiburg.de/iffn...> [Downloaded 05/10/2016].

Prøsch-Danielsen, L. & Simonsen, A. Veget Hist Archaebot (2000) Palaeoecological investigations towards the reconstruction of the history of forest clearances and coastal heathlands in south-western Norway. *Vegetation History and Archeobotany* [Internet] 9 (4) 189-204. doi:10.1007/BF01294634

METHODS

The site was located by the Heathland Center at Lygra in Hordaland, Western Norway. Lygra is known for its past with agriculture and peat-farming of the heathlands (IFFN, 2009, p.35). Samples were taken from a mire with a 50 cm Russian corer (figure 1 and 2).
The depths from 250 cm to 350 cm were used for our research. After the cores were taken, they were analysed for structure and texture with the method of Troels Smith (1955), mostly to find out where the charcoal layers from the heathland burnings were. Pollen analysis were then used on the samples from the core, using a light-microscope with 40x magnification to identify important species (for example *Betula, Sphagnum spp.* and *Alnus*) for indicating forest or heathland vegetation. Only approximately one hundred pollen-grains were counted in each sample.

Figure 2: Sediment samples being taken with a Russian corer.

RESULTS

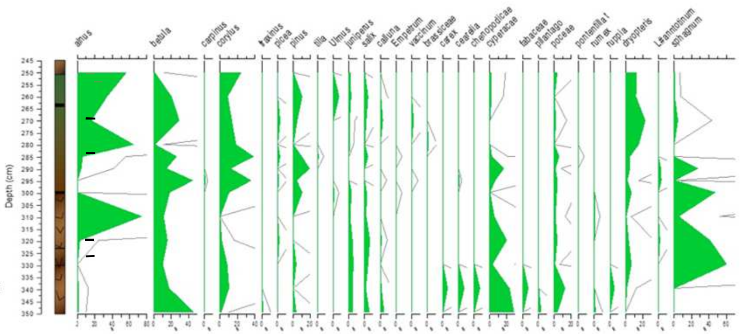

Figure 3: Pollen diagram showing results from analysis on Lygra, Depth includes 250-350 cm. Bar next to depth shows lithography, where fibrous sediments are marked with black "v"-s. Findings of charcoal layers are marked with black lines, and transitions between vegetational types are marked with grey lines. Pollen percentages (green) are based on a sum of total terrestrial pollen, and the grey unshaded curves are a 10x exaggeration.

28 different pollen taxa were identified from 13 different levels spaced 5-10 cm apart in depth. The green curves in figure 3 shows that at a depth of 350 cm *Betula* dominates until a decline when *Sphagnum* and *Alnus* becomes dominating.Traces of other pollen were found throughout the sample. *Dryopteris* reaches its maximum after a decline in *Sphagnum.*

There were burnings at depths of approximately 330, 323, 300, 285, 270 and 263-264 cm (figure 4). *Cyperaceae* decline begins after the first burning at 300 cm, then there's an incline in the same species until the next burning at 285 cm. There are declines in *Alnus*-pollen where the burnings occur, and to a small degree this also counts for *Betula* and *Corylus.*

At a depth of 350 cm, species like *Betula* and *Cyperaceae* dominates. There is a decline in both species after the first burning, at a depth of 323 cm. *Cyperaceae* reaches a new peak short after the second burning, at a depth of 320 cm, before it again declines after the next burning (300 cm). This continues until the burning at 285 cm, where *Cyperaceae* doesn't make a strong comeback.

Figure 4: Part of the core sample, with black parts showing the charcoal-layers.

DISCUSSION

As figure 3 indicates we have had vegetational changes. But we can not see a declining forest as expected. There have been an increase of tree-pollen after the first burning, which doesn't quite correspond with our expectations of finding a decline after the burnings. At the same time, trees like *Alnus* produce big amounts of pollen, so it could be possible that some of the pollen comes from airborne pollution.

In our analysis, we only used two proxies; soil charcoal macrofossils and pollen. To gain a more representative result, more proxies should have been used. Also, the results from the pollen analysis should have been calibrated using megafossils to further understand whether or not some of the pollen from various trees actually are a result of airborne pollution from a nearby site, like mentioned above.

Prosch-Danielsen and Simonsen (2000) identified patterns in the pollen diagrams for the transition between forest and heathland in other locations in Western Norway, and our results fit well to stage A of this pattern as *Alnus* and *Betula* are dominating in figure 3. Since *Alnus* produces a lot of pollen, calibrations may reveal the transition clearer. At the same time, there is less traces of *Sphagnum* in the upper parts of the core than what was expected, even though there might have been other vegetational types at a depth of 250 cm than there is today. Further research could be made by doing pollen analysis of the depths above 250 cm, to see whether this part of the core fits better to our expectations of finding a mire. On the other hand there is an increase in *Dryopteris*, which indicate an increase in humidity, and therefore maybe show traces of mire after all.

Even more research could include getting the transitions from forest to mire and the burnings dated, and compared to transitions in other heathlands in Norway, for example using the research mentioned above. This could tell us whether or not the transitions are likely to be caused by human influence, or if they are a result of climate change.
One possible error in our research could be a lack of knowledge about species when doing the pollen analysis. The pollen could belong to other species than what was classified in the laboratory. Pollution of the core samples could also be an error, especially since the samples were transported quite far after the sampling. It should also be taken into consideration that only about one hundred pollen-grains were counted in each sample, and that the analysis was done by three students. One hundred was probably not enough to get a good result, and also countings could have been done differently between the students.

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