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Pollen analysis in the context of clearance cairns from boreal forests – a reflection of past cultivation and pastoral farming

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ABSTRACT

The former agricultural use of two sites located in the boreal forest of eastern Norway is investigated through pollen analysis. A peat profile was taken from the vicinity in each of two clearance cairn fields where several cairns were analysed for pollen. The pollen samples from the peat profiles give an environmental context for the pollen samples from the clearance cairns, and this combination of samples assists in evaluating the management practices that were in place on the cairn fields during different time periods. In both study areas cultivation layers under the clearance cairns are dated to the Late Roman Iron Age (cal. AD 200–400), while the oldest clearance cairns are dated to the Migration period (cal. AD 400–570), and a second phase of clearance cairn establishment is dated to the Medieval period (cal. AD 1030–1537). Abandonment of the two cairn fields is dated to *c.* AD 1700. Pioneer trees were a feature on or around the clearance cairn fields during most of the Iron Age, whereas the cairn fields were more open in medieval times. The investigation suggests that cereal cultivation on the clearance cairn fields is difficult to detect in local peat deposits, and that caution is needed when interpreting lack of Cerealia pollen. Management practices on the cairn fields are discussed and a change in management practice is indicated in association with medieval intensification.

1. Introduction

Palynological research into long-term landscape change and human impact on their surroundings is often based on regional pollen records from lake or bog deposits (e.g. Berglund, 1991). Recent research has focused on improving our understanding of pollen signals and how spatial patterns of land-use and vegetation types are recoded in sedimentary basins (e.g. Bunting, 2008; Gaillard et al., 2008; Hellman et al., 2009a, 2009b). As wetlands are sometimes not optimal archives when investigating fine-scale land-use and human activity in the landscape, on-site pollen data from archaeological sites can be important. Pollen records from archaeological sites are often distorted by poor pollen preservation and/or uncertain pollen stratigraphy (e.g. Bunting and Tipping, 2000; Dimbleby, 1985; Tipping, 2000; Tipping et al., 2009) and a combination of pollen data from archaeological sites and nearby local wetlands has proven useful when reconstructing former human activity and land-use (e.g. Emanuelsson, 2001; Hjelle et al., 2012; Overland and Hjelle, 2009, 2007; Overland and O'Connell, 2011, 2008). In this paper we show how, in marginal settings, a peat bog or a forest hollow may detect nearby human activity and land-use (at 25–80 m distance), but fails to register types of activity such as cereal cultivation as distinctly as on-site pollen analysis from archaeological layers, despite the poor pollen preservation in these layers. A combination of pollen records in an archaeological context and nearby peat profiles is complementary and provides a more detailed picture of local vegetation, farming activity and human impact than any record by itself. This study contributes to the evidence of past diverse agricultural landscapes within marginal areas, which is difficult to detect unless on-site sampling of archaeological sites is achieved. The study also highlights the care needed when interpreting lack of Cerealia pollen, as the wetland profiles show a clear deficiency in detecting nearby cereal cultivation.

In this study prehistoric and historical clearance cairn fields situated in present-day coniferous forests have been investigated in order to study management practices of these arable remnants. In eastern Norway, as well as in south and middle Sweden, large fields with clearance cairns reflecting past cultivation have been recognized since the time of Carl Linnæus (Linnæus, 1751). Recent research has dated clearance cairn fields to several time periods: Late Bronze Age, Iron Age, Medieval period, and even modern times (e.g. Gren, 2003, 1989; Holm, 2007; Lagerås, 2000, 1996; Lagerås

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and Bartholin, 2003; Lagerås et al., 1995; Pedersen, 1999, 1990; Pedersen and Widgren, 1999). Radiocarbon dates show that the fields have had several active phases in prehistoric and historic times, suggesting that management may have changed through time. Research in Sweden over the last 30 years has led to the development of several theories and models on the use of cairn fields in marginal areas, including permanent cultivation versus rotation systems; cereal cultivation versus hay production; and intensive (infield) versus extensive (outland) use (e.g. Gren, 2003, 1989; Lagerås, 2000; Lagerås and Bartholin, 2003; Widgren, 1997). Clearance cairn fields in Norway have not been investigated in great depth (Holm, 2007), even though they may potentially harbour important aspects of Bronze Age, Iron Age, and medieval agricultural history. Most often they are investigated as parts of agrarian systems reflecting infields/outlands (Prøsch-Danielsen, 1996; Sageidet, 2009, 2005a, 2005b). It has been argued that the clearance cairn fields in eastern Norway represent a different farming system than the traditional 'Iron Age' farms with infields and outlands (Øye, 2002), and that they represent an extensive and mobile settlement type with differences in territorial and social organisation (Pedersen, 1999, 1990). The marginal setting in terms of agriculture, at high elevation and with rather poor soils, may suggest a discontinuous land-use history, equivalent to the farming history of the south Swedish uplands (e.g. Lagerås, 2007; Sköld et al., 2010).

By comparing pollen records from bogs situated at 25–80 m distance from the clearance cairn fields with on-site pollen samples from the clearance cairns, management of the systems may be viewed in a broad environmental and chronological context, and the reliability of the often poorly preserved pollen samples may be evaluated. The present paper contributes to an understanding of the agricultural system and management practice on clearance cairn fields situated in marginal areas: whether the cultivation was intensive or extensive; whether the fields were grazed and/or mown as well as cultivated; and whether the agricultural systems and management practices changed through time.

2. Study areas

2.1. Bækkimellommarka

In woodland characterised by *Betula pubescens*, *Picea* sp., *Prunus padus*, and *Sorbus* sp., a peat core was extracted from a small forest hollow situated *c.* 50 m south of a clearance cairn field, but with the nearest cairn situated 25 m east of the core (Fig. 1a). A total of 315 clearance cairns and one stone fence are found on a south facing slope, covering *c.* 6.4 ha, at an elevation of 540–600 m above sea level (Holm, 2007). Three clearance cairns and one lynchet were excavated and pollen samples collected.

The majority of archaeological finds in the general Bækkimellommarka area are Late Iron Age clearance cairn fields and burial mounds, the nearest of which is situated *c.* 650 m southwest of Bækkimellommarka (Holm, 2007).

The bedrock is sandstone, covered by calcareous moraine. February is the coldest month (average −7.9 °C), July is the warmest (average 15.4 °C), and mean annual rainfall is 684 mm (NMI, 2012).

2.2. Grundsetrmarka

In an area dominated by *Pinus sylvestris*, *B. pubescens*, *Picea* sp., and *Salix* sp., a peat core was extracted from an open bog, situated *c.* 80 m east of a clearance cairn field (Fig. 1b). The cairn field, of *c.* 5 ha, is situated *c.* 350 m above sea level, and is at present a *Picea* plantation. It includes *c.* 275 clearance cairns, one stone fence, and two probably Iron Age burial mounds (Holm, 2007). Seven clearance cairns and the stone fence were excavated and pollen samples collected.

The archaeology of the wider Grundsetmarka area suggests human activity since about AD 1, and includes clearance cairn fields, burial mounds, lynchets, Early Iron Age deer traps, and iron production sites, Viking Age stray finds, and medieval iron production sites (Holm, 2007).

January is the coldest month (average −10 °C), July is the warmest (average 15 °C), and mean annual rainfall is 670 mm (NMI, 2012).

3. Methods

3.1. Field work and laboratory methods

The peat cores were extracted in June 2002, by hammering a PVC-pipe (1.5 m long, diameter 110 mm) into the peat deposits. The PVC-pipes were cut open in the laboratory, and 1 cm^3 samples extracted. Continuing in the same coring points, a further 50 cm of peat was extracted with a Russian corer and sampled at 5 cm intervals in the field using small plastic tubes (1 cm diameter). From profile walls in the excavated structures, pollen samples were collected in vertical series (example in Fig. 1c); stratigraphy and profile drawings from all sites are presented as Supplementary data.

Samples of 1 cm^3 were prepared for pollen analysis with 10% KOH, standard acetolysis and HF (Fægri and Iversen, 1989). The samples were stained using fuchsin and mounted in glycerol. Pollen identifications follow Fægri and Iversen (1989), and we made extensive use of the reference collection at the University of Bergen. *Potentilla*-type includes *Fragaria*, *Potentilla* and *Comarum*. *Cerastium*-type is split into *Cerastium fontanum* group and *Cerastium cerastoides* group (Punt and Hoen, 1995). *Trifolium* ssp. is split into *Trifolium repens*-type and *Trifolium pratense*-type, and *Rumex* sect. *Acetosa* into *Rumex acetosa*-type and *Rumex acetosella*-type (Odgaard, 1994). Cereal identifications follow Beug (2004). In most samples from the peat cores more than 1000 terrestrial pollen grains were identified, whereas from the clearance cairn fields the pollen sums are mostly in the range 200–600. Charcoal microparticles >5 µm were counted.

The pollen data are presented in percentage pollen diagrams, calculated on the basis of ΣP (total terrestrial pollen). The percentages of spores, aquatics, and other microfossils are based on $\Sigma P + X$, were X is the constituent in question. The zonations in the two pollen diagrams from bogs were estimated using the program ZONE (Juggins, 1991). In these diagrams, the taxa are mainly arranged after weighted average from bottom (left) to top (right), which is the mean of the counts for each pollen type over those samples in which the pollen type occurs. In the pollen diagrams from the clearance cairn fields the taxa are arranged alphabetically under sub-groups reflecting ecology (Behre, 1981; Lid and Lid, 1994). The diagrams were plotted using the program Core 2.0 (Natvik and Kaland, 1993). The in-filled pollen curves represent percentage values, and the shaded areas represent 10× magnifications of the percentage values.

Ordinations were carried out on the samples from the clearance cairn fields to identify major patterns in the data. DCA (Detrended Correspondence Analysis) shows a short gradient (<2) in the species data and PCA (Principal Component Analysis) was used (ter Braak and Prentice, 1988). The analyses were done using CANOCO ver 4.5 for Windows (ter Braak and Šmilauer, 2002) with square-root transformation of the pollen percentage data. *Anemone*-type and *Melampyrum* are interpreted as locally over-represented in some samples, and were made supplementary in the ordinations.