JAMES RENNIE BEQUEST

REPORT ON EXPEDITION/PROJECT/CONFERENCE

~~Expedition~~/Project/~~Conference Title~~: 'Study of Trace Gas Fluxes in Arctic tundra'

Travel Dates: 15th July 2004 to 27th August 2004

Location: Abisko, Sweden

Group Member(s): Kerry Dinsmore

Aims: To study carbon fluxes over different vegetation types in the Swedish tundra and to compare these results with a parallel study carried out at Toolik lake, Alaska.

OUTCOME (not less than 300 words):-

Carbon fluxes were measured using a 1 m^2 chamber and an attached CO_2/H_2O gas analyser over numerous vegetation types, such as *Betula nana*, *Salix glauca* and tussock tundra. At each plot, cover was estimated, soil temperatures measured and 'Normalised Difference Vegetation Index' (NDVI) was measured using a Skye sensor, this data can be used to estimate leaf area index (LAI) . A 20 × 20 cm area was harvested within each plot and later the above ground biomass was sorted into species and then into this years growth and last years growth. The dicotyledon leaves were scanned to obtain a value for LAI. The data collected over the field season has yet to be analysed though is intended to be used directly in a number of different papers. The results will also add to a base of knowledge that is being built up on the function of circum-polar tundra ecosystems and may lead to further research ideas.

During my time in Sweden, I also had the opportunity to work on my own honours project currently titled 'How is the 'leaf area index' of a *Betula* forest affected by an outbreak of the moth *Epirrita autumnata*?'. *Epirrita autumnata* larvae feed on the leaves of the mountain birch, *Betula pubescens* and in years of extreme outbreaks can completely defoliate large areas of the forest. When viewed from a distance it becomes clear that the areas affected by the outbreak take on a patchy distribution. Mapping the distribution of defoliated patches over a topographic map may uncover a predictable pattern, for example related to low-lying areas or frost hollows. The defoliation of large areas during the summer months when the forest canopy would usually be at its fullest will decrease the LAI over large areas and therefore may have a significant effect on the NEP of the landscape. By using the LAI data in a NEP model I should be able to detect by how much the *Epirrita* damage will affect the area's productivity.

The under-storey throughout most of the forest is dominated by *Empetrum hermaphroditum*. Other major species include *Vaccinium myrtillus, vitis-idaea,* and *uliginosum*, *Juniperus comunis, Salix glauca* and *Betula nana* and to the lesser extent *Astragalus alpinus, Equisetum arevense, Actrostaphalous alpinus, Saussurea alpina, Bartsia alpina* and *Epilobium angustufolium*. The under-storey vegetation in particular the *Empetrum* also appears to have been damaged by the moth outbreak. Throughout the summer season, both the *Betula* canopy and the under-storey appear to have produced new growth to compensate for the *Epirrita* damaged leaves. By using a 'Normalised Difference Vegetation Index' and looking at the ratio of brown to green *Empetrum* leaves I hope to be able to both quantify damage and re-growth and gain a further understanding on of how the vegetation reacts to such insect disturbances.

The study was carried out in the forest with fish-eye photographs being taken at regular 100m intervals, capturing the birch canopy. A 'Skye' sensor was then used to measure the NDVI of the under-storey. Both

the photographs and the under-storey NDVI values will be used to calculate the LAI of the vegetation. At each sample point the canopy damage was estimated on a scale of 1-5 (5 indicating complete defoliation) and the dominant under-storey species were recorded.

Once this data had been collected, three areas where identified which sprawled over a roughly equal area of each of the various damage levels. At 10 sites within each area, a 20 × 20 cm plot of *Empetrum* was studied. Firstly the NDVI was recorded using the 'Skye' sensor, any evident re-growth was then picked off and a second NDVI reading taken. The remaining *Empetrum* was harvested and returned to the lab to be dried. At each site, a visual assessment of the re-growth in the above *Betula* canopy was also made. The *Empetrum* re-growth was classified as any new growth beyond a point of apical death; the re-growth on the *Betula* was identified by being lighter in colour, more curled and slightly furrier than the older leaves. Another identifying feature of the canopy re-growth is that it appeared completely untouched amongst semi-eaten or dead leaves.

The dried *Empetrum* will now be separated into green and brown leaves and weighed. The ratio of green to brown and the weight of re-growth will then be compared across different grades of canopy damage.