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Stable isotopes and Antarctic moss banks: Plants and soil microbes respond to recent warming on the Antarctic Peninsula

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The Antarctic Peninsula is one of the most rapidly warming regions on Earth, with air temperature increases of as much as 3°C recorded since the 1950s. However, the longer-term context of this change is limited and existing records, largely relying on ice core data, are not suitably located to be able to trace the spatial signature of change over time. We are working on a project exploiting stable isotope records preserved in moss peat banks spanning 10 degrees of latitude along the Antarctic Peninsula as an archive of late Holocene climate variability.

Here we present a unique time series of past moss growth and soil microbial activity that has been produced from a 150 year old moss bank at Lazarev Bay, Alexander Island (69°S), a site at the southern limit of significant plant growth in the Antarctic Peninsula region. These moss banks are ideal archives for palaeoclimate research as they are well-preserved by freezing, generally monospecific, easily dated by radiocarbon techniques, and have sufficiently high accumulation rates to permit decadal resolution. We use accumulation rates, cellulose δ13C and fossil testate amoebae to show that growth rates, assimilation and microbial productivity rose rapidly in the 1960s, consistent with temperature change, although recently may have stalled, concurrent with other evidence. The increase in biological activity is unprecedented in the last 150 years.

Along with work completed on Signy Island (60°S), in the South Orkney Islands, in which we used carbon isotope evidence to show recent climate-related enhancement of CO_2 assimilation and peat accumulation rates in Antarctica, the observed relationships between moss growth, microbial activity and climate suggests that moss bank records have the potential to test the regional expression of temperature variability shown by instrumental data on the Antarctic Peninsula over centennial to millennial timescales, by providing long-term records of summer growth conditions, complementing the more distant and widely dispersed ice core records. We will conclude by placing the records into the wider context of the latest progress of analysis of moss bank cores obtained along the length of the Antarctic Peninsula and Scotia arc.

Royles, J., M. J. Amesbury, P. Convey, H. Griffiths, D. A. Hodgson, M. J. Leng and D. J. Charman (2013). Plants and soil microbes respond to recent warming on the Antarctic Peninsula. Current Biology 23(17): 1702-1706.

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