

# Ecological impacts of the Industrial Revolution in a lowland raised peatbog near Manchester, NW England

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## Abstract

1. Ombrotrophic peatbogs provide valuable records of environmental change on long timescales but are rarely preserved in an undamaged state near the major centres of industrial activity. Holcroft Moss is a rare example of an intact lowland peatbog in NW England, which provides a valuable opportunity to trace industrial impacts on vegetation in a sensitive environmental archive in close proximity to the early industrialising cities of Manchester and Liverpool. 2. We reconstructed the environmental changes of a Holcroft Moss before and after the Industrial Revolution using a high-resolution record of pollen, non-pollen palynomorphs, microcharcoal, peat composition (organic content, ash-free bulk density) and heavy metal content constrained by a radiocarbon and SCP (spheroidal carbonaceous particle) chronology. We examine the relationship between abiotic and biotic environmental tracers using principal components analysis and evaluate the role of local and regional climatic and anthropogenic drivers using canonical redundancy analysis and partitioning of variation. 3. Results show significant changes in bog vegetation composition during the last 700 years. From the 14th to 18th centuries AD, atmospheric climate variability and local agropastoral disturbance (grazing and fires) were the main drivers of vegetation change. From the mid-18th century onwards, the intensification of regional coal-fired industry contributed to increases in atmospheric pollutants such as dust, heavy metals and acid deposition that severely impacted vegetation, driving the decline of Sphagnum. Grasses subsequently rose to dominance in the 20th century associated especially with cumulative nitrogen deposition. Although atmospheric pollution significantly decreased after the Industrial Revolution, vegetation has not returned to previous pre-industrial conditions, reflecting the ongoing impact of external press drivers which pose challenges for conservation and restoration. 4. Synthesis. Palaeoecological studies are needed to reveal the long-term history of vegetation degradation and to offer guidelines for restoration and conservation practices.

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