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Trends in ^{13}C discrimination of temperate grassland since 1864

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Elevated atmospheric CO_2 diminishes stomatal conductance of C_3 plants (Ainsworth & Rogers, 2008. *Plant Cell & Environment* 30: 258–270), and this may reduce transpiration and increase continental run-off (Betts et al., 2007. *Nature* 448: 1037-1042). According to our knowledge, it is unknown, if the CO_2 increase in the last century has actually led to such responses in temperate grassland ecosystems. Investigation of ^{13}C discrimination, $^{13}\Delta$, is one way of approaching this question. $^{13}\Delta$ is controlled by c_i/c_a, the ratio of intercellular to atmospheric CO_2 concentration, in leaves of C_3 plants. Accordingly, $^{13}\Delta$ is a quantitative indicator of the leaf-level coupling of CO_2 and transpiration fluxes, and a measure of intrinsic water use efficiency (WUE_i). We analysed the carbon isotope composition (δ^{13}C) of archived vegetation samples from the unfertilized plot of the Park Grass Experiment at Rothamsted, England, to assess changes in $^{13}\Delta$ and WUE_i which have occurred since 1864. δ^{13}C of vegetation decreased from –27.3‰ to –29.0‰ over the last 140 years, following the trend of the δ^{13}C of atmospheric CO_2. Thus, $^{13}\Delta$ remained approx. constant at 20.9‰, meaning that c_i/c_a has not changed, and thus c_i has increased in proportion to atmospheric CO_2 (from $\sim$212 μmol mol^{-1} in 1864 to $\sim$278 μmol mol^{-1} in 2005). In the same period WUE_i increased by 31%. Conversely, yields have not changed between 1891 and 1992 (Jenkinson *et al*. 1994. *Journal of Agricultural Science* 122: 365-374). These results suggest that any CO_2 fertilization effect on canopy photosynthesis was probably off-

set by other factors (such as reduced nutrient availability) and that transpiration has decreased, if the atmospheric vapour pressure deficit has remained unchanged.