Scientific report CLIMMANI Short Visit Grant 2012

Project title: "Microbial community structure and function along a natural soil warming gradient"

Applicant: James Weedon, Institute of Ecological Sciences, Vrije Universiteit Amsterdam (VU)

Host:Prof. Bjarni Sigurđsson, Agricultural University of Iceland (AUI)

Purpose of the visit

This short visit was carried out to initiate cooperation between scientists from VU Amsterdam and the AUI in the framework of the FORHOT research network, and to carry out initial soil sampling for the first phase of this collaboration.

Understanding the effects of climate change on ecosystem function requires knowledge about how soil processes respond to altered temperature and moisture regimes. Most important soil processes are carried out by the soil microbial community, the vast phylogenetic and functional diversity of which has come to be appreciated in the last two decades with the development of cultivation-independent molecular methods. Mechanistic understanding of the response of terrestrial ecosystems to climate change will have to be based on knowledge of the response of microbial community structure and function to changes in temperature and moisture. This knowledge is still limited, but essential e.g. to interpret the outcomes of climate manipulation experiments.

A recent earthquake (May 2008) at the locality of Reykir close to Hveragerdi in SW Iceland has resulted in a unique "natural experiment" of soil warming. An area which was previously undisturbed now lies over a geothermal heat source, resulting in a gradient of soil temperatures from ambient to + 50°C over a distance of less than 100m. Given the difficulty of experimentally manipulating soil temperature this provides a unique opportunity to study the effects of soil temperature on above- and below-ground ecological processes. The results of such studies will contribute to our understanding of terrestrial ecosystem responses to climate change. The FORHOT research group was established to coordinate international research at this site.

My PhD research (since 2006) has focussed on the effects of experimental climate change manipulations on soil microbial communities in sub-arctic Sweden and their associated functions, particularly nitrogen cycling. We apply molecular techniques to characterize soil microbial communities and investigate their responses to changes in microclimate. The FORHOT field site represented an ideal opportunity for me to extend this experimental work to a new, but similar system. Thereby adding value to my current PhD project research, and at the same time allowing the reciprocal sharing of skills and ideas with researchers in Iceland.

Work completed

Four main tasks were completed during the Short Visit:

1) I assisted Prof. Sigurdsson in mapping soil temperature at two locations at Reykir (a spruce plantation and an open heathland). These maps allowed us to establish four replicate transects at each site, each transect following the soil temperature gradient from ambient to + 40 °C.

2) With Edda Oddsdottir (Iceland Forestry Research) I prepared reagents and set up and tested lab facilities for the extraction of microbial DNA from soil and subsequent validation of the quality of extractions.

3) At each of the two sites, soil samples were taken at 10 (spruce forest) or 9 (heathland) locations per transect, resulting in a total of 76 soil cores spanning the full range of soil temperature at each site. DNA was immediately isolated from each of the samples for future molecular analysis and the remaining material was transported to The Netherlands where it will be used by FORHOT collaborator Anne Daebeler (PhD student, NIOO-KNAW) to measure ammonia nitrification and the community structure of the microbial nitrifying community.

4) I met with scientists from Agricultural University of Iceland, and Iceland Forest Research to plan the current work and discuss future opportunities for collaboration. In addition I gave a presentation of my research to an audience of local scientists and students.

Preliminary results

Sufficient quantities of good quality DNA were successfully isolated from the soil samples. This is shown by the Nanodrop traces in **Figure 1**. This shows the absorbance spectra of a random selection of DNA extracts – peaks at 260nm show good quality DNA, and the area of the peak is proportional to the DNA concentration. In our case between 10 and 150 ng per microlitre. This is more than enough to continue with the planned analyses (16S amplicon pyrosequencing and/or taxononomic and functional gene quantitative PCR). These analyses will be conducted over the next few months and will result in a paper as well as provide information for future, targeted sampling and/or experimental work related to FORHOT.

Soil samples are also currently being measured for soil moisture, pH nitrification activity and nitrifier community structure by Anne Daebeler at NIOO-KNAW (Wageningen, Netherlands). This data will contribute to her thesis research and most likely result in a manuscript.

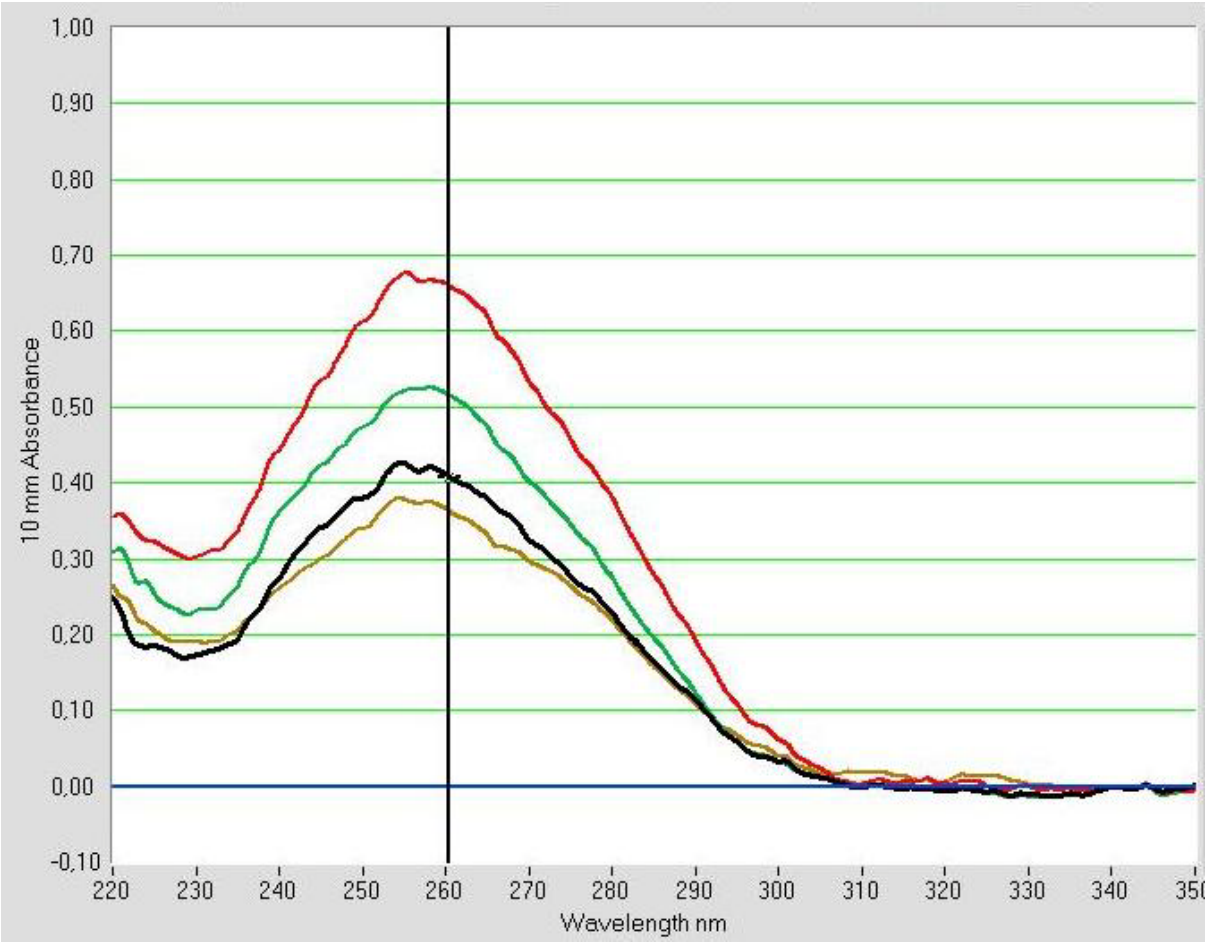

Figure 1 Absorbance spectra of DNA extracts from Reykir soil samples. Peaks at 260nm represent good quality nucleic acids. Concentrations between 10 and 150 ng per microlitre were found (in 50 microlitre extract).

Future collaboration

Both myself and my supervisor Peter van Bodegom (VU Amsterdam) will continue collaboration with AUI as partners in the FORHOT research network. This could include joint grant applications and/or setting up MSc student projects to conduct further field and molecular work. As molecular data from the current field campaign are generated we will also be collaborating with scientists from AUI and Iceland Forest Research in writing and preparing manuscripts for publication (see below).

Projected publications (in international peer-reviewed journals)

Weedon, Sigurdsson, Oddsdottir, van Bodegom *et al.* (2013) Soil bacterial community structure along a geothermal soil warming gradient *In Preparation*

Daebeler *et al.* (2013) Ammonia nitrification and nitrifier community structure along a temperature gradient in geothermal forest soils *In preparation*