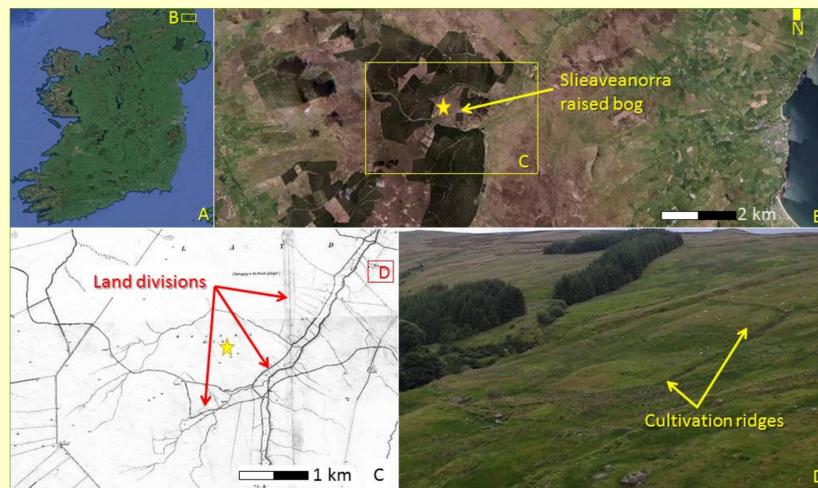


Do sub-decadal climate impacts on human populations leave a detectable legacy in palaeoenvironmental archives? A tephra-dated interrogation of settlement in a marginal environment

1 Introduction

Understanding vulnerability of societies to climate change can be greatly enlightened by looking at past impacts of climate change and the adaptive responses of populations to various changes. Historically, extreme weather events are known to have had devastating effects on human populations, leading to mass mortalities and migrations. **But do such impacts have a temporal legacy sufficient to be detected in the typically decadal to multi-decadal resolution of most palaeoenvironmental records?** Here we examine the palaeohydrological and land-use history of a marginal upland area in northeast Ireland during a period of known climate, environmental and demographic crises.



2 Study area

Slieveanorra Bog lies within a raised and blanket bog complex 300 m above sea level in the Antrim uplands, NE Ireland (Fig. 1). Today, the nearest settlements are located below 200 m, and the area is used solely for forestry and sheep grazing. Abandoned houses and field systems are testimony to settlement in the area in the past.

◀ **Figure 1.** A) Location of study area. B) Location of Slieveanorra Bog, illustrating distance of main settled areas today (green zones). C) First edition (1830s) of Ordnance Survey map showing presence of land divisions surrounding Slieveanorra Bog. D) Relict field enclosures and cultivation ridges near Slieveanorra. Yellow star = coring site.

Key events AD 1000-2000

Short-term environmental events

Irish annals record frequent episodes of extreme weather (cold, wet, drought, stormy) the most notable of which include wetter summers 1315-7; Great Frost 1739-40

Long-term climate oscillations

Medieval Warm Period; Little Ice Age (pulses in 13-14th, 15-16th and 18-19th centuries); Modern warming

Global/hemispheric events

1257 Samalas; Laki 1783; Tambora 1815

Major famines and epidemics resulting in mass mortality and/or migration

Great European Famine 1315-8 (coinciding with Bruce Invasion of Ireland); Black Death 1348-9; famine 1740-1; the Irish Famine 1845-52

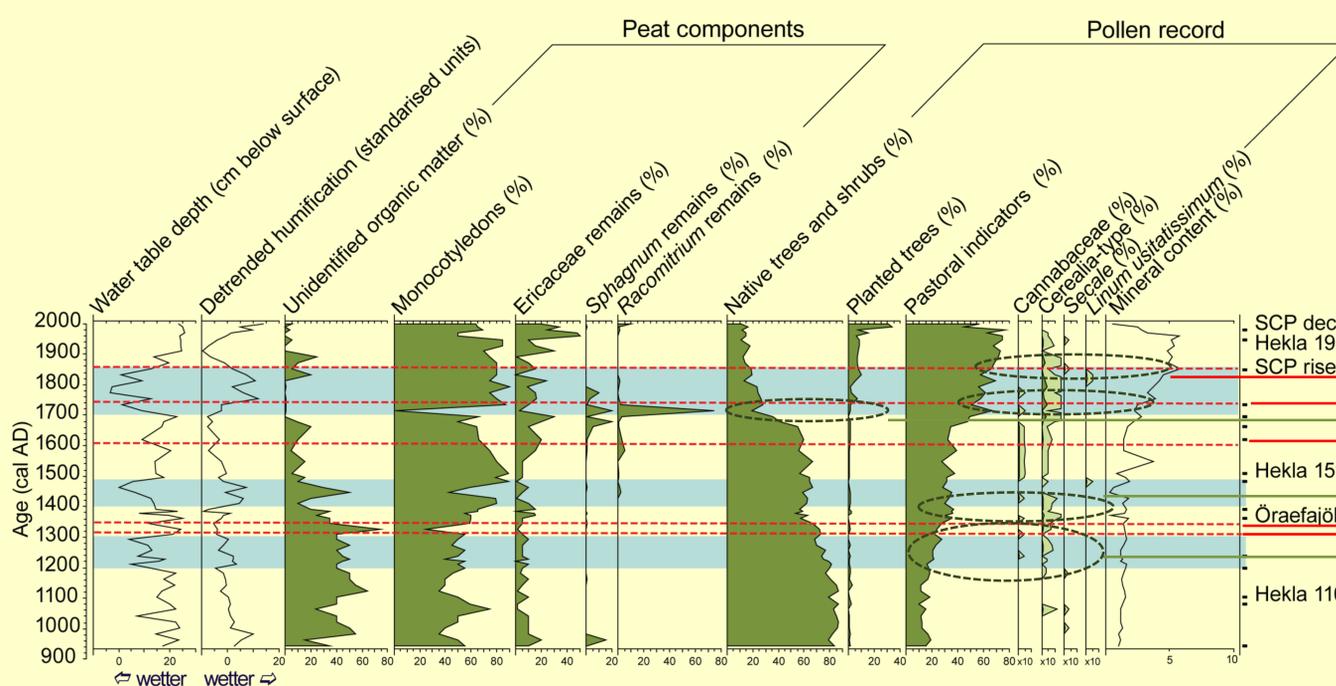
Palaeohydrology: testate amoebae, peat humification and plant macrofossil analysis. Palaeo-water table depth calculated using the EU transfer function (Amesbury et al. 2016).

Vegetation and land-use histories: standard palynology

Chronology: ¹⁴C dating, tephrochronology and Spheroidal Carbonaceous Particles (SCPs)

Age model: P-Sequence in OxCal (Bronk Ramsey 2008; 2009)
Sample resolution is, on average, bidecadal.

METHODS



▲ **Figure 2.** Compiled palaeoenvironmental data from Slieveanorra, with phases of wetter bog surface (indicating colder and/or wetter climate) highlighted by blue bands. Positions of dated levels indicated on the right (tephra and SCP events labelled). Timing of historically recorded demographic crashes represented by dashed red lines.

3 Results

- Slight reduction in farming at time of Irish Famine, but rapid recovery until final abandonment in the early 20th century.
- Expansion of farming despite onset of wet/cool phase, and notwithstanding 1740-1 famine.
- Four centuries of gradual woodland decline culminates with severe woodland clearance following Plantation of Ulster by Scots & English.
- No impact evident at time of 1740-1 famine.
- Wet shift associated with Little Ice Age? Farming persists until mid-15th century at which time it declines during wettest phase.
- Black Death of 1348-9 has no notable impact on level of farming in this area.
- Brief decline in farming at time of Great European Famine & Bruce Invasion. Rapid recovery.
- Land clearance and mixed crop agriculture endures through wet/cool phase in 13th century.

4 Conclusions

1. Settlement in the uplands was not driven by "improved" climate, nor by population increase in the 18th century.
2. Three wet phases at Slieveanorra correspond with pulses of the Little Ice Age. Only the wettest/coldest phase in the mid-15th century appears to have impacted on the level of land-use in this area. The almost continual presence of settlement in this area during the last 800 yr demonstrates long-term resilience to climate oscillations in a marginal environment.
3. Of the four major demographic crashes known during the period, only the Great European Famine and the Irish Famine are represented by a decrease in farming, and these are temporary. This may be because
 - i. the population was less exposed to epidemics, due to its relative isolation
 - ii. the population was less susceptible to famine, due to a self-sufficient, mixed agricultural economy
 - iii. population levels recovered sufficiently rapidly not to leave an impact in the palynological record.
4. Overall, the comparative economic independence of the populations living in this marginal environment may have been a leading factor that rendered them resilient to climate perturbations in the long-term.

Acknowledgments

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