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Age-dependent impacts of peatland restoration on the net ecosystem CO_2 exchange of blanket bogs in Northern Scotland

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The Flow Country of Northern Scotland is the largest area of contiguous blanket bog in the UK covering an area in excess of 400 km2. This region is the single largest peat and soil C repository in the UK, and plays a key role in mediating regional atmospheric exchanges of greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH4) and water vapour (H_2O). However, these peatlands were subject to significant afforestation in the 1980s, where large areas of blanket bog were drained and planted with Sitka spruce (Picea sitchensis) and Lodgepole Pine (Pinus contorta), resulting in modifications to micro-topographic features, vegetation composition and soil properties such as bulk density and water holding capacity, all of which are known to influence the production and emission of key GHGs. Since the late 1990s restoration work has been undertaken to remove forest plantations and to restore the peatland areas by raising the water table, predominantly by drain and furrow blocking, in order to encourage the recolonisation of Sphagnum species.

Here we report findings from an eddy covariance study of CO_2 and H_2O exchange from an unmanaged peatland and a chronosequence of restored peatland sites, which were felled in 1998 and 2004. Located within the Forsinard Flows National Nature Reserve in Northern Scotland, these sites are being studied to better understand the key drivers of carbon dynamics in these ecosystems and also assess the age-dependent impacts of peatland restoration on the net CO_2 sink strength. Preliminary data show rates of CO_2 uptake increased with time since restoration, with peak assimilation rates of -9.9 and -14.4 micro mol CO_2 m-2 s-1 measured at the 10 and 16 year old restoration sites, respectively. Carbon losses through ecosystem respiration followed a similar pattern. The data collected to date indicates that while peatland restoration is actively increasing CO_2 uptake at each of the sites, more long-term observational data is required to produce robust carbon budgets and assess the vulnerability of these ecosystems to future climatic change.