Call for collaboration

Globally assessing the impacts of disturbances on montane soil diversity and function

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Background: *Understanding how changes in biodiversity are related to changes in function is a critical challenge, especially in a time of global change. Mountain ecosystem services are susceptible to climate change and exposed to intensive human management. Mountains occupy 16.5 % of the earth surface (Körner, Paulsen & Spehn 2011) and are characterised by steep vertical gradients. Across these gradients and mountain ranges snow depth and temperature fluctuations widely with climate change generally leading to reduced levels of snowpack, lower levels of soil moisture (Mote et al. 2005), and fewer freeze-thaw events, and/or warming temperatures altering seasonal timing (Seager and Vecchi 2010). Montane gradients are often overlaid with gradients of land use intensity. While intensive forms of land use are essential for humans to obtain natural products such as food and fibre, they have contributed to the transformation of ecosystem patterns and processes (Foley et al. 2005). In particular, human activities have altered the rate, pathways and efficiency of the movement of nutrients within and between the various biotic or abiotic ecosystem compartments. For example, herding animals mobilize essential nutrients stimulating primary productivity and enhancing decomposition as grazers remove vegetation and deposit faeces on soil surfaces. Further, humans harvest remove nutrients as food and fibre causing N mineralization rates to decline. These changes do not only affect today's ecosystem functioning mediated by soil but may also result in long-term legacy effects on ecosystem processes, thereby changing the resilience of ecosystems and their adaptive capacity to sustain ecosystem services in the face of uncertainty and global change (Folke et al. 2002; Elmqvist et al. 2003; Carpenter et al. 2009). The effects of climate change, in particular, a decrease in soil moisture and increase in temperature, may only enhance the degree land-use alters ecosystem form and function. While our understanding of montane ecosystems is critical for maintaining global patterns of biodiversity and ecosystem functioning, our ability to quantify the biodiversity in these regions and predict how changes in biodiversity alter important ecosystem functions in a changing climate remains limited.*

Aim: To collect soil samples across the mountain ranges in the GNOMO to assess the impact of land-use and climate change on links between microorganisms and ecosystem function. We will take advantage of mountains exemplifying "natural experiments" permitting testing ecological theories (Körner 2007) and the wide range of mountain system in the network. Moreover, depending of the number of sites across the network and access to weather data, we can draw insights on the impacts of climate change on soil microbial diversity and soil functioning. We will analyse bacteria, fungi, and soil fauna (e.g., nematodes, tardigrades, and mites) using 16S and 18S rDNA target-metagenomics and mid/near infrared spectronomy and measure multiple ecosystem processes. The molecular analysis will identify baseline changes in soil biota, specific bacterial clades influencing certain ecosystem functions such as methanogenesis and nitrification, and offer a functional profile of the bacterial genes influencing processes through Phylogenetic Investigation of Communities by Reconstruction of Unobserved States (PICRUSt; Langille et al., 2013). Disturbances are often linked to changes in biodiversity and ecosystem function with the loss of functioning related to the abundance of specific soil biota and the intensity of the resulting belowground stresses (Brussaard et al. 1997; Muller et al., 2002). We propose, based on the below described approach and by building on the GNOMO, to test the hypothesis that shifts in soil biodiversity are linked to key soil functions (i.e., C mineralization, N mineralization, and nitrification) and landuse (as a disturbance) will disrupt these links. We expect the effects on climate changes (e.g., decreasing snow pack or increasing temperatures) will only serve to disrupt potential links between form and function.

What we need: Soil samples collected from six sites located at three elevations along a gradient. Three sites should be undisturbed (low, mid, high elevation) and three samples in a disturbed area (low, mid, high elevation). The elevations should be 500 m apart (equal to ~2 C warming). Thus, there should be three pairs of samples. As "undisturbed" we consider any site without direct human impact (in other words, sites that are not used or used only by wild animals in appropriate densities); we assume climate change or nitrogen deposits as background for the different sites, while "disturbed" environments are characterised by human utilisation: pasturing domestic animals, trampling, grazing, or biomass harvesting. Participants are welcome to sample more than one gradient, but in this case, a minimal distance between the gradients should be respected. At each sample site, participants will extract 5 soil cores (0-5 cm, and where possible a second set of cores, 5-15 cm depth). These subsamples will be pooled by depth and approximately 30 grams will be frozen (-20°C) and the remaining soil will be stored at 5°C and sent for analysis to France and USA. A detailed protocol is currently in preparation and will be send to all participants along with sampling supplies and mailing instructions.

If you are interested in participating, please fill in the following form by **MARCH 1st, 2016**:

http://goo.gl/forms/7FzzkoDs6q

You will need to provide the following information:

(1) Name and contact information of participants from your site
(2) Location of study site (lat, long)
(3) What are the main disturbances your ecosystems?

Once we have this basic information, we'll adjust the protocol (if necessary) and send out detailed information about how to sample, how to store, etc. and the following steps. The proposed sample time is the middle of the period between snow melt and first snow fall (e.g.,for European Alps this would be June/July).

Kind regards

Thomas, Aimee & Zach