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Prehistoric agriculture in western Norway – Evidence for shifting and permanent cultivation based on botanical investigations from archaeological sites

Lene Synnøve Halvorsen[a,b,*], Kari Loe Hjelle[a]

[a] Department of Natural History, University Museum of Bergen, University of Bergen, P.O. Box 7800, N-5020 Bergen, Norway
[b] Department of Biology, University of Bergen, P.O. Box 7803, N-5020 Bergen, Norway

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ABSTRACT

Pollen and macrofossil samples from six archaeological sites in Hordaland in western Norway were analysed to gain an overview of the onset and development of agriculture and land-use practices in the region. Samples from soil profiles covering the time-period 7000 cal. BCE to cal. 1200 CE were analysed. The results show that agricultural practices were in effect at the latest from the Late Neolithic (2300–1800 cal. BCE) or the Early Bronze Age (1800–1200 cal. BCE) at all sites and that different forest types were cleared and converted for farming. *Hordeum vulgare* was cultivated and animal husbandry existed. Plant macrofossil remains and pollen support and complement each other and indicate that the first period of agriculture did not have a pronounced effect on the vegetation around the sites. Both a kind of shifting cultivation and more permanent cultivation took place in the Late Neolithic and Early Bronze Age, whereas permanent cultivation with an increased emphasis on livestock and increased opening of the vegetation is indicated from the Late Bronze Age with further intensification in the Iron Age. The study demonstrates the potential of on-site analysis from archaeological sites in elucidating past land-use practices and the development of agriculture.

1. Introduction

Early farming based on botanical, osteological and archaeological material from Hordaland in western Norway has previously been reviewed (Hjelle et al., 2006). The authors conclude that there are traces of anthropogenic influence on the landscape (grazing livestock) from the Early Neolithic (4000–3300 BCE), with evidence for cultivation from the Middle Neolithic (3300–2300 BCE) and the major onset of cereal cultivation and husbandry from the Late Neolithic (2300–1800 BCE) (see Table 1 for time-periods). Whereas the earliest cereal cultivation in the pollen records has been debated (Prescott, 1996, 2009; Rowley-Conwy, 1995), the existence of a farming economy from the Late Neolithic is well documented by macro remains of cereals and arable weeds from on-site contexts (Bakkevig et al., 2002; Hjelle et al., 2012; Soltvedt, 2000). The presence of macro remains from threshing waste alongside cereal grains is considered a secure sign of local agriculture (Sørensen and Karg, 2014). The first cultivation may have been a slash and burn process that allowed light to the ground and made use of the nutrients in the soil and charcoal (Andersen, 1988a; Diinhoff, 1999; Iversen, 1973). At several places in western Norway the same areas were cultivated from the Late Neolithic to the Middle Ages, but it is a question as to when permanent cultivation replaced the rotation systems or whether they were both in use at the same time. Complex agricultural systems with cultivated and fertilized infields and outfields used for grazing and fodder collection may have developed from the Bronze Age, but increased in importance during the Iron Age (Diinhoff, 1999; Kaland, 1986; Kvamme, 1988; Øye et al., 2002). Pollen from cereals and arable weeds and from grasses and meadow plants have long been used as indicators of cultivation and grazing, respectively (Behre, 1981, 1986), and has made the basis for several studies on cultural landscape development (Berglund, 1991; Birks et al., 1986). Plant macrofossils are also of great value in identifying agricultural and/or husbandry practices (Whitehouse et al., 2014) and work has been done to elucidate the connection between agricultural practices and weed assemblages (Bogaard, 2002, 2005; Jones et al., 1999, 2005; Rösch, 1996; Rösch et al., 2014). Using archaeological (on-site) contexts, this approach, plus the fact that intensive field management results in a dominance of annual weed species compared to perennials, has been used to differentiate between shifting and permanent cultivation in the Neolithic (Jacomet et al., 2016).

Although the development of agriculture has been discussed based on investigations of prehistoric cultivation layers (e.g. Diinhoff, 2004;

* Corresponding author at: Department of Natural History, University Museum of Bergen, University of Bergen, P.O. Box 7800, N-5020 Bergen, Norway.
E-mail address: lene.halvorsen@uib.no (L.S. Halvorsen).

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Table 1
Archaeological time-periods and abbreviations used in the text.

Archaeological time periods			Time span cal. BCE/CE	Abbreviation
Middle Mesolithic (MM)		Middle Mesolithic	8100–6500 BCE	MM
Late Mesolithic (LM)		Late Mesolithic	6500–4000 BCE	LM
Neolithic (N)		Early Neolithic	4000–3300 BCE	EN
		Middle Neolithic	3300–2300 BCE	MN
		Late Neolithic	2300–1800 BCE	LN
Bronze Age (BA)		Early Bronze Age	1800–1200 BCE	EBA
		Late Bronze Age	1200–500 BCE	LBA
Iron Age (IA)	Early Iron Age (EIA)	Pre-Roman Iron Age	500 BCE–0 CE	PRIA
		Early Roman Iron Age	0–200 CE	ERIA
		Late Roman Iron Age	200–400 CE	LRIA
	Late Iron Age (LIA)	Migration Period	400–570 CE	MP
		Merovingian Period	570–780 CE	MVP
		Viking Period	780–1030 CE	VP
Middle Ages (MA)		Middle Ages	1030–1537 CE	MA
Historic times (HT)		Historic times	1537 CE–present	HT

Øye et al., 2002), few studies have published results from combined micro- and macrofossil investigations of cultivation layers in relation to archaeological sites in western Norway (Hjelle et al., 1992, 2012). As a matter of routine, samples for botanical analysis are sampled at rescue excavations carried out at the University Museum of Bergen (cf. Hjelle et al., 2016). This paper seeks to show the potential in archaeobotanical and palynological analyses from these types of contexts. In the current study, six sites representing early farming contexts are investigated. The sites were excavated using topsoil stripping (Diinhoff, 2004, 2013; Løken et al., 1996), revealing soil profiles with cultivation/cultural layers. Samples for pollen and plant macrofossil analyses were taken from these on-site contexts and, when present, from peat next to the soil profiles (considered to be off-site contexts).

The aims of the paper, based on the botanical data, are

- to show the potential of using soil profiles within archaeological sites for investigating land-use history
- to identify land-use practices through time
- to identify the vegetation prior to farming, and throw light on whether adaptations to local conditions resulted in different land-use practices
- to compare information obtained from pollen analysis and archaeobotanical analysis of cultivation layers

2. Material and methods

2.1. Study area, site selection and sampling strategy

The county of Hordaland, covering coastal and fjord landscapes of western Norway, was selected for the present study. The investigated sites were chosen from the database of palaeobotanical and palynological samples from archaeological excavations at the University of Bergen, based on three criteria: 1) radiocarbon dates between 2300 cal. BCE and 200 CE existed, 2) the sites were excavated no earlier than 1990 to ensure comparable archaeological field methods (Diinhoff, 2005), and 3) samples for both pollen and macrofossil analysis from soil profiles and cultivation layers were available. The analysed samples fall within the time 7050 BCE–1650 CE; from the Late Mesolithic to Historic times (Table 1). Most samples have been analysed during this study although some were analysed in connection with the excavation projects.

The sites (Fig. 1, Table 2) cover a climatic gradient from oceanic in the west (high annual precipitation and high winter temperatures) to more continental climate in the east. The bedrock includes phylitte and gabbro and the superficial deposits are fluvial at Skåla and morainic at the other five sites. This means easily worked soils, high in nutrients, at all sites.

During excavation, layers of anthropogenic origin were identified based on colour, consistency and the amount of charcoal (Table 3). A layer was considered a cultivation layer when charcoal fragments were present, the amount of stones was low, and the layer had a homogenous appearance reflecting mixing (Øye et al., 2002: 23). A clearance layer has a horizon of charcoal not mixed with the soil, whereas a cultural (activity) layer contains charcoal, but has neither the marked horizon of a clearance layer nor the mixed appearance of a cultivation layer (op. cit.).

Generally, the sites are dryland sites which affects the preservation and the amount of fossilised material (pollen and plant macro remains) retrieved from the sites (e.g. Colledge and Conolly, 2014; Dimbleby, 1985; Jacomet, 2013). The samples were collected from soil profiles with layers with varying amounts of organic (humus) material, silt, sand and charcoal (Table 3), mostly identified as cultivation layers at the time of excavation. Samples for pollen analysis and larger samples for plant macrofossil analysis were collected from the same levels. Additionally, macrofossil samples from cultivation layers were collected at several points along horizontal transects at Dolvik (DOL-CL1/CL2) and Kvitevoll (KVI-D/E), and a pollen sample from an ard mark were collected at Kvitevoll (KVI-Ard) (Fig. 1). At Dolvik, Søreide and Kvitevoll peat contexts were sampled (DOL-K1, SØR-PT, KVI-Box, respectively). Layer descriptions are given in Table 3 and, in more detail, in the figure captions (Fig. 2–6).

Eighty-one of 113 macrofossil samples are from layers dated to LN and EBA. This is due to older layers being continuously sampled, which is rarely the case for younger layers, usually due to modern disturbance. Of 33 samples containing cereals, 29 are dated to LN or EBA.

2.2. Pollen and macrofossil analysis

Samples for pollen analysis (1 cm^3) were subsampled in the laboratory from monoliths or plastic tubes taken from soil profiles and cultivation layers during the excavations. Preparations followed Fægri and Iversen (1989) including treatment with 10% KOH, warm HF and acetolysis. The samples were mounted in glycerol, and pollen analysis was carried out using phase contrast. Identifications followed Fægri and Iversen (1989) for general identification, Punt and Hoen (1995) for Caryophyllaceae, Beug (2004) for Cerealia, and Odgaard (1994) for *Rumex acetosella*-type, and the reference collection at the University of Bergen. Charcoal particles > 5 μm were counted.

Plant macrofossil samples (volume 0.1–1.6 l from profile walls, 1.4–9 l from horizontal cultivation layers, Table 3) were wet-sieved using a stack of three sieves measuring 2, 1 and 0.5 mm, subsequently floated using a wash-over technique and the remaining material analysed. Samples from the box core at Dolvik (DOL-K1) and peat layers at Søreide (SØR-PT) contained uncharred material considered contemporary with the charred. The processes involved in the formation and deposition of the uncharred material differ from the charred (e.g. Jacomet, 2013; van der Veen, 2007) thus, the uncharred macrofossils were treated separately from the charred. Non-charred material from the dryland soil profiles were considered to be of modern origin and were excluded from the analyses. Identifications followed Cappers et al. (2006) and the reference collection at the University of Bergen.

The nomenclature for higher plants follows Lid and Lid (2005).

2.3. Chronology

Soil profiles displaying cultural sequences often have a complex stratigraphy and agricultural processes may include removal or addition of soil, ash or dung, and periods of cultivation may have different