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Peatland carbon cycling at a Scottish wind farm: the role of plant-soil interactions

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Peatlands play a fundamental role in the terrestrial carbon cycle by storing 1/3 of the world's soil carbon (Limpens *et al*. 2008). In the UK, peatlands are often located in areas with potential for electricity generation by harvesting wind energy. Concerns have been raised, however, over the stability of these carbon stocks when large scale wind developments are sited upon them.

This project aims to improve understanding of the impact of wind farms on carbon sequestration in peatlands. Wind turbine 'wake-effects' can alter microclimatic conditions, as a result of significant differences in air temperature, humidity, wind speed and turbulence (Baidya Roy and Traiteur 2010). These changes are likely to have a significant impact on above and below ground abiotic conditions and biotic properties, together with the processes they regulate that govern peatland carbon cycling. Specifically, the effects of interactions between typical peatland plant functional types (graminoids, bryophytes and shrubs) (Ward *et al*. 2009) and peat microbial community composition and function are poorly resolved.

We examined a spatial gradient across an area of blanket bog at Black Law wind farm (Lanarkshire, Scotland) and executed a series of controlled mesocosm experiments to examine the impacts of potential microclimatic changes on plant-soil interactions and carbon sequestration processes. In particular we focused on the form and function of plant and microbial communities as determinants of decomposition (Ward *et al*. 2010) and greenhouse gas (GHG) emissions (Artz 2009).

Measurements of plant-litter-soil carbon, nitrogen, microbial community composition (i.e. phospholipid fatty acid biomarkers) and litter mass loss have been made across the wind farm peatland to attribute spatial variance in biotic and biogeochemical properties. In addition, multi-factorial mesocosm experiments have been made to determine how abiotic and biotic changes caused by wind farm effects could influence peat GHG emissions. These experiments used intact peat cores to assess the interacting effects of temperature, water table and plant functional type on GHG fluxes and rates of peatland plant litter decomposition.

Results show significant differences in soil chemistry and microbial community composition across the wind farm gradient with few seasonal effects. Findings from controlled mesocosm experiments offer evidence that CO_2 and CH_4 fluxes were significantly altered over a 4°C temperature range at three different water table heights. The more anaerobic cores produced greatest CH_4 fluxes, whereas warmer more aerobic conditions favoured CO_2 production. Plant functional types differentially influence emissions, with graminoid cores exerting the greatest control over GHG fluxes. Significant synergistic effects suggest that abiotic drivers are key, yet plant-soil biology interacts to mediate carbon cycling. Thus, changes to plant-soil interactions resulting from wind farm 'wake-effects' could have important implications for peatland carbon sequestration.