A palaeoecological investigation of past woodlands to inform present and future woodland conservation management strategies in northern Scotland

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Introduction During the 1980s and the early 1990s areas of peatland in northern Scotland have been extensively covered with non-native conifer plantations which drastically affected the landscape and present ecosystems. To restore these peatlands, plantations are felled and restoration management is put to practice. Forestry and Land Scotland (FLS) aims to develop policies to reinstate the 'natural' woodland as at present not much is left. This study used palaeoecological data (pollen grains, non-pollen palynomorphs (NPP), charcoal) retrieved from peatland areas in northern Scotland (fig. 1) to explore the development of natural woodlands in northern Scotland over the last 10.000 years and answered questions as: What tree species were growing in these locations in the past? What did these woodlands look like? What events (climate/human related) caused woodland to decline and eventually disappear in northern Scotland? Answering these questions provided the basis for advising FLS whether these past natural woodland communities would thrive and sustain themselves if reinstated today or in the future. It is the first study to incorporate this type of data in woodland conservation for northern Scotland and the first time Scottish Forestry and FLS are using palaeoecological studies to be informed about possible new land-use policies, sustainable practices and climate change in relation to natural woodlands.

Fig. 1 Location of sites: **R**owens, **B**raehour and **D**alchork

Methods

Fieldwork
- Auger surveys to gauge overall stratigraphy at 3 peatland areas: Rowens, Braehour, Dalchork
- 3 cores extracted for palaeoecological study

Labwork
- Sediment description (Troels-Smith, 1955)
- Subsampling c. 2g every 4/8 cm
- Pollen preparation (Faegri et al., 1989)
- Count 500 total land pollen (TLP) of each subsample + NPP + microscopic charcoal (fig. 2)

Analysis
- Pollen diagrams
- Change-point analyses
- Vegetation reconstruction

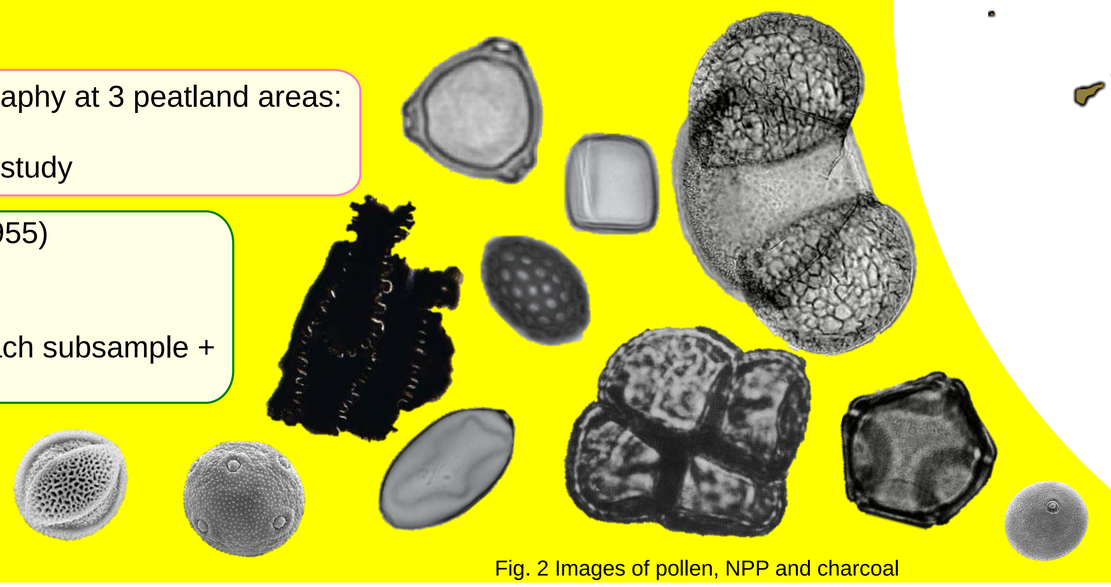

Fig. 2 Images of pollen, NPP and charcoal

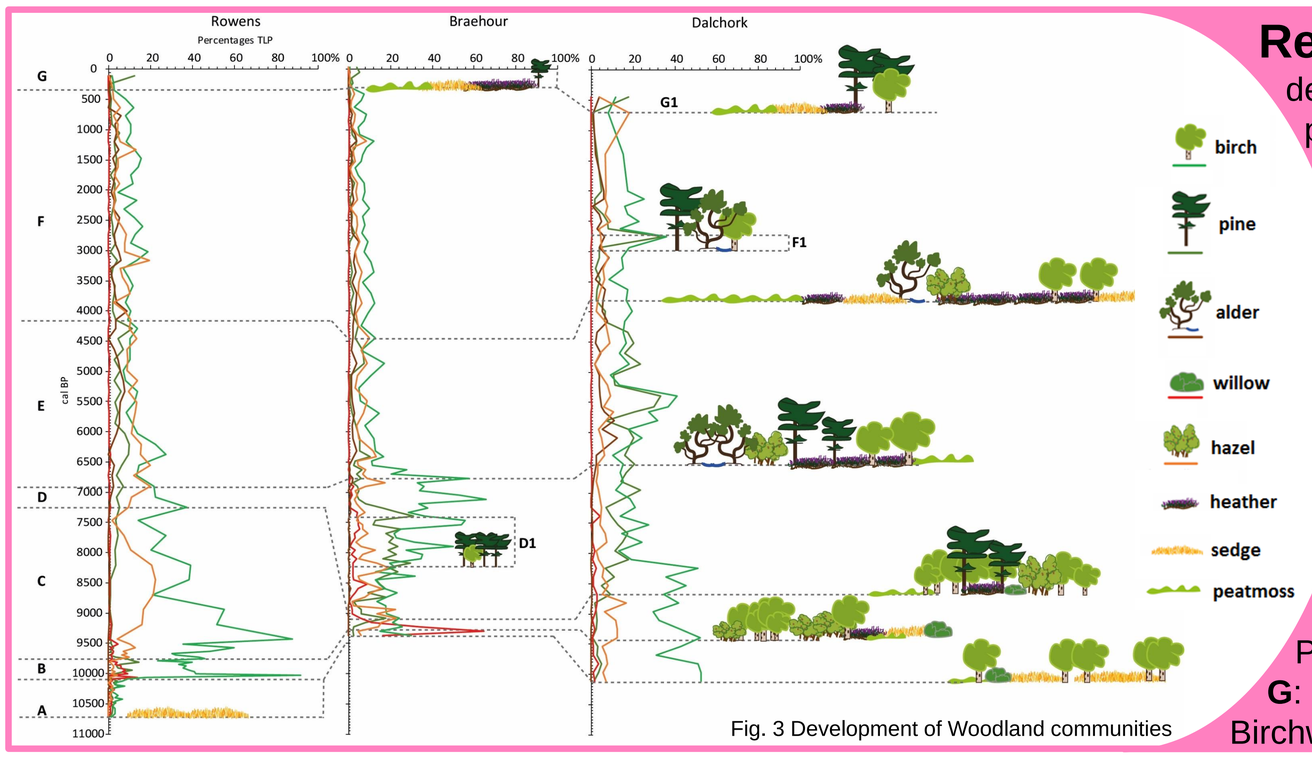

Fig. 3 Development of Woodland communities

Results and Discussion

The pattern of woodland community development is similar across the three study sites, although the timing of the presence of communities differs over time and space due to geographical and edaphic constraints, competitive interactions with established trees and stresses on taxa approaching their latitudinal range-limits. Fig. 3 shows the woodland development at the different research sites and the letters A-G (bottom to top) indicate the different woodland communities present:

A: No woodland established

B: Wet woodland with Willow and Birch

C: Upland Birchwood / Wet woodland with Birch, Hazel Willow and Pine

D: Wet Birchwood, Upland birchwood and Native Pinewood with Willow, Birch, Hazel and Pine. D1: Subphase with a dominance of Native Pine wood.

E: Wet woodland, Upland Birchwood and native pinewood with Alder, Birch, Hazel and Pine

F: Upland Birchwood and Wet woodlands with Birch, Hazel and Alder. F1: Sub-Phase showing a brief return of Pine into the local landscape at Dalchork

G: Non-native Coniferous plantations and peatlands. Continuation of Upland Birchwoods in Dalchork (G1)

Climate change and woodland disturbances

Past natural events (cold/warm periods, volcanic eruptions) were linked to woodland change, disturbance, decline and demise (fig. 4), i.e.:

- 9.4 ka event causes major woodland decline
- 8.2 ka event causes woodland disruption
- Both the 4.2 ka and the Hekla 4 eruption coincide with a further decline of woodlands, possibly driving these changes
- Mid-Holocene Optimum (from 7000 cal BP), which was period of climatic warming, lines up with the establishment of Alder in northern Scotland.

Present and Future

If reinstating natural woodland is the aim, this study provides the data for what tree species should be reinstated. Taking into account present and future climatic change, the focus should be on woodland communities that thrived in warmer and wet conditions such as seen during the Mid-Holocene Climatic Optimum: open *Upland Birchwoods* and *Wet birchwoods with Alder, Birch and Hazel*.

Natural woodland expansion in these areas should always take into account what the impact on other habitats (such as peatlands) in these areas can be, and reinstatement should only happen when optimal conditions for both peatland and woodland habitats can be ensured for all ecosystem services associated with these areas: i.e. carbon uptake.

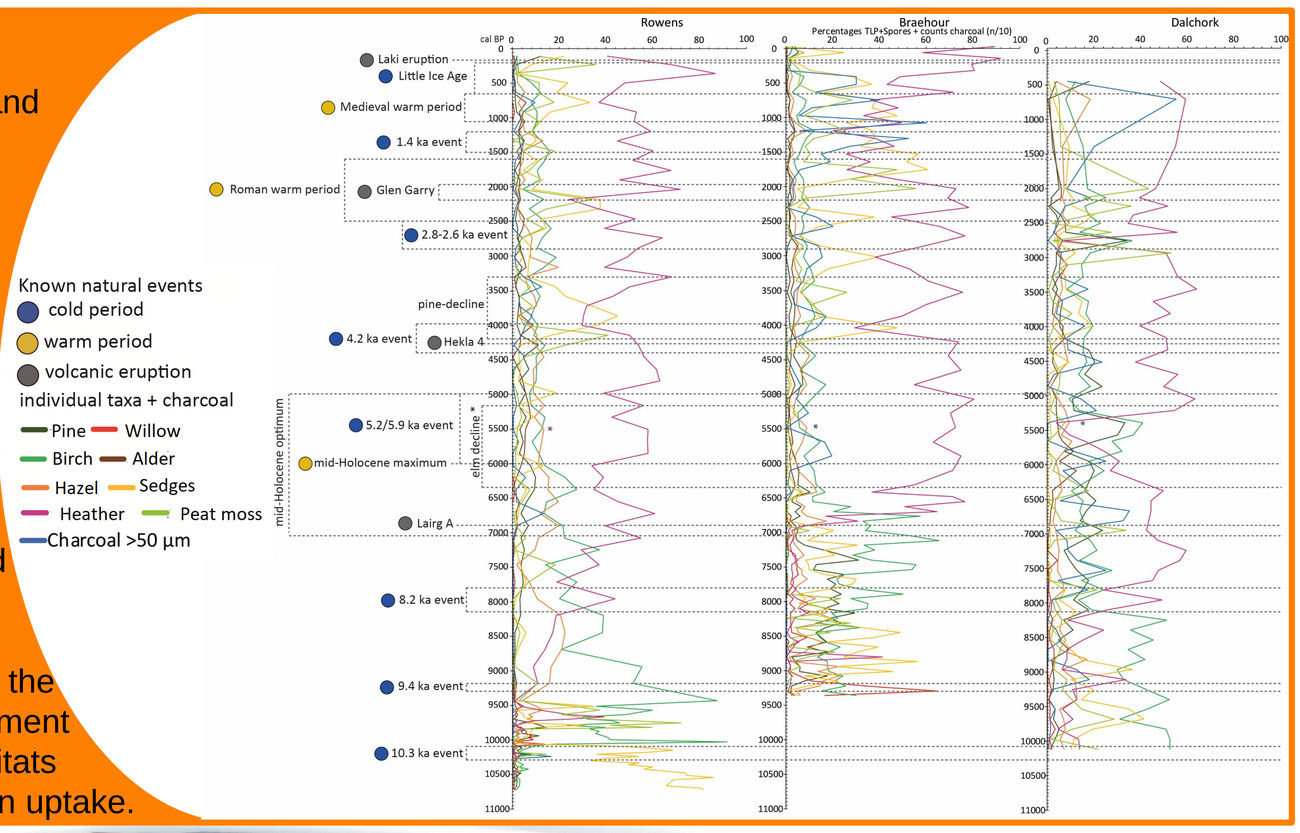

Fig. 4 Past natural events linked to woodland change, disturbance decline and demise

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