# Plant remains as sources to cultural history in Southeast Norway

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## Abstract

Plant remains are valuable sources for cultural history. Humans and animals live inextricably together with plants. This article investigates how a large dataset of botanical macrofossils can give insights into cultural history in southeastern Norway in the period 400 BC– AD 400. In this period, iron was introduced in the production of weapons and tools, which led people to change practices in their interaction with nature. Farming is dependent on a great variety of environmental resources for cultivation and the gathering of food, medicine, and fodder. By combining archaeological and botanical data from 40 localities from Viken and Innlandet counties this article investigates the macrofossil diversity within the localities, as well as the regions they belong to. All archaeobotanical finds from the localities have been systematized and analyzed quantitatively. The results reveal patterns in regional biodiversity as well as a representation of species in structures and features in archaeological sites.

*Keywords: Archaeobotany, plant history, plant utilization, South-eastern Norway, regional variances*

## Introduction

Plants are and have always been essential for human life and activities; this is as true for cereals and timber as well as other plants used as food, medicine, or material culture. Archaeobotanical remains from archaeological excavations serve as important sources for interpreting past practices in farming, foraging, food, fodder, medicine, and rituals (Day 2013; Jacomet 2013; van der Veen 2018). Such “ecofacts” may provide a bridge to past concepts of nature and human-nature relations (Richer and Gearey 2018) because they are actual remains of, and sources to the study of, landscape and vegetation and therewith provide concrete insights about the environment that people perceived. This article explores how plant remains sampled from 40 localities in Innlandet and Viken counties in southwestern Norway can yield nuanced information on how people interacted with plants in the period 400 BC– AD 400.[1]

Large-scale analyses of archaeobotanical remains may contribute to an awareness about typological patterns in the representation of macrofossils from archaeological excavations and hence be helpful for future analyses of more detailed plant utilization. Combined results from all sites are expected to display great variance when it comes to the representation of species, the actual number of macrofossils and their archaeological relation. In this article,

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we investigate the following three areas: 1) if there are observable patterns in the distribution of archaeobotanical remains within site types, structures, and features from the selected area and time period, 2) the species richness within the localities, and 3) whether historical regional variance in macrofossil diversity in Innlandet and Viken may be revealed through big data analyses.

The results from these investigations serve as a foundation for discussing how archaeobotanical results may be used for exploring further cultural historical activity in the localities. Through these investigations, we also identify some ever-present challenges in the sampling strategies and pinpoint information could provide more detailed insights into past human-plant interference.[2]

## Background

Much of the historical interest in studying people's interference with plants centers around the domestication and cultivation of land, especially in the Iron Age, since this period is characterized by important innovations in farming and cultivation (Solberg 2003 [2000]; Myhre 2002; Welinder *et al.* 2004). The interest in studying technological inventions and abilities of crop domestication can be said to be founded on an economic view of nature – nature being a supply of resources – going back to the 17th century (Hverven 2018). People's understanding of the concept of nature has undergone drastic changes throughout history in close relation to changes in ideological and religious convictions (Taylor 2020). People relate to nature, and they do this with both conscious and subconscious intentions and motivations. In a semiotic mindset (Lotman 2008 [1996]), ecofacts and human messages of various kinds are all important jigsaw puzzle pieces in the bigger picture of past societal organization, cultural encounters, technological development, cognitive status, climatic changes, and environmental impact. For example, Norwegian toponyms preserve insights regarding how places have been used or how the surrounding landscape has been perceived.

In Norway, pollen analyses (microfossils) have been widely integrated as sources to vegetation history (Fægri 1944; Hjelle 2005; Høeg *et al.* 2019), whereas macrofossils are traditionally less used in analyses of historical perspectives on human-environmental interactions. Pollen diagrams can illustrate changes in species composition and communicate how plants and forests have formed the landscape from before the period of ice melting up to today through processes such as deforestation, ground clearing, and climate change, as well as other landscape changes caused by human activity, such as fodder harvesting and pasturing (Høeg 1996:11–14). The different plant species' pollination strategies influence the abundance of pollen in a site, which biases the understanding of the cultural implications in the landscape. Moreover, the diagrams often focus on the plants as indicators of various anthropogenic activities in the landscape and do not necessarily consider the implicit value of the plant and therewith their cultural uses (Richer and Gearey 2017). The taxonomic resolution is typically lower for pollen identification than for macrofossils, which makes it easier to link pollen to a plant family, whereas the seeds often provide more information for determining the plant species.

Archaeobotanical sampling (macrobotanicals) has been integrated into regular excavation practice in Norway since the 1980s (Hjelle *et al.* 2017 with references). Macrobotanicals enable studies of the activity within a location since soil samples can be compared from different activity areas within a site. Suitable methods for interpreting such data have been outlined focusing specifically on cereals and grain cultivation (Grabowski 2014). The amount, quantity, and analytical treatment of excavated soil-samples vary from site to site. Possible use areas connected to corresponding plants are occasionally suggested in the archaeological reports, often with reference to more recent knowledge of plant traditions (e.g., Høeg 1996:151–153).

There are many unknown facets of people's interaction with plants in the Iron Age. Increased population growth of both people and their domestic animals in the Iron Age required more food and fodder (Myhre 2002; see also Gjerpe this volume; Loftsgarden and Solheim this volume). As in more recent times, many of the harvested plants were probably gathered in the outfields (Teixidor-Toneu *et al.* 2020) and represented a significant contribution to past farming societies (e.g., Bharucha and Pretty 2010; Turner *et al.* 2011). Since broad data sampling is usually the standard in all excavations, plant history can be extracted from these excavations, even without being the initial aim and purpose of the excavation.

## Materials and methods

The dataset for this study consists of reported finds of macrofossils from excavations performed in southeastern Norway in the period 1993–2018 by the Museum of Cultural History, University of Oslo (KHM).[3] The archaeological period ranges from 400 BC– AD 400 and includes macrofossils collected from 40 localities in the former counties of Østfold and Akershus (since 2020, part of the new county Viken), Hedmark and Oppland (since 2020, united in the new county Innlandet).[4] Innlandet is represented by 14 localities with 18 farm numbers. Viken is represented by 26 localities with 30 farm numbers. Larger excavations sometimes contain more than one locality (with multiple farm numbers). These are here combined.

The macrofossil samples were analyzed by external laboratories post-excavation. The laboratories are based in Nordic countries such as Norway, Sweden, and Denmark. In the current dataset, macrofossil data is compiled from the lab reports themselves or excerpts from these reports (which are presented in archaeological reports).

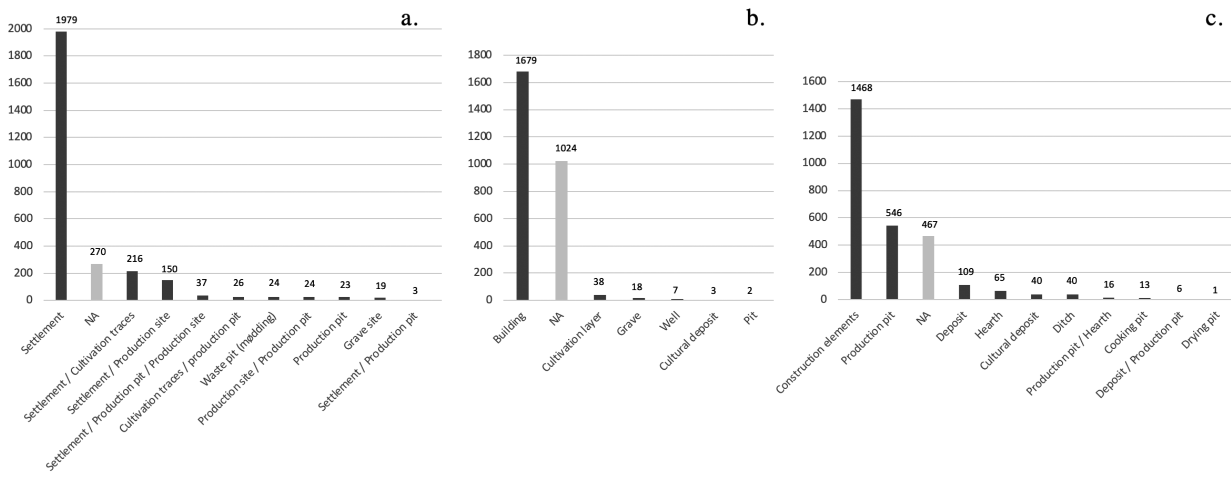



Figure 1. Number of reported archaeobotanical finds per site type (a), structure (b) and feature type (c). NA means "Not Available".

For this study, we included all macrobotanicals that we could access information on, both dated and undated (primary sources for dataset is listed in the bibliography). Microfossils (pollen) are not included. The majority of macrofossils sampled by KHM today are not dated, but context material from the same feature is often dated and is often used as a period indicator for the macrofossils. Charred material, dominated by cereals and charcoal, is often prioritized for analyses. Charcoal and wooden remains are particularly valuable since they provide an opportunity to put a date on the use and place in question (ongoing $^{14}$C-database construction at KHM[5]). Among seeds, cereals are considered valuable since they are larger and thus provide more material for dating analyses compared to smaller wild seeds, but also because cereals indicate cultivation and domestication of land (Hjelle *et al.* 2017:303). Few uncharred seeds and plant remains are likely to be old, unless there are particular preservation conditions (waterlogging or mineralization) in the excavation area (Sture 2016 with references). Wild herbs have very few dated representatives. Consequently, the dataset consists of a majority of undated macrobotanicals, relying on the dating of context material. By presenting the data side by side, the possibilities and the challenges in the material can be addressed independent of dating.

For the investigation of observable patterns in the distribution of archaeobotanical remains (the first of the areas of investigation listed in the Introduction to this paper 1), the data is organized through a set of parameters. The two counties of Viken and Innlandet, containing 25 municipalities, were chosen because they are known to contain localities with large macrofossil quantities. A locality contains one or more site type (e.g., settlements, production sites). Within a site type there are one or more structures, such as houses, graves etc., whereas features in a site type are typically postholes, forges, cooking pits etc. Sometimes processed plant materials are found within features. These objects, such as wooden plugs, textile cloths etc., may be species determined, or dated. The macrobotanicals are sometimes recognized as plant parts such as seeds, bark, charcoal, nuts, or fruit which may or may not be botanically identified at a species level. The preservation status may be charred, dried, waterlogged, or mineralized – however this is not always stated in analysis reports.

The site types were classified into ten categories, structures were grouped into six categories and features were grouped into ten (fig. 1). Plant taxa appearances in specific site types, structures, and features were explored using a generalized mixed-effect regression model (family binomial) with locality (i.e. excavation site) as a random effect. This model allows analyzing non-normal data such as counts and percentages when random effects are present. Here, random effects are used to avoid pseudo-replication (i.e. repeated measures from the same location; Bolker *et al.* 2009).

For the investigation of the distribution of species richness within the localities (the second of the areas of investigation listed in the Introduction to this paper), macrobotanicals have been systematized in groups of tree, cereal and herbs, and macrofossil data was systematized in spreadsheets for the two counties (tab. 1 and 2). The column *Total taxa no.* refers to the total number of species (taxa diversity) found at a given site and is represented by macrofossils such as charcoal, seeds, bark, buds, stems, nuts, cone scale, and leaves. *No. of tree taxa* represents the total number of tree taxa represented by nuts, charcoal, leaves, or bark. *No. of herb taxa* represents herbaceous plant taxa determined from seeds. Herbaceous plants do not have woody stems and many of them may be regarded

| Locality | Farm nr. | Site type | Total no. of taxa | No. of tree taxa | No. of cereal taxa | No. of herb taxa | Total no. of macrofossils | Qu. of tree macrofossils (of which fruit/leaf/bark) | Qu. of cereal macrofossils | Qu. of herb macrofossils | Taxa of highest abundance in a feature/ Taxa of second highest abundance in a feature | Quantity (dated) | Structure | Feature |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leikvang | 14/2 | settlement | 21 | 10 | 2 | 9 | 599 | 555** | 9 | 35 | Galium spurium | 8 (365-425 AD) | longhouse | posthole |
| | | | | | | | | | | | Hordeum vulgare | 4 (35-30 AD) | longhouse | posthole |
| Ljøstad | 296/1, 2 | settlement | 18 | 7 | 4 | 7 | 340 | 298** (1) | 34** | 8** | Cerealia | 2 (45-250 AD) | house area | posthole |
| | | | | | | | | | | | Brassica sp. | 1 (215-420 AD) | house area | posthole |
| Vevla | 26/1 | settlement | 13 | 8 | 1 | 4 | 242 | 232** (1) | 5 | 5 | Persicaria lapathifolia | 2 | longhouse | posthole |
| | | | | | | | | | | | Cerealia | 1 (0-85 AD) | longhouse | posthole |
| Vold | 6/1 | settlement | 21 | 11 | 3 | 7 | 1296 | 1278** (59) | 4 | 14 | Chenopodium album | 2 | cultivation layer | layer 3 |
| | | | | | | | | | | | Galium aparine | 7 | cultivation layer | layer 3 |
| Åker | 7/201 | settlement | 50 | 8 | 3 | 39 | 4533 | 141 (42) | 2787 | 1605 | Stellaria media | 197 | house area | posthole |
| | | | | | | | | | | | Stellaria media | 192 | house area | posthole |
| Berg | 138/1, 4 | settlement/ cultivation traces | 9 | 4 | 2 | 3 | 56 | 39** | 5 | 12 | Spergula arvensis | 9 | house area | posthole |
| | | | | | | | | | | | Hordeum vulgare* | 1 (250-375 AD) | house area | posthole |
| Fulu store | 3/8, 10 | settlement | 18 | 12 | 5 | 1 | 329 | 297** (4) | 30** | 2 | Hordeum vulgare var. Nudum | 19 (405-375 BC) | - | burial / drying pit |
| | | | | | | | | | | | Triticum turgidum subsp. | 3 | - | burial / drying pit |
| Melstrøm | 18/9 | settlement | 10 | 7 | 3 | 0 | 44 | 39** (1) | 5 | 0 | Cerealia | 3 | - | burial |
| | | | | | | | | | | | Secale cereale | 1 | - | burial |
| Nyhuset Haukstad | 94/3060 | settlement | 13 | 4 | 3 | 6 | 604 | 272 | 224 | 108 | Avena sativa | 70 | - | bloomery furnace |
| | | | | | | | | | | | Stellaria media | 39 | - | bloomery furnace |
| Valum gård | 20/1 | settlement | 38 | 4 | 5 | 29 | 2473 | 12** | 889 | 1572 | Chenopodium album | 568 | longhouse | posthole |
| | | | | | | | | | | | Hordeum vulgare var. vulgare | 388 | house | - |
| Trogstad | 16/1, 17/1 | settlement/ cultivation layer | 22 | 15 | 3 | 4 | 271 | 249** (2) | 19 | 3 | Cerealia | 9 | house | forge/smithy |
| | | | | | | | | | | | Hordeum vulgare | 2 (680-890 AD) | house | posthole |
| Børstad | 4/1 | cooking pit locality/ production site (iron) | 11 | 8 | 2 | 1 | 222 | 207** | 4 | 11** | Linum usititassimum | 10 (350-110 BC) | - | forge |
| | | | | | | | | | | | Avena sativa | 2 | - | forge |
| Hveem | 72/1 | settlement/ cultivation traces | 15 | 4 | 2 | 9 | 108 | 87 | 9 | 12 | Hordeum vulgare | 6 (200-125 BC) | - | cultivation layer |
| | | | | | | | | | | | Persicaria sp. | 1 (15-90 AD) | - | posthole |
| Dæhlen | 66/6 | settlement/ cultivation traces | 29 | 2 | 4 | 23 | 1272 | 355 (4) | 420 | 497 | Chenopodium album | 146 (180-60 BC) | house area | posthole |
| | | | | | | | | | | | Cerealia | 192 | house area | posthole |
| Sum | | | | | | | 12389 | 4061 | 4444 | 3865 | | | | |

Table 1. Table presenting the excavated locations from Innlandet and the reported macrofossils from each locality organized in columns presenting the total number of taxa, divided in the number of tree taxa, cereal taxa and herb taxa from each site, as well as the total number of macrofossils and how they are distributed between trees, cereal and herbs.

** value is set to 1 where quantity was not given. Fragments are counted as 1 seed. *when more than one species have the same highest quantity in a locality the example is chosen at random. Quantity is given along with available dating results. If context material has been dated (material found together with macrofossil in the same feature), this is indicated in italics. Note that "seeds of *Hordeum vulgare*" in Valum gård was given for the whole structure and not per feature.

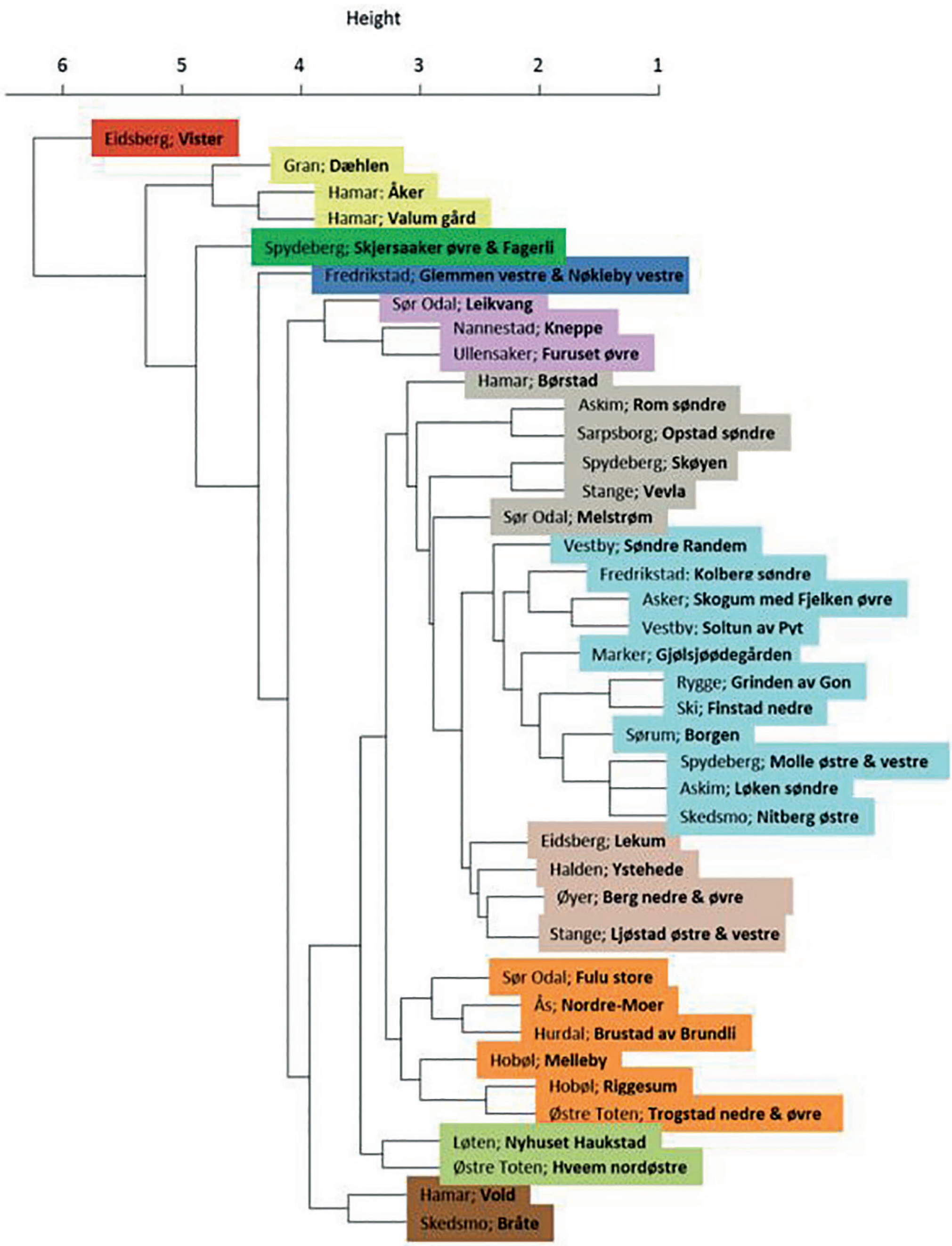



Figure 2. A dendrogram showing clusters of excavated localities based on similarities of species presence/absence.

| Locality | Farm nr. | Site type | Total no. of taxa | No. of tree taxa | No. of cereal taxa | No. of herb taxa | Total no. of macrofossils | Qu. of tree macrofossils (of which fruit/ leaf/bark) | Qu. of cereal macrofossils | Qu. of herb macrofossils | Taxa of highest abundance in a feature/ Taxa of second highest abundance in a feature | Quantity (dated) | Structure | Feature |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Borgen | 30/1 | settlement | 6 | 5 | 1 | 0 | 650 | 646 | 4 | 0 | Cerealia | 2 (260-450 AD) | longhouse | posthole |
| | | | | | | | | | | | Cerealia | 1 (350-530 AD) | longhouse | posthole |
| Brustad | 19/1 | settlement / cooking pits | 16 | 8 | 3 | 5 | 375 | 365 (1) | 4 | 6 | Papaver sp.* | 1 | longhouse | posthole |
| | | production site (iron) | | | | | | | | | Corylus avellana | 1 (130-230 AD) | longhouse | posthole |
| Bråte | 78/11 | settlement | 26 | 10 | 4 | 12 | 853 | 816 | 9 | 28 | Cerealia | 4 (330-540 AD) | house | posthole |
| | | | | | | | | | | | Persicaria lapathifolia* | 3 (260-540 AD) | house | posthole |
| Finstad nedre | 137/1 | settlement | 9 | 7 | 1 | 1 | 448 | 445** | 2 | 1 | Cerealia | 2 (425-540 AD) | two aisled house | posthole |
| | | | | | | | | | | | Galium aparine | 1 | two aisled house | posthole |
| Furuset øvre | 110/1 | settlement / | 25 | 6 | 3 | 17 | 263 | 25 (11) | 4 | 234 | Stellaria media | 28 | wind break | posthole |
| | | production site | | | | | | | | | Corylus avellana | 1 (120-230 AD) | - | burial |
| Kneppe | 36/120 | settlement | 20 | 6 | 1 | 13 | 131 | 91 (10) | 1 | 39 | Chenopodium album | 5 | house | posthole |
| | | | | | | | | | | | Chenopodium album | 4 | longhouse | posthole |
| Nitberg østre | 33/31 | settlement | 5 | 5 | 0 | 0 | 215 | 215 | 0 | 0 | Picea abies - needle leaf | 44 | smithy | pit |
| | | | | | | | | | | | Picea abies - needle leaf | 41 | smithy | pit |
| Nordre Moer | 54/3 | settlement | 15 | 9 | 4 | 2 | 1889 | 1870 (2) | 15** | 4 | Cerealia | 3 (95-30 BC) | four post consr. | posthole |
| | | | | | | | | | | | Euphorbia helioscopia | 2 | four post consr. | posthole |
| Skogum / Fjelkem | 21/1 | settlement | 6 | 5 | 1 | 0 | 241 | 240 | 1 | 0 | Hordeum vulgare | 1 | - | cooking pit |
| Soltun av Pyt | 39/42 | settlement /prod. site | 7 | 6 | 1 | 1 | 323 | 319 | 2 | 2 | Hordeum vulgare | 2 | - | cultural deposit |
| Søndre Randem | 8/3 | settlement | 10 | 6 | 3 | 1 | 313 | 309 | 3** | 1** | Triticum aestivum | 1 | house | posthole |
| | | | | | | | | | | | Cerealia | 1 | house | posthole |
| Gjølsjøødegården | 97/7 | settlement | 10 | 3 | 5 | 2 | 49 | 28 | 13 | 8 | Galium sp. | 5 | longhouse | posthole |
| | | | | | | | | | | | Hordeum vulgare var. nudum | 4 | longhouse | posthole |
| Glemmen / Nøkleby | 202/11, | settlement | 24 | 7 | 3 | 14 | 1810 | 864 (3) | 918 | 28** | Cerealia | 143 | house | wall ditch |
| | 203/120 | | | | | | | | | | Cerealia | 256 | house | posthole |
| Grinden av Gon | 9/2 | settlement | 7 | 6 | 1 | 0 | 572 | 571 | 1 | 0 | Cerealia | 1 (400-360 BC) | house with paddock | posthole |
| Kolberg søndre | 28/6 | settlement | 10 | 9 | 1 | 0 | 744 | 742 | 2 | 0 | Hordeum vulgare | 1 | - | cooking pit |
| | | | | | | | | | | | Hordeum vulgare | 1 | - | hearth |
| Lekum | 90/1 | grave field | 8 | 7 | 1 | 0 | 17 | 16** | 1 | 0 | Hordeum vulgare var. nudum | 1 (205 BC-5 AD) | - | grave |
| Løken søndre | 54/8 | settlement | 5 | 4 | 1 | 0 | 217 | 216 | 1 | 0 | Hordeum vulgare | 1 (360-100 BC) | - | burial |
| Melleby | 45/1 | settlement | 17 | 10 | 2 | 5 | 196 | 187 | 4 | 5 | Persicaria maculosa* | 1 | longhouse | postpipe |
| | | | | | | | | | | | Carex nigra* | 1 (377-197 BC) | longhouse | postpipe |
| Riggesum | 51/1 | settlement | 14 | 11 | 2 | 1 | 312 | 307 | 4 | 1 | Hordeum vulgare var. nudum | 1 (362-178 BC) | two aisled house | posthole |
| | | | | | | | | | | | Spergula arvensis* | 1 (1657-1950 AD) | longhouse | posthole |

| Locality | Farm nr. | Site type | Total no. of taxa | No. of tree taxa | No. of cereal taxa | No. of herb taxa | Total no. of macrofossils | Qu. of tree macrofossils (of which fruit/ leaf/bark) | Qu. of cereal macrofossils | Qu. of herb macrofossils | Taxa of highest abundance in a feature/ Taxa of second highest abundance in a feature | Quantity (dated) | Structure | Feature |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Molle østre & vestre | 2/1, 2/2 | settlement | 14 | 6 | 1 | 7 | 797 | 781 (7.) | 2 | 14 | Spergula arvensis* | 2 | smithy | ditch |
| | | | | | | | | | | | Stellaria media* | 2 | smithy | post |
| Opstad søndre | 2073/7, 146 | settlement | 5 | 1 | 4 | 0 | 1211 | 3 (3) | 1208 | 0 | Hordeum vulgare | 371 (470-395 BC) | longhouse | posthole |
| | | | | | | | | | | | Triticum aestivum | 4 (395-370 BC) | longhouse | posthole |
| Rom søndre | 91/2 | settlement | 8 | 2 | 3 | 6 | 240 | 2** | 234** | 4 | Hordeum vulgare | 100 | - | posthole |
| | | | | | | | | | | | Cerealia | 100 | - | posthole |
| Skjersaaker / Fagerli | 40/7 | settlement | 38 | 11 | 2 | 25 | 485 | 317 | 4 | 164 | Chenopodium album | 9 | longhouse | - |
| | | | | | | | | | | | Stellaria media | 9 | longhouse | - |
| Skøyen | 5/1 | settlement | 18 | 7 | 3 | 8 | 867 | 538 (31) | 308 | 21 | Cerealia | 73 | house | post |
| | | | | | | | | | | | Hordeum vulgare | 25 | longhouse | post |
| Vister | 185/2, 185/7 | settlement | 49 | 6 | 3 | 40 | 1228 | 494 (1) | 465 | 269 | Cerealia | 116 | house | posthole |
| | | | | | | | | | | | Hordeum vulgare | 112 | house | posthole |
| Ystehede | 196/17 | settlement | 3 | 2 | 0 | 1 | 11 | 4** (3) | 0 | 7 | Rubus saxatilis | 3 | two aisled house | posthole |
| | | | | | | | | | | | Rubus saxatilis | 2 | two aisled house | posthole |
| Sum | | | | | | | 14457 | 9913 | 2745 | 560 | | | | |

Table 2. Table presenting the excavated locations from Viken and the reported macrofossils from each locality organized in columns presenting the total number of taxa, divided in the number of tree taxa, cereal taxa and herb taxa from each site, as well as the total number of macrofossils and how they are distributed between trees, cereal and herbs.
** value is set to 1 where quantity was not given. Fragments are counted as 1 seed. *when more than one species have the same highest quantity in a locality the example is chosen at random. Quantity is given along with available dating results. If context material has been dated (material found together with macrofossil in the same feature), this is indicated in italics.

as useful plants and edible crops. *No. of cereal taxa* sums up all identified grains that are cultivated by humans. Note that a plant part was counted as a single taxon if it is identified at family, genus, or species levels (e.g., Salicaceae and *Populus tremula* count as 1 taxon each dependent on identification level). The total quantity of macrofossil samples in a locality is given in the column *Total no. of macrofossils* and divided into three columns: *Qu. of tree macrofossils* (of which x is fruit/leaf/bark), *Qu. of cereal macrofossils* and *Qu. of herb macrofossils*. The *Taxa with the highest / second highest abundance in a feature* are identified for all the localities in Innlandet and Viken (tab. 1 and 2, respectively), and enabled comparisons between the highest quantity of macrobotanicals in the various locations.

To evaluate regional variability of macrofossil diversity between sites (the third of the areas of investigation listed in the Introduction to this paper) we used a cluster analysis based on Euclidian distances using the functions *dist* and *hclust* (method "average") from the R stats library (Venables and Ripley 2002; Oksanen *et al*. 2008) that results in a dendrogram grouping excavation site based on macrofossil similarities (fig. 2). Sites were compared based on presence or absence of the taxa included in the dataset. The resulting groupings were color-coded and organized in a map (fig. 3). Excavation sites in the map were color-coded based on the groupings resulting from the cluster analysis. GPS coordinates for each excavation site were taken from norgeskart.no, as coordinates given in archaeological reports sometimes vary. The position of a locality was found by searching the farm number and municipality. Maps were made using QGIS3.14.16.[6]

## Results

Investigations confirm that there are observable patterns in the distribution of archaeobotanical remains within site types, structures, and features from this time period and area (fig. 1). *Site types*: the majority of archaeobotanical remains in the excavations from 400 BC to AD 400 are from settlements (71%), settlements/cultivation traces (8%) and settlement/production sites (5%). *Structures*: most archaeobotanical remains are preserved from buildings (61%); over a third of the structures are not determined. *Features*: the archaeobotany distribution over features are somewhat more varied. About half of the archaeobotanical remains (53%) are found in construction elements (such as postholes, wall ditches), one-fifth (20%) in production pits (such as cooking pits, forges), and nearly 5% in deposits.

The final dataset consists of 40 localities with a total number of 25,607 macrofossil samples. Of these, 13,974 (55%) samples are tree macrofossils (charcoal, nuts, leaves etc.), 7,189 (28%) are cereal macrofossils (cultivated grains), and 4,444 (17%) are herb macrofossils (wild or cultivated herbaceous plants such as flax, goosefoots, grasses, raspberry etc.). For Viken, the data (13,218 samples) consists of macrofossils from trees 9913 (75%), cereals 2,745 (21%), and herbs 560 (4%). The data from Innlandet (12,389 samples) consists of macrofossils from trees 4,061 (33%), cereals 4,444 (36%), and herbs 3,884 (31%). In general, these results confirm that Innlandet county has a balanced ratio between total no. of herb/tree/cereal. Viken has very little herb material represented (4%). Only sites with very few taxa (n = 3–5) lack cereals, and this is the case for two localities (Nitberg Østre and Ystehede).

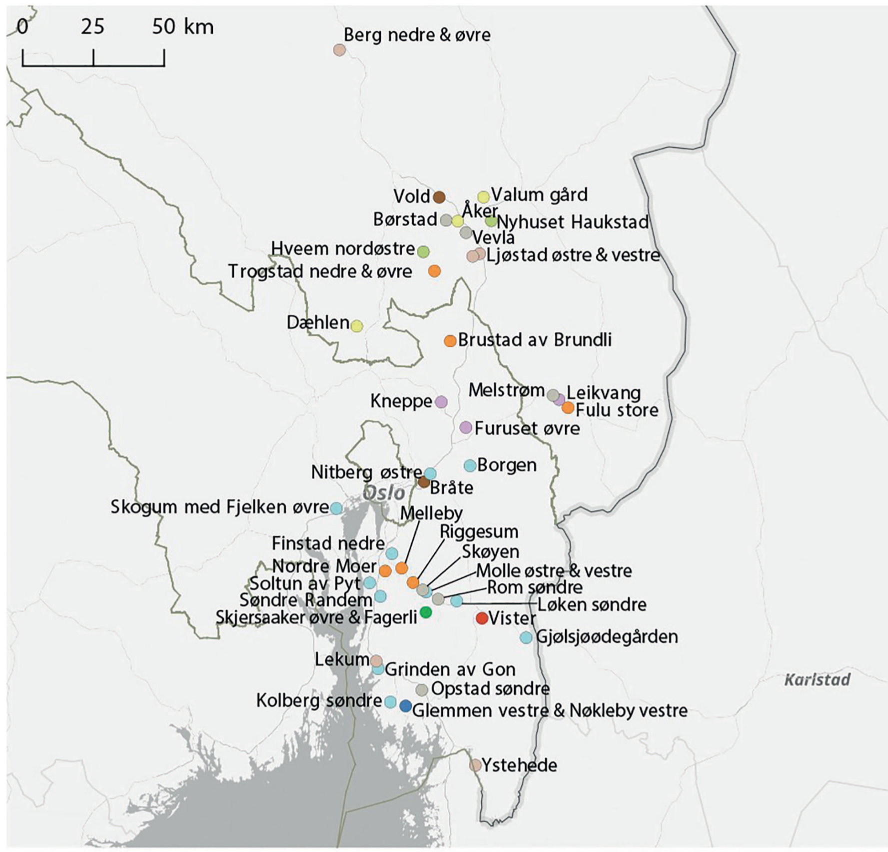
The most species-rich locality in Innlandet is Åker with 50 represented taxa and in total 4,533 macrofossil samples (141 tree samples, 2,787 cereal entries, 1,605 herb samples). The least species-rich locality in Innlandet is Berg Nedre and Øvre with nine taxa and 56 macrofossil samples. In Viken, the most species-rich locality is Skjersaaker Øvre / Fagerli with 38 represented taxa and 485 macrofossil samples. The most species-sparse locality in Viken is Ystehede with only three taxa and 11 macrofossil samples.

In Innlandet, some kinds of cereals are represented with the highest abundance (at 6 out of 14 localities) and the second-highest abundance (9 out of 14 localities). Herbaceous plants are represented with the highest abundance (eight out of 14 localities) and the second-highest abundance (5 out of 14 localities). In Viken, cereals are represented with the highest abundance (16 out of 26 localities), and the second-highest abundance (8 out of 21 localities). Herbaceous plants are represented with the highest abundance (8 out of 26 localities) and the second-highest abundance (9 out of 21 localities).

The macrobotanicals found in the largest quantities per samples are *Stellaria media* (Åker, house, posthole), *Avena* (Nyhuset Haukstad, furnace), *Chenopodium album* (Valum gård, house area, posthole; Dæhlen, house area, posthole), *Hordeum vulgare var. vulgare* (Valum gård, house area, feature na.), *Hordeum vulgare* (Opstad Søndre, house, posthole; Rom Søndre, house, posthole; Vister, house, posthole), in addition to the undefined *Cerealia* (Dæhlen, house area, posthole; Glemmen Vestre/Nøkleby Vestre, house, wall ditch/ house, posthole; Rom Søndre, posthole; Skøyen, house, post; Vister, house, posthole).

The cluster analysis shows 11 groups of localities based on similar composition of taxa (fig. 2). The possible geographical patterns in the groupings of the dendrogram are visualized in a map (fig. 3) showing the localities in colours that correspond to the dendrogram cluster groups. The taxa that are common to the cluster group are displayed under the map (fig. 3); however, localities often contain more than the taxa that were common to the cluster (as seen in tables 1–2). The light blue cluster consists of 11 sites that have two taxa in common. Three trends are identified. First, most sites across the studied area have little botanical macrofossil diversity (see light brown, grey sites; fig. 3). Second, some sites are highly diverse and are concentrated in specific areas (see brown, yellow), especially in the north of the study areas.

Sites with color according to cluster




Characteristic taxa per cluster

- Betula, Quercus, Pinus, Corylus
- Pinus, Alnus
- Cerelia, Hordeum, Betula, Pinus, Corylus, Populus, Tilia Chenopodium, Stellaria, Prunus, Sorbus, Viola
- Hordeum, Betula, Pinus, Galium, Chenopodium, Thlaspi
- Cerealia
- Cerealia, Hordeum, Betula, Pinus, Corylus, Quercus Fraxinus, Tilia
- Cerealia, Betula, Pinus, Spergus, Persicaria, Chenopodium Stellaria, Alnus, Picea
- Cerealia, Hordeum, Betula, Pinus, Galium, Rubus, Spergula, Carex, Persicaria, Chenopodium, Stellaria

Figure 3. Map showing counties Viken and Innlandet. Sites have colors that correspond with how they cluster in the dendrogram (fig. 2). Taxa that are common to a cluster group are displayed under the map. Individual localities may hold more taxa than the taxa common to the identified cluster group.

Whilst highly diverse sites are usually found in the north, the three most diverse sites (Vister, Glemmen Vestre, and Nøkleby Vestre) are found in the south of the studied region.

## Discussion

The majority of archaeobotanical samples are taken from houses within settlements, which offers potential for studying human utilization of plants in these settlements. Samples from other site-types, as well as contextual samples from the outfield of archaeological localities, would be of great interest to better understand the dynamics between infield and outfield, as well as to broaden the understanding of various use areas of plants in the past.

The results reveal a positive relation between the diversity of features in a site, the diversity of macrofossil botanical taxa, and the quantity of samples. This could indicate that human-plant interference has been diversely distributed in the different sites, and potentially that macrobotanical traces can be taken as indicators of past activities. No significant correlation between macrofossil diversity and specific structure and features was identified. Cultivated plants defined as *Cerealia* (*Avena* sp., *Hordeum* sp., *Secale* sp., *Triticum* sp.) appear significantly less in hearths and production pits than in other types of features. This may be an indication that the processing of cereals, roasting and drying, have not taken place in production pits, and not in random hearths, but may have been organized around specific hearths in the locations, such as in Gjølsjøødegården in Viken where one hearth in the north of the house has been identified as being for roasting purposes (Kile-Vesik 2016).

Macrofossil diversity correlates with the number of herb samples, but not with the general number of macrofossil samples alone. This can be illustrated by the most species-rich locality (38 taxa) in Viken, Skjersaaker Øvre/Fagerli, which has a total of 485 macrofossils, of which 4 are cereals, 164 are herbs, and 317 are trees. Opstad Søndre and Nitberg Østre in Viken have only 5 taxa. In Opstad Søndre these are spread over 1,211 macrofossils, of which 1,208 are from cereals, none are from herbaceous plants, and three are from trees. Nitberg Østre has a total of 215 macrofossils, of which none are from cereals, none from herbaceous plants, and all 215 are from trees. The more macrofossil samples we have of herbaceous plants in a locality, the higher the diversity, which is clearly illustrated with Åker, the most species-rich locality in Innlandet, with 50 taxa, spread over 4,533 macrofossils, of which 2,787 are cereals, 1,605 are herbs, and 141 are trees. The least species-rich locality in Innlandet is Berg Nedre and Øvre (9 taxa). It has a total of 56 macrofossils, of which 5 are from cereals, 12 are from herbaceous plants, and 39 are from trees. Thus, a locality can be rich in cereal or tree macrofossils, but at the same time poor in species diversity. So what does this mean?

The correlation between herb samples and species diversity may be obvious because the Nordic flora of herbaceous plants is greater and more varied than the number of cereal varieties or species of trees. However, the result is also a reminder that changes in biodiversity, human-plant interactions, and plant practices can be revealed from studying the rich material of herbaceous plants.

Sites with high numbers of macrofossils may be a sign of more cultivation or harvest activity in an area, but can also be a result of more or specific sampling during the excavation. Moreover, since charcoal and cereals are targeted for dating purposes, trees and cereals may be overrepresented in the samples. The soil quality and preservation conditions also affect the sampling results. Seeds from different species are preserved in both varying quality and in varying quantity, where the most sturdy plant parts and the species producing the toughest and/or largest seeds may be overrepresented in the samples. Some plants are more prolific seed-producers than others: for example, *Chenopodium album* produces on average 3,000 to 70,000 seeds per plant (https://www.cabi.org/isc/datasheet/12648).

Some macrofossils may be over-represented in archaeobotanical reports because of the difficulty in distinguishing between modern and archaeological specimens (Mueller-Bieniek *et al.* 2018). The appearance of many species associated with “disturbed” ruderal soils has been used as indicative of human activity (Behre 1981), yet these plants could have been key foods and medicines in the past, potentially tended, managed, or even cultivated around sites (Richer and Gearey 2017). A recurrent methodological problem is mixed soil as a consequence of post-deposition taphonomic processes, such as bioturbation, erosion, natural redeposition, and subsequent cultural activities (cultural redeposition) (Høeg 1996:9–10). Bioturbation causes uncertainties about the original deposition of seeds. However, a larger quantity of macrofossils can be seen as an argument for the macrofossils being “old” and originally deposited, since there will be less chance that bioturbation has influenced a large bulk of seeds than single found seeds. Consequently, there should be a potential in discussing use areas for herbaceous plant remains found in large quantities. Some of the presented sites above have representations of bulks of macrofossils in large quantities (>50) in postholes, defined or undefined cerealia, *Chenopodium album* and *Stellaria media*. Cereals are automatically interpreted as results of human use. But what about *Chenopodium* and *Stellaria*?

The lab analyses of macrofossils from Dæhlen suggest that the area in the excavation in which the samples of *Chenopodium* sp. seeds are found had been used in the household (Hellesøe and Skogsfjord 2010a:15 and appendix). The plant remains from the location are not treated individually in the report. However, the bulk of *Chenopodium album* can be dated via contextual finds to 180–60 BC. The archaeological report from Åker describes finds of seeds of *Stellaria media* together with finds of other typical “weeds” (Pilø 1994b), and none of these are considered potential sources in the interpretation of the place. Laboratories often distinguish between recently cultivated plants (food plants such as cereals, seeds, and berries) and “weeds” (Norw. ugress) (such as *Chenopodiaceae* sp., *Stellaria media* and *Centaurea cyanus*). However, the term “weed” reflects a modern understanding of often useful plants (Borgen 2020). The plants we consider weeds today may have been equally important to past settlers as cultivated crops. Indeed, many of these plants have likely been introduced to the Scandinavian area because of their value as food (e.g., *Aegopodium podagraria* and *Camelina sativa*) (Elven *et al.* 2018). The archaeobotanical lab report from Åker emphasizes the use value of *Chenopodium* as food, since seeds of the plant have been found in the stomach of one of the Danish bog bodies.

Both *Stellaria* and *Chenopodium* have been used for various purposes traditionally – especially as food and fodder (Grabowski 2014:19 with references). The first written collection of plants and their uses in a Norwegian context is Gunnerus's *Flora Norvegica* from 1776/1777 (Jørgensen *et al*. 2016). Gunnerus lists many plants used as food and fodder, but while he mentions *Stellaria* for such purposes, he does not mention *Chenopodium*. The ethnobotanical survey made by Ove Arbo Høegh in 1974 mentions *Stellaria* as fodder, but also as a useful plant for medicinal purposes, as a kind of dressing for wounds and skin problems, for dyeing, and for its ability to remove smell from hands after slaughter. He mentions the use of *Chenopodium* both as food and fodder. Gunnerus and Høeg diverge in their presentation of several plants, due to their different intentions, which in turn govern their source collection. Whereas economic growth coloured Gunnerus's collection of plant knowledge, Høeg was more interested in covering social and ritual practices, as well as medicinal ones (Teixidor-Toneu *et al*. 2020).

In Furuset Øvre, Ullensaker in Viken, two seeds of *Chenopodium album* were found in a pit potentially connected to a cremation burial. The finds are too few to provide a conclusive interpretation. Still, it could be interesting to draw attention to other graves with macrobotanical finds. Barley seeds found in a burial, barn, or grave field may be traces of different functions, e.g., ritual significance, fodder, or grave gifts. Two instances show the appearance of *Hordeum vulgare* L. (barley) in graves (Nordre Moer, Ås in Viken and Lekum, Eidsberg in Viken), however with only one seed each. The low quantity cannot be taken as an identification of an intentional deposit in either instance. But seeing the finds from different locations together may add a fresh perspective to the general understanding of how the plant has been used in the particular context.

The map showing regional variance in the period 400 BC– AD 400 (fig. 3) reveals taxa combinations in different sites. The yellow-colored excavation sites on the map have more herbs and fewer trees in common. The variety of taxa may also indicate that excavations in these sites have been carried out in soil layers where there was a more open landscape or cultivated area. The yellow sites include both *Cerealia* and *Hordeum*, which are typically recognized as cultivated crop plants. They also include the trees *Betula* and *Pinus*, as well as *Galium*, *Rubus*, *Spergula*, *Carex*, *Persicaria*, *Chenopodium*, and *Stellaria*, which are typically recognized as weeds. The similarities in sharing this diverse palette of species across localities indicate that they should be treated as useful herbaceous plants. The patterns in clustered areas are, however, quite distinct in the Viken and Innlandet regions. Brown-colored sites have many different trees, some quite short-lived: *Prunus*, *Sorbus*, *Corylus* etc. This could indicate that excavations have been carried out in layers where woods were chopped down and had opened up space for shorter-living trees, which again could be a sign of cultivation. These sites are recognized by *Cerealia* and *Hordeum*, as well as *Chenopodium*, *Stellaria*, and *Viola*. A number of trees are also identified in all these localities: *Betula*, *Pinus*, *Corylus*, *Populus*, *Tilia*, *Prunus*, and *Sorbus*. Orange-coloured sites have a collection of longer-living trees, perhaps indicating that excavation layers are from pre-cultivated areas. These localities are, however, also characterized by *Cerealia* and *Hordeum*, as well as the trees: *Betula*, *Pinus*, *Corylus*, *Quercus*, *Fraxinus*, and *Tilia*.

One site may have been used over a long period. Although houses, postholes and ditches may have been reused, the plant remains at a certain site can be used to date agricultural activity at the site (Hjelle *et al*. 2017) and possibly rituals, cooking activity, fodder storage, and foraging. The archaeobotanical remains may not only indicate the cultivation of crops, but also, through the large amount of herbaceous plant remains, provide a window into broader past activities, including animal husbandry, foraging for food, fodder, and medicine. These cultivation activities can in many cases also be traced in the excavation sites' place names, some of which have originated in the same period.

Place names may be dated based both on linguistic and on extra-linguistic criteria. For instance, the appellative *-vin* (meaning 'natural meadow, pasture') occurs in many Norwegian toponyms (e.g., Bergen, earlier *Bjǫrgvin*, 'mountain pasture') and may be dated based on a number of phonological factors. The *-vin* element (usually an ending in a place name) commonly triggers a variety of vowel assimilations (umlauts) on the place name element it is attached to, depending on the period from which the name derives. Older and younger ages of *vin*-names may therefore be distinguished based on phonological traits of the names. For example, Helleland (2003) shows that the name *Dæli* < **dal-vin* 'valley pasture' (vowel fronting **a* > *æ*) must pre-date ca. AD 600–700, when this particular assimilation, or umlaut (*i*-umlaut), ceased to be active. By contrast, the cognate name *Dolve*, also derived from **dal-vin*, must be somewhat younger since it lacks *i*-umlaut but displays *u/w*-umlaut (vowel rounding **a* > *o*), active ca. AD 700–800. A name without umlaut altogether, such as *Sandven*, must post-date both of these processes (ca. AD 800–1000). In this way, certain name elements have been dated to specific periods in Nordic language development. Apart from these linguistic criteria, vin-names are generally also lacking from newer Norwegian settlements in the western isles (ca. AD 800 –1000). Together these grammatical and distributional factors suggest that -vin place names date roughly to the Proto-Norse and Early Old Norse periods (ca AD. 1–1000, NSL 1997: 493–94). The oldest names in this dataset which may stem from the period under study include the appellatives *-vin*, *-angr*, and *-heimr* (typically in reduced form, e.g., *Borgen* < *borgvin* 'settlement pasture', *Skogum* < *skógheimr* 'forest home' etc.). Many of the place names in the dataset provide indications of continual cultivational uses, such as names indicating natural pastures, for example *Skøyen* < *skaðvin* (with an unclear element *skað-*) and more generally *Leikvang* < *leikvangr* 'sports meadow', *Bråte* < *broti* 'trees felled in a wood and left lying on the ground', *Åker* < *akr* 'field for tillage', and *Vister* < *vistir* 'dwellings', among others. Even though no absolute correlation can be drawn between the place names and the archaeobotanical remains in this particular study, the examples presented here may add some perspective to the potential in investigating past activity in a place using a combination of sources.

## Concluding remarks

This article has investigated the distribution of archaeobotanical remains in 40 localities from the counties of Innlandet and Viken in southeastern Norway, dated to the period 400 BC– AD 400. All botanical macrofossils from these localities have been systematized using a set of parameters that makes both archaeological and botanical information visible. Macrofossils are found mostly in features and especially in construction elements. Macrofossil diversity correlates to the number of herb samples. The compilation of a larger dataset makes it easier to compare the appearance of macrofossils across sites and to consider regional variances. A regional variance between Viken and Innlandet is confirmed. The most species-rich localities are situated in Viken, in the south of the investigation area. Still, there are generally a larger number of herb macrofossils detected in Innlandet. The quantity of taxa and macrofossils that are not trees and cereals is striking. Wild plants must have been of value for some important activities being carried out in settlements and in the outfield, and they may have played cultural, social, and economic roles. Referring to wild plants as weeds in historical analyses limits the value of considering the herbaceous plants as useful plants because of attitudes held by many people today towards these plants. Their role in past societies should not be overlooked because of a contemporary view of these plants. First when such plant remains are more systematically treated in historical disciplines will it be possible to deduce more exactly how they may have been used. Place names with Proto-Norse roots offer deep historical perspectives on land uses at certain localities, where many provide direct indications of historical cultivation activity. We hope these combined results can inspire more systematic identification and investigation of both wild and cultivated plants within and across archaeological and historical disciplines.

### *Notes*

1. The dataset is part of a database initiative in the research project *Nordic People and Plants* collecting archaeobotanical data from archaeological excavations carried out from the Museum of Cultural History, University of Oslo, from 1932 until the present. RCN SAMKUL funded project: Nordic People and Plants. Rediscovering and Safeguarding Nordic Ethnobotanical Heritage project no. 283364.
2. The University Museums practice different routines in sampling, analyses, and storage of archaeobotanical remains. Hjelle *et al.* (2017) describe the current situation for the university museums in Stavanger and Bergen.
3. The majority of excavations managed from the Museum of Cultural History are funded through the "polluter pays principle". When new construction projects are planned in an area of cultural heritage (i.e. often remains of human activity) and dispensation is granted from the "Heritage Protection Act", an excavation will take place to secure the remains for research and documentation. Excavations set out to raise and answer specific questions in combination with broad data sampling.
4. The recent county borders established during the Erna Solberg-government 2017–2021, are currently under public debate, and may be dissolved in favour of the old counties.
5. Ongoing work by Steinar Solheim, Kjetil Loftsgarden, and Frode Iversen, Museum of Cultural History, University of Oslo. See also Loftsgarden and Solheim this volume.
6. QGIS Development Team, 2021. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org), and modified in Adobe illustrator Cs6.

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