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The relative roles of climate and land use in the degradation of a terrestrial ecosystem: a case study from Kjarardalur, West Iceland

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Around AD 870 the virgin environment of Iceland became populated by humans and mammal land herbivores. Since then, the island has lost nearly all of its native birch woodland, resulting in dramatic degradation of landscapes and ecosystems, attributed mainly to over-exploitation of woodlands and late-medieval climate deterioration. As part of policy making in agriculture, a heated debate is ongoing over limitations to sheep grazing in pastures suffering from long-term degradation. In this context the history of climate and land use is of great importance. Those who consider grazing a minimal attribute to land degradation argue that the harsh climate conditions of the little ice age are the primary mechanism behind the current degraded landscape. Others err on the side of caution and propose a careful approach to grazing.
This study forms a contribution to the historical context of the impact of grazing upon the Icelandic terrestrial ecosystem. Using the analyses of pollen and spores from coprophilous fungi as principal methods, we present data about historical environmental change from within two different land holdings in Kjarardalur Valley, West Iceland. One dataset comes from within a landholding governed by the chieftain farm Reykholt, the other comes from within the land of the indipendent farm, Norðtunga. In the past the valley was used primarily as a pasture, associated with shielings (organised seasonal grazing).
Pollen data from the pasture in Kjarardalur Valley, West Iceland, demonstrate a rapid loss of birch (Betula pubescens) woodland from grazing areas owned by the major farm and institution, Reykholt. The suppressive nature of grazing is demonstrated by the expansion of woodland as soon when animal stocks are reduced, probably as a consequence of the bubonic plague after AD 1402. Resumed exploitation of resources eventually depleted all birch woodland from the Reykholt landholding and precipitated soil erosion. The trajectory of environmental change in the adjacent woodland belonging to the independent farm, Norðtunga is quite different. There woodland and landscape stability recovered from an initial period of decline and survived throughout the 11 centuries of land use and unfavourable climate during the little ice age. After c. AD 1700 a significant rise in livestock numbers, particularly sheep, caused a decline in the remaining woodland at both sites. In the case of the Reykholt land holding this led to the final depletion of birch woodland. The research shows that careful land management, perhaps resulting from secular ownership of land, could have minimised the deterioration of terrestrial ecosystems.