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Human impact and landscape utilization from the Mesolithic to medieval time traced by high spatial resolution pollen analysis and numerical methods

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ABSTRACT

Pollen analysis in relation to archaeological excavations has been carried out by the coast of central Norway to investigate for the first time long-term human impact on the vegetation in this region. A total of 297 samples from eleven archaeological sites and connected bogs/peat profiles reveal the vegetation development from the Mesolithic until today. Principal Component Analysis (PCA) is used to identify and elucidate the development through time and space, and the results of pollen diagrams from bogs are compared to the results of on-site pollen data. Human impact has transformed the vegetation to a varying degree in different time periods. A dense population connected to the shoreline is slightly visible as opening-up of the forest in the Mesolithic, whereas re-use of Mesolithic settlement sites for cultivation and grazing in the Late Neolithic and Early Bronze Age (from c. 2300 cal BC) is clearly documented by palaeobotany but weakly recorded in the archaeological record. Areas for settlement and cultivation are found from the Late Bronze and Iron Ages and pollen analysis contributes to a detailed picture of utilization of the landscape. The investigation shows the potential of combining archaeological and botanical data and analysing several small pollen sequences within an excavation area to reveal spatial patterns in vegetation development and human impact through time.

1. Introduction

Through time people have lived in and with their surrounding landscapes and for several thousand years also transformed the vegetation into cultural landscape types important for their economy and survival. Information on vegetation history and development of agriculture is mainly gained through palaeoecology and environmental archaeology (e.g. Behre, 1988; Berglund et al., 1991; Gaillard et al., 2009; Odgaard and Rømer, 2009) and pollen analysis is especially important to obtain information on the continuous vegetation development through time. This may also include analysis of samples from archaeological contexts. Archaeological sites have been important contexts for plant macro remains and bones, but also on-site pollen analysis may give primary evidence of vegetation and the use of plants. The generally low focus on on-site pollen analysis is due to preservation conditions which for pollen is best in bogs and lake sediments, but also due to the uncertainty of post-depositional processes and the origin of pollen in archaeological contexts (e.g. Dimbleby, 1985; Greig, 1982; Tipping et al., 2009; Whittington and Edwards, 1999).

By combining pollen diagrams from several sites (bogs, lakes) within a region, it is possible to identify vegetation development and human impact on different spatial scales; from local differences within a valley or small region (e.g. Davies and Tipping, 2004; Fyfe et al., 2004, 2008; Lagerås, 2006; Overland and Hjelle, 2009), to differences on landscape levels (e.g. Berglund et al., 1991; Nielsen and Odgaard, 2010; Prøsch-Danielsen and Simonsen, 2000, 2005). Another approach is to focus on combining pollen data from several archaeological sites within a relatively small area to get the vegetation development and pattern of landscape utilization through time and space, as in the present paper.

Agriculture was introduced to southern Norway during the fourth millennium BC, but the impact on vegetation and landscape seem low until the final establishment towards the end of the Middle Neolithic, c. 2400 cal BC (Hjelle et al., 2006; Høgestøl and Prøsch-Danielsen, 2006). From this time onwards opening of the forest, development of cultivated fields, pastures, meadows and heathlands took place, but with differences in time and space depending on natural constraints such as topography, soil and climate, as well as cultural influences. Cultural impulses from southern Scandinavia

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were important for the establishment of agriculture (e.g. Diinhoff, 1999; Hjelle et al., 2006; Høgestøl and Prøsch-Danielsen, 2006; Myhre, 2004; Prescott, 1996; Prescott and Walderhaug, 1995). New insight into agricultural development in southern Norway has been gained through the interaction between archaeology and palaeobotany in interdisciplinary studies (Bakkevig et al., 2002; Bårdseth and Sandvik, 2010; Hjelle, 2005; Hjelle et al., 2006; Høgestøl and Prøsch-Danielsen, 2006; Sageidet, 2005; Soltvedt, 2000; Soltvedt et al., 2007). Less attention has been paid to the cultural landscape development of central Norway although pollen diagrams reveal a general pattern comparable to further south (Paus and Moe, 1996). The oldest cereal cultivation in the Trøndelag region of central Norway is dated to the Bronze Age (Solem, 2002), but most of the radiocarbon dates including contexts containing macro remains of cereals, are from the Iron Age (Grønnesby, 2005; Sandvik and Selvik, 1993; Solem, 2006). The focus on palaeobotanical investigations in relation to archaeology in this region has however been low compared to further south.

In this paper we give palaeobotanical data (Hjelle and Solem, 2008; Hjelle et al., 2005, 2010) from a large-scale archaeological excavation that aimed to reveal changes in resource exploitation through time (Bjerck, 2008a). A special attention is given to the transition from hunting/gathering to early agriculture, as well as to the establishment of an agrarian economy. We will focus on the information given through pollen analysis from multiple palynological sites, the interaction between palaeobotany and archaeology during excavation, and the possibilities to extract information on agricultural history and landscape development through ordination techniques. The high spatial resolution pollen data include both samples from peat deposits and on-site contexts.

2. Materials and methods

2.1. Study area and investigated sites

The investigated sites are found within an area of c. 1200 m × 400 m on the north-eastern part of the island Gossen, off the coast of central Norway (Fig. 1). Prior to the investigations, the area held a few farms with infields and outfields. Most of the area was heathland with patches of pine, some deciduous trees and planted spruce. The climate is oceanic and peat of up to 2 m thickness covered the archaeological remains. In relation to construction of a gas pipe line from the North Sea to the mainland, archaeological surveys were carried out (Åstveit, 2005) resulting in excavations of 28 sites covering the time period 9000 cal BC–cal AD 1000 (Bjerck, 2008a). In the present paper the results of investigations on and/or in relation to

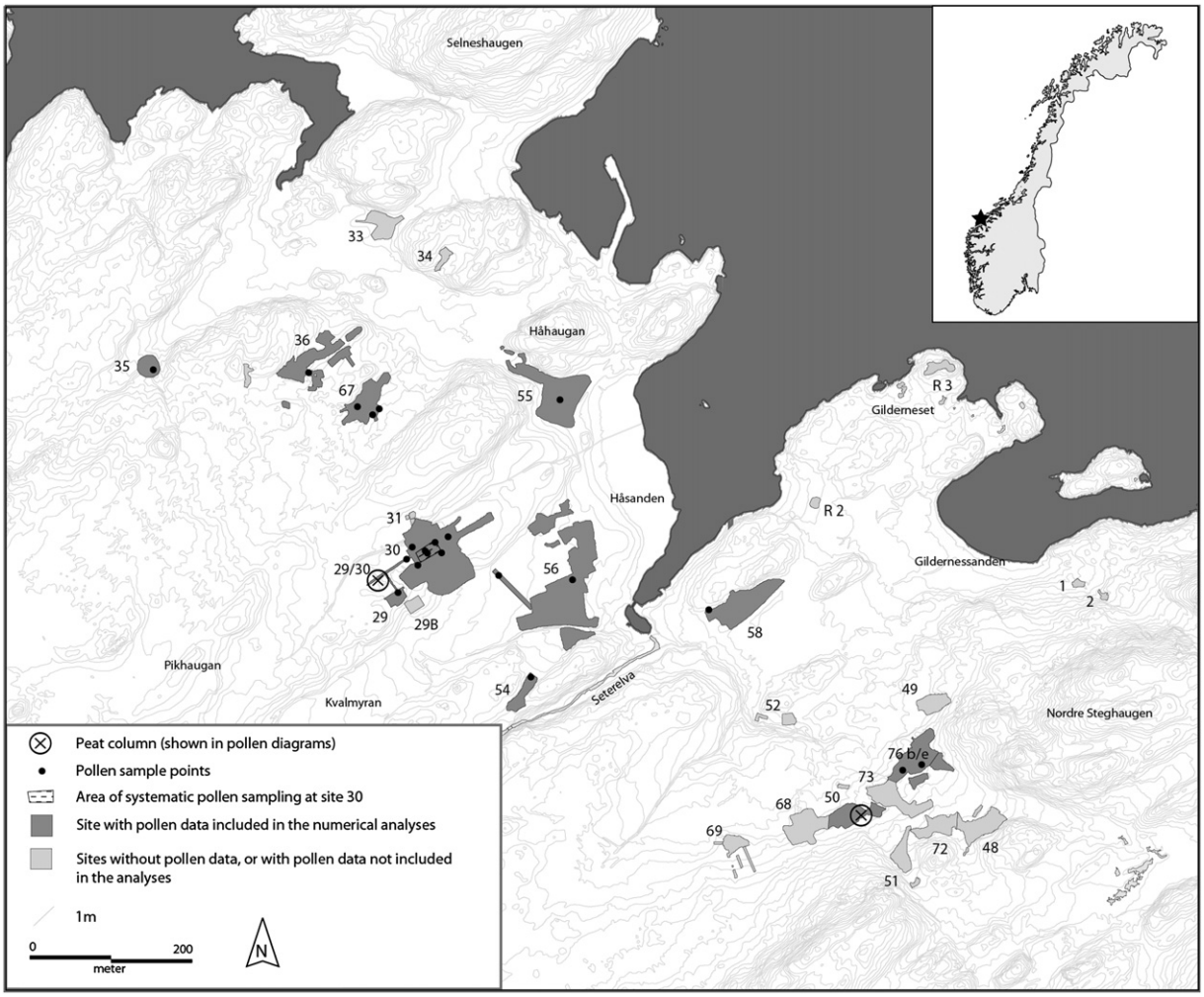

Fig. 1. Map showing the investigation area on the north-eastern side of the island Gossen in Norway. Sites included in the present paper and their relation to archaeological periods (cf. Fig. 2; Table 1): 29: LM, MN, LN/EBA, EIA (Åstveit, 2008a); 30: LM and MN/LN/EBA (Åstveit, 2008b); 29/30: Bog between sites 29 and 30; 35: EN (pollen samples younger) (Åstveit, 2005); 36: LM–MN, LBA–EIA (Meling, 2008a); 50: LM and LN (Åstveit, 2008c); 54: MNb–LN, LBA (Åstveit, 2008d); 55: EIA–LIA (Meling, 2008b); 56: BA–EIA (Meling, 2008c); 58: LBA–EIA (Meling, 2008d); 67: MN (Åstveit, 2008e); 76b/e: Peat from MM (76b) and IA (76e) (Bjerck, 2008b; Hjelle and Solem, 2008).