12. AN ARCHAEOBOTANICAL INTERPRETATION OF AGRICULTURAL PRACTICES AND PLANT ECONOMY AT THE IRON AGE SITE OF DILLING, SE NORWAY

Ivanka Hristova, Sofi Östman, Philip I. Buckland and Jenny Ahlqvist

ABSTRACT

The archaeobotanical study of Dilling includes the analysis of 719 samples, representing 115 houses, most of which collectively cover the Pre-Roman Iron Age to the Migration Period (200 BC – AD 500). This extensive sampling allows for a general picture of everyday activities to be reconstructed from the remains of plants found at the site, and which can be extrapolated to the region as a whole. The results show that a variety of activities have taken place, at different intensities, across the seven excavation areas. The preservation of the plant remains, however, differs considerably between the areas. In general, the preservation of plant macrofossils is poor at the site, but the large number of samples, and the application of a multiproxy approach, provides a unique opportunity to better understand everyday life in the region during the Iron Age. The combination of the archaeobotanical results, geoarchaeology (see chapter 13) and charcoal remains (chapter 11) collectively provides a valuable source of information on past agricultural practices, crop processing and diet. This is the first attempt to present an overview of the huge dataset from Dilling, and there is undoubtedly room for further interpretation and discussion.

Keywords: Early Iron Age, archaeobotany, macrofossil analysis, Norway, Scandinavia

INTRODUCTION

Relatively little is known about prehistoric agricultural practices and subsistence strategies in southeast Norway. Evidence based on the radiocarbon dating of cereal grains and the bones of domestic animals suggests that early farming starts in Southern Scandinavia during the period 4000 – 3700 BC. Most of this data, however, comes from Denmark and parts of Southern Sweden and Finland (Sørensen & Karg 2014, Vanhanen *et al.* 2019). In southeast Norway, direct evidence for agricultural activities and animal husbandry is extremely scarce. Pollen records suggest the first occurrence of barley in the area some 6000 years ago (Høeg et al. 2019), most likely representing small-scale farming in the Early Neolithic. Charred cereals from Kvastad A2 (Reitan *et al.* 2018), dated to the transition to the Middle Neolithic and Late Neolithic periods (3498–3035 BC), provide additional insights into early farming in the area around the Oslo fjord. Well-established arable farming in the region is confirmed in the Late Neolithic period (Glørstad et al. 2020; Prescott 2020), and the expansion of agricultural activities is noticeable from the Early Iron Age onward, ca. 450 BC (Solheim 2021).

This paper focusses on the results of the extensive archaeobotanical analyses undertaken at Dilling. At the time of writing, Dilling is one of the largest and most extensively sampled and analysed sites in eastern Norway, mainly spanning the periods of the Pre-Roman/Roman Iron Ages (ID 216874; 400 BC–AD 250+) and Migration Period (ID 216873; mainly AD 300-500) (see chapter 2 for more details of the dating of each area). A total of 115 structures (houses) were sampled for plant macrofossil remains, in addition to numerous samples from the areas around and between these structures. Most of these samples, and more, were also analysed geoarchaeologically, and this chapter should be read in tandem with that on the geoarchaeology (see chapter 13). The excavation was divided into two zones and a total of seven areas, stretching from west to east, which are referred to as follows in this paper: ID 216873, and Areas 1-6 in the larger excavation zone ID 216874 (note that duplicate house numbers are used between the larger zones). Earlier excavations of a similar scale have been undertaken in connection with large infrastructure (road/rail) projects in neighbouring counties, such

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as the E6 and E18 projects (Gjerpe 2013). In these projects, the archaeological sites were spread over an extended linear area and divided into distinct localities. At Dilling, there appears to be more continuity in a more limited geographical area. This provides both benefits and challenges, as a concentration of activities can produce not only abundant archaeological and environmental traces but also create a difficult stratigraphy for interpretation, especially where different phases and structures overlap.

Excavation and detailed sampling on the scale of Dilling provides scope for the reconstruction of agricultural practices and subsistence strategies through time and space. The data can also give information on human impact on the local landscape, and provide valuable insights into preservation and taxonomic representativity. This wealth of information and insights will undoubtedly be of use when interpreting remains from other sites - especially sites which have not benefitted from such extensive sampling.

MATERIALS AND METHODS

A total of 719 macrofossil samples from 115 houses, and features connected to them, were provided for archaeobotanical analyses. The majority of structures have been archaeologically interpreted as either longhouses or associated structures, with the exception of a number of potential pit houses in Area 6. Three of the latter have been analysed for plant macrofossil remains. Most of the samples come from postholes (ca. 550), but other features interpreted as wells, ovens/hearths, wall ditches, pits, floors, and cultural layers, activity areas, and paths are also represented.

Sampling was undertaken by the archaeological staff at Oslo University, Museum of Cultural History, and samples were sent for analysis at the Environmental Archaeology Lab at Umeå University (MAL), Sweden. Unprocessed sample volumes varied between 0.5 to 6 litres, with some features sampled in multiple layers; mostly the postholes but also wells, pits, and fireplaces. Prior to processing, most samples were stored in a drying room (+30 °C) to eliminate moisture and reduce the risk of mould which could have prevented accurate radiocarbon dating. Due to EU restrictions on the handling of soils from outside of the EU, the macrofossil samples were subsequently heated at 170 °C for four hours. This temperature is sufficient to kill off nematodes and soil organisms but low enough so as not to damage the preserved charred plant material (although further systematic testing is required to verify the latter). Eight waterlogged samples from wells were stored in a cold store at ca. 4 °C prior to processing and the analysis of subfossil plant material. All bulk samples were subsampled for soil chemical and pollen analyses, and a number of these were subsequently analysed at MAL.

A number of samples (ca. 87) were processed by the Oslo team prior to shipping the floated organic material to MAL.

Dried samples were disaggregated under running water, manually floated and wet sieved through 2 mm and 0.5/0.25 mm sieves. The resulting material (flotant) was sorted under a binocular microscope (10x - 80x magnification) and the preserved botanical material identified with the help of MAL's plant reference collection and reference literature (Cappers et. al. 2006; Jacomet 2006). Names of the genera and species are according to the *Norwegian and Swedish Flora* (Lid and Lid 2005), and *Nordens Flora* (Mossberg and Stenberg 2018). Only carbonised material was extracted from these dried samples. Waterlogged samples were similarly washed, floated and sieved, and subfossil plant remains extracted. The amount of woody charcoal was estimated as a relative proportion of the floated sample volume. Material for radiocarbon dating (cereals and spruce needles) was extracted during identification, weighed, and packaged for submission to a dating lab.

Other material of potential archaeological significance encountered during the macrofossil processing was also recorded, and its volume or quantity estimated. For Dilling, this included bone, ceramics, pieces of slag, and other small pieces of archaeological remains.

RESULTS AND DISCUSSION

Preservation conditions

The botanical results indicate a mix of cultivated plants (crops), arable weeds and ruderals (which colonise disturbed ground), meadow and pasture species, wetland species, and gathered plants (nuts and berries) at the site. The overall preservation of the material is poor, with many of the macrofossils highly fragmented or damaged. Of the 719 samples, 320 contained no identifiable plant macrofossil remains, although some of these did contain charcoal pieces and other inorganic finds. A considerable number of the seeds of cultivated plants were broken or had lost their identifiable characteristics. Preservation varies between areas (Figure 12.1 and Figure 12.2), with the proportionally best preservation of cereal macrofossils in Areas 1, 2, 4 and Id 213873. The worst cereal preservation was in Areas 3 and 5, although Area 5 contained the largest number of macrofossils without having the highest number of samples (Figure 12.2).

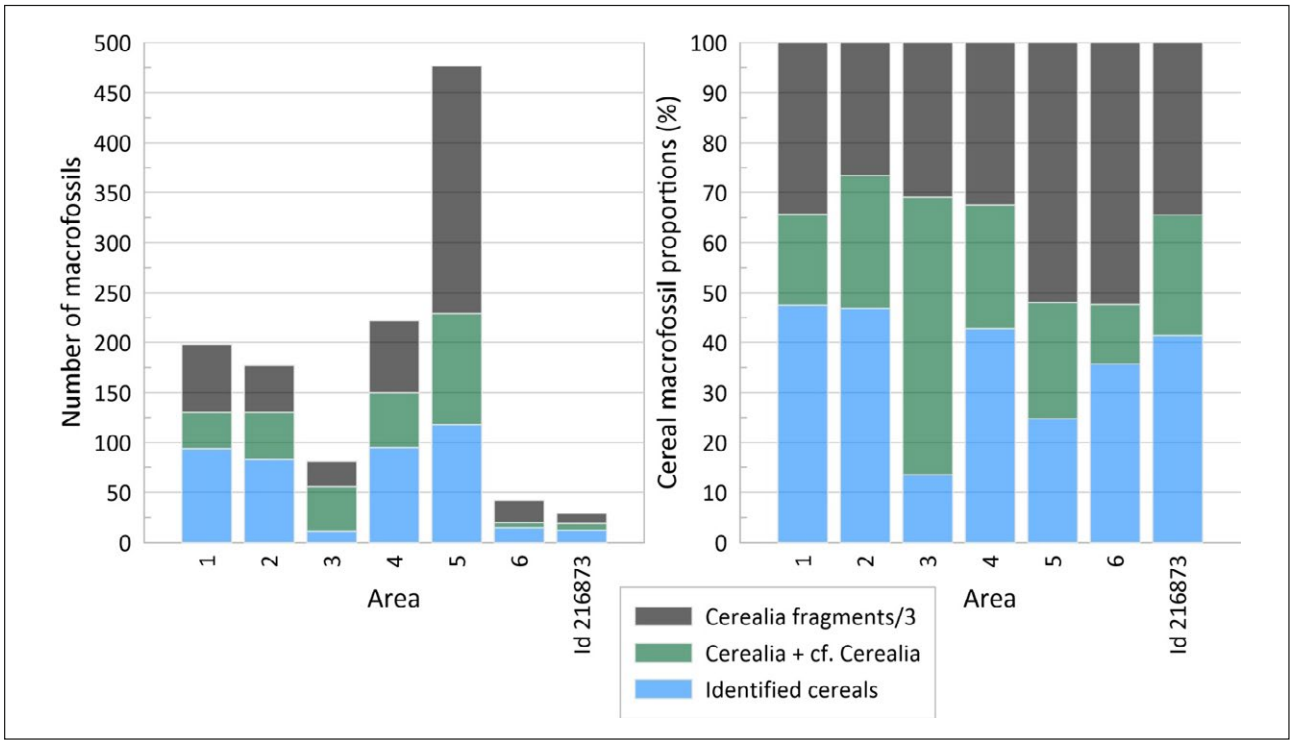

Figure 12.1. *Stacked bar charts showing the number (left) and proportion (right) of cereal macrofossils with three different preservation states. Cereal grain fragment counts have been multiplied by three to approximate whole grain equivalents. See Figure 12.2 for number of samples per area.*

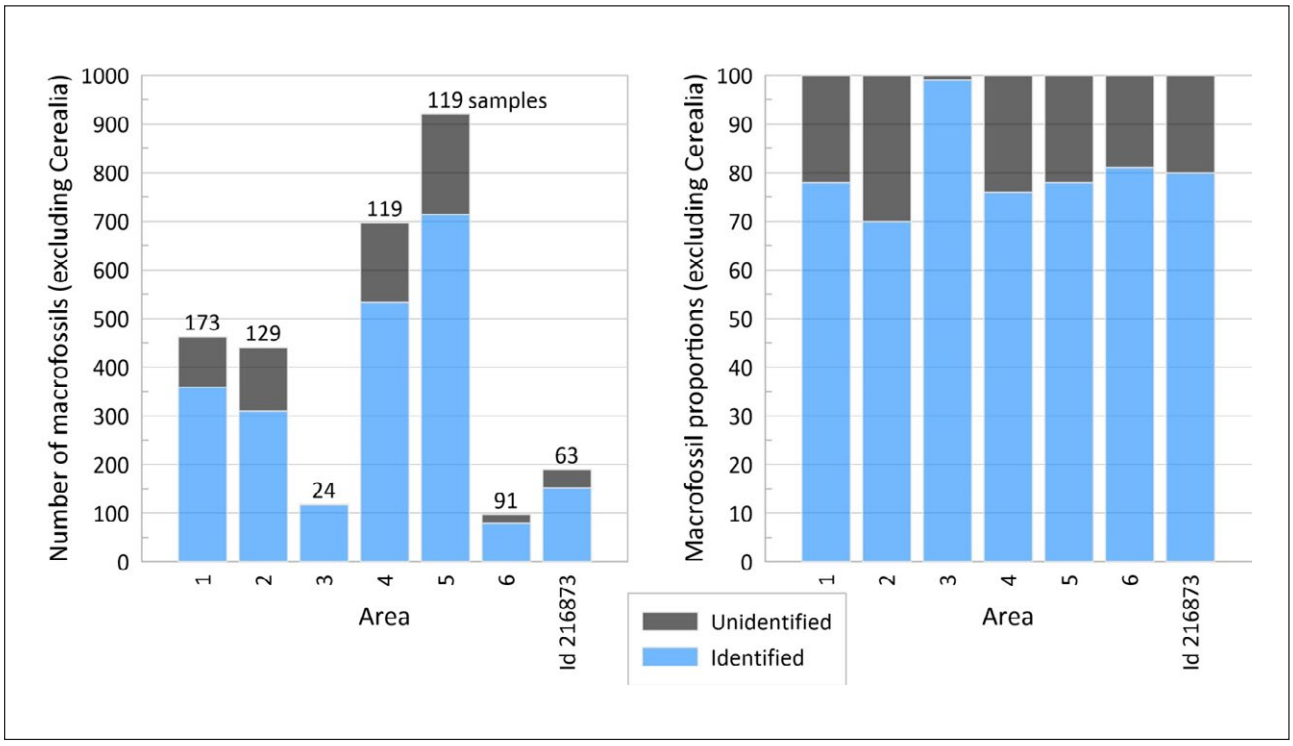

Figure 12.2. *Stacked bar charts showing the number (left) and proportion (right) of identified and unidentifiable macrofossil remains which are not cereals. The number of samples per area is shown above the bars in the figure on the left.*

In all areas, 30-50% of the cereal grains were fragmented, and a further 15 to 50% were not identifiable to species or subspecies (Figure 12.1). In contrast, the proportion of other seeds (i.e. not cereals) which were unidentifiable is mostly between 20-30%, and almost all of the 118 non-cereal seeds were identified in the 24 samples from Area 3 (Figure 12.2). The unidentifiable fraction of these samples is almost entirely

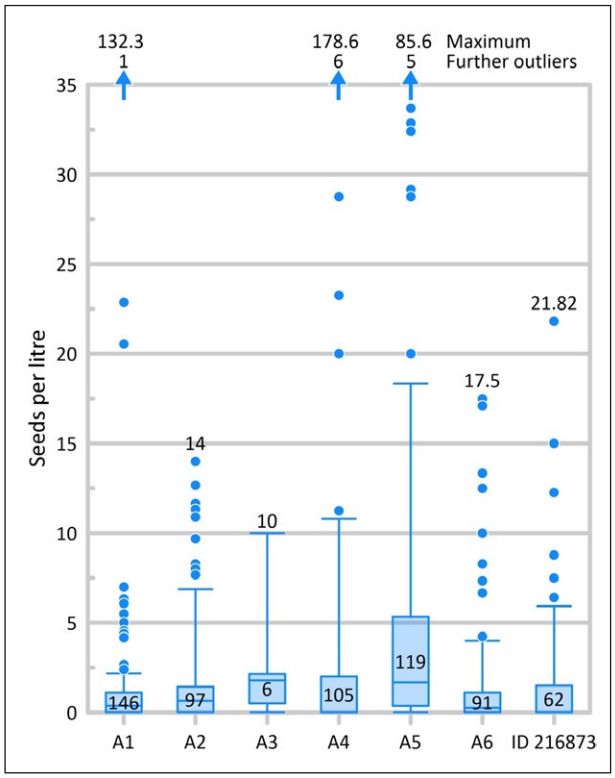

Figure 12.3. *Box and whisker plots showing concentration of seeds per litre un-floated sediment. Centre line in each box shows the median value, box edges the quartiles (25 and 75% of the data). Whiskers show the 90% limit of the data and the dots indicate outliers beyond this. The chart is truncated at 35 for clarity, and the number of further outliers and the maximum value of the highest outlier are given at the top. Numbers in the boxes show the number of samples per area where pre-floatation volumes could be measured, and thus concentrations calculated.*

comprised of the remains of seeds from small seeded plants that have lost their outer layer.

Samples from Areas 4 and 5 contain the highest numbers of preserved botanical remains, but it is difficult to say whether this is a result of feature selection, sample handling and processing, or the nature of the archaeological context (Viklund et al. 2013). Preservation can be affected by a large number of factors, including soil types, water regimes, disturbance, sample processing and transport, as well as the activities and events that caused the botanical remains to become carbonised. Gustafsson (2000) argues, on the basis of an experimental study, that sampling and floatation mostly impacts cereal grains, and it is possible that this could explain some of the differences seen at Dilling. It is also possible that the heat treatment applied to the Dilling samples has caused some of the fragmentation, although experimentation on already identified material, with pre-treatment at different temperatures, is needed to test this. Nevertheless, the unfavourable soil conditions and soil acidity found at Dilling, as well as fluctuations in site hydrology have almost certainly

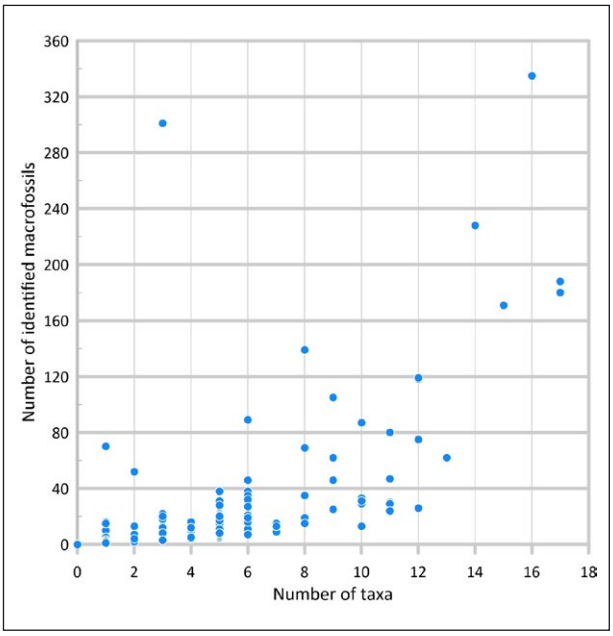

Figure 12.4. *Scatter graph showing number of identified macrofossils against number of taxa per sample.*

contributed to the damage or destruction of the organic remains (chapter 13; Jacomet 2007).

In addition to the post-depositional and taphonomic processes described above, there is also the possibility that activities at the site during its period of occupation could have affected preservation. If plants or seeds within the houses were exposed to temperatures over 400 °C during cooking or in a fire, they could easily have been destroyed. Exposure to fire at different temperatures, and with different levels of oxygen availability can have influenced the preservation of botanical remains (Märkle & Rösch 2008). Food preparation activities may also damage plant material, and the stage in preparation at which the material was carbonised will always influence its future preservation (Dincauze 2000).

An overview of the results

Despite the poor general preservation, over 5000 plant remains were identified, representing more than 70 taxa, of which 2083 are cultivated plants. The concentration of seeds per litre sampled sediment varies between 0 and 178 seeds. In most cases, the concentration is between two and 20 seeds per litre sediment, rarely more than 35 seeds (Figure 12.3), with the number of identified macrofossils per sample varying between 0 and 335 (Figure 12.4). The general ecological sampling rule, that the number of expected species increases in proportion to the number of individuals found, is essentially followed in the material. Two notable exceptions are: one sample including a large amount of *Chenopodium* sp. (goosefoot) and

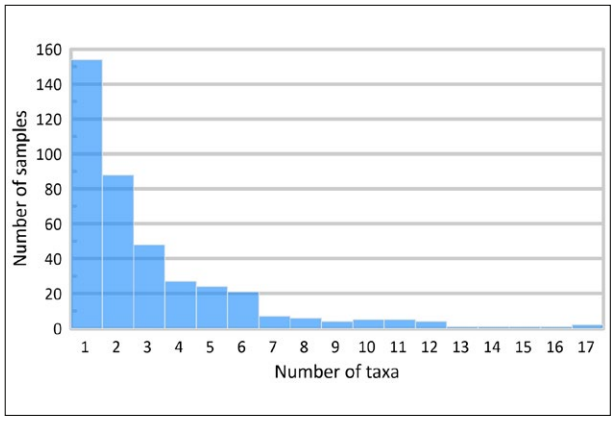

Figure 12.5. *Histogram showing the frequency at which different numbers of taxa occur in samples. A further 320 samples included no plant macrofossils identifiable to any taxonomic level.*

spruce needles (Area 1, House 42, sample 34291), and another containing a large number of spruce needles (Area 6, sample 716436). As discussed below, the spruce needles may indicate post-depositional bioturbation by rodents. Individual samples included up to 17 different taxa (Figure 12.5), with the majority of samples including no more than 1 to 6 taxa. This 'long-tailed' distribution is common in archaeological material and is as expected at Dilling.

In total, 663 seeds and seed fragments were classed as 'indeterminate' due to poor preservation preventing identification to at least family level. Despite this, a large number of cereal grains (Cerealia) were identifiable to species or subspecies level. A total of 1246 individual cereal fragments were found in addition to whole grains. These fragments are quantified in this paper, to give an approximate indication of the total abundance of cereals, by multiplying them by three (i.e. three fragments = one whole grain equivalent), as shown in Figure 12.1. The dominant cultivated species is barley (*Hordeum vulgare*) which can be found spread over the areas and in most of the houses. Among the barley subspecies, hulled barley (*Hordeum vulgare* var. *vulgare*) is most prevalent.

The most widespread arable weeds are fat-hen (*Chenopodium album*) and chickweed (*Stellaria media*). The wetland plants are represented by true sedges and spike-sedges (*Carex* sp. and *Eleocharis* sp.).

Among the gathered plants (nuts and berries), hazelnut shell fragments (*Corylus avellana*) and seeds of bog bilberry (*Vaccinium* cf. *uliginosum*) are those most often found in the samples.

A summary of the botanical remains per area is presented in Table 12.1 (see Hristova *et al.* 2020 for the laboratory report upon which this summary is based).

Specifics for different areas

ID 216873

Samples from thirteen houses in Area ID 216873 were analysed for macrofossil remains. Most of the houses studied were dated to between AD 100 and AD 500, with the exception of houses 1, 12 and 14, which were dated 800 – 300 BC. Overall, the amount of preserved plant remains was quite low and what was found was in poor condition. Two of the houses (10 and 15) did not contain any seeds or fruits, and a few others contained very scarce botanical remains, characterized by weed/ruderals or other wild plant species. Cultivated plants were detected in five of the houses (1, 2, 3, 4 and 13) (Figure 12.6). The limited

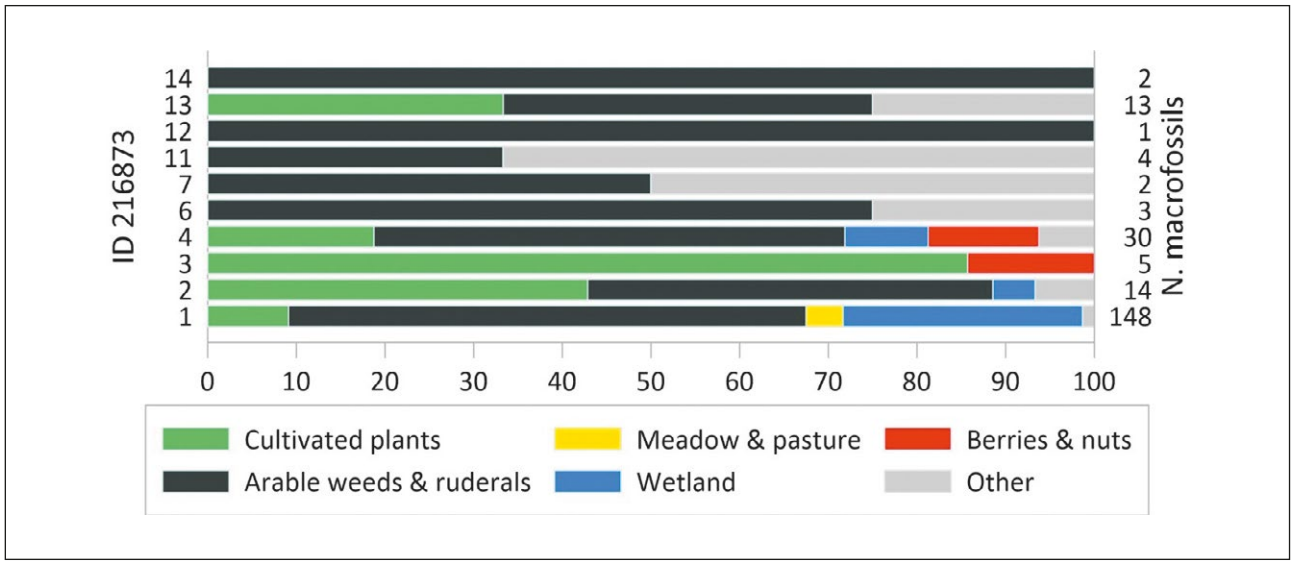

Figure 12.6. *The relative proportion of plant ecological groups per house in Area ID 216873. Houses with no identifiable remains have been excluded for clarity, as have samples from outside of houses. House numbers are on the left, number of macrofossils per house on the right. See Table 12.1 for total macrofossil numbers.*

Table 12.1. *Summary of the archaeobotanical finds per area, grouped by functional or ecological type. (See text for information on Cerealia and fragments).*

Taxon	1	2	3	4	5	6	Id 216873	Total number
Cultivated plants								
Cerealia (incl. fragments/3)	85	78	67	118	337	23	15	723
Avena sativa	0	0	0	0	2	0	1	3
Hordeum vulgare	32	36	8	17	70	2	0	165
Hordeum vulgare var. *nudum*	5	1	0	4	4	2	1	17
Hordeum vulgare var. *vulgare*	41	37	2	13	43	9	7	152
Secale cereale	1	0	0	0	0	0	0	1
Triticum sp.	2	1	0	0	1	0	0	3
Triticum dicoccum/spelta	1	2	1	3	3	0	1	11
Triticum monococcum/dicoccum	0	0	0	0	0	0	0	0
Camelina sativa	0	0	0	0	18	0	0	18
Linum usitatissimum	2	1	0	16	44	1	0	64
Humulus lupulus	0	0	0	0	1	0	0	1
Arable weeds & ruderals								
Avena sp.	7	0	1	0	5	0	0	13
Atriplex sp.	5	4	0	0	1	2	2	14
Brassica sp.	0	0	0	0	0	0	1	1
Cerastium sp.	0	0	0	7	2	0	0	9
Chenopodium album/C. sp.	42	23	0	52	163	18	17	315
Chenopodium/Atriplex sp.	0	0	0	0	15	0	0	15
Echinochloa crus-galli	0	1	0	1	14	0	1	17
Euphorbia helioscopia	0	2	0	0	0	1	0	3
Fallopia convolvulus	4	3	0	5	4	1	3	20
Galeopsis sp.	0	1	0	1	6	1	0	9
Galium sp.	0	0	0	2	25	0	1	28
Galium spurium	1	1	1	0	11	0	6	20
Galium spurium/aparine	0	0	0	0	0	0	10	10
Phleum sp.	0	0	0	0	0	0	5	5
Persicaria lapathifolia	41	22	2	13	48	1	4	131
Persicaria lapathifolia/maculosa	0	0	0	0	2	0	0	2
Persicaria maculosa	1	0	0	1	0	1	0	3
Persicaria sp.	0	0	0	3	6	0	0	9
Polygonum aviculare	0	0	0	0	4	0	0	4
Setaria verticillata/viridis	0	0	0	0	0	0	0	0
Solanum nigrum	0	0	0	0	4	3	0	7
Spergula arvensis	27	8	0	3	7	0	2	47
Stellaria graminea	0	0	0	0	0	0	1	1
Stellaria media	205	18	0	21	174	3	72	493
Stellaria sp.	0	2	0	5	17	0	1	25
Thlaspi arvense	0	2	0	0	5	0	0	7
Vicia cracca	0	0	0	0	7	0	0	7
Meadow and pasture								
Rumex acetosella	1	1	0	0	1	0	1	4
Rumex crispus	0	1	0	0	0	0	0	1
Plantago lanceolata	0	1	0	1	0	0	0	2

Taxon	1	2	3	4	5	6	Id 216873	Total number
Plantago major	0	75	0	0	1	1	0	77
Silene sp.	1	11	0	0	1	1	0	14
Wetlands								
Carex di.	6	2	0	3	36	0	7	54
Carex ovalis	0	0	0	0	0	1	0	1
Carex sp.	0	0	0	0	2	0	2	4
Carex tri.	14	11	3	13	11	8	14	74
Eleocharis sp.	0	1	0	1	3	1	5	11
Berries and nuts								
Arctostaphylos uva-ursi	0	0	0	0	1	0	0	1
Corylus avellana (shells)	5	2	1	5	12	3	4	32
Juniperus communis	0	1	0	0	0	0	0	1
Rubus idaeus	0	0	0	0	2	0	0	2
Vaccinium sp.	0	0	0	0	6	0	0	6
Vaccinium cf. *uliginosum*	0	0	0	0	13	0	0	13
Rubus fruticosus	0	0	0	0	0	0	1	1
Other								
Bromus sp.	0	0	0	0	1	0	0	1
Fabaceae	0	0	0	3	6	1	2	12
Lamium sp.	0	0	0	0	1	0	0	1
Lepidium sp.	0	0	0	2	1	0	0	3
Malva sp.	0	0	0	0	0	0	1	1
Picea abies (needle fragments)	249	12	0	1	0	156	0	418
Poaceae	3	19	0	4	14	0	1	41
Potentilla sp.	4	14	2	3	2	3	1	29
Ranunculus sp.	23	20	0	5	13	5	0	66
Rumex sp.	0	0	0	1	2	1	6	10
Solanum sp.	0	10	12	6	0	6	0	34
Trifolium sp.	0	11	0	5	0	0	0	16
Veronica sp.	0	3	0	0	1	0	0	4
Vicia/Lathyrus	0	0	0	0	2	0	0	2
Viola sp.	0	0	0	1	0	0	1	2
Pinaceae (cone scale)	0	0	0	0	0	0	1	1

preservation of the carbonised botanical material could be explained by the lack, or limited extent, of burning activities which would normally lead to carbonisation. The relative volume of charcoal fragments in many of the houses was low, and even where high the volume of the floated samples rarely exceeds 5 ml. This again suggests limited burning activities in the area (chapter 11). An alternative explanation could be that the area, or parts of it, was not used for household activities and may have served as a production area.

The most common cultivated plant is hulled barley (*Hordeum vulgare* var. *vulgare*). Single finds of oats (*Avena sativa*), naked barley (*Hordeum vulgare* var. *nudum*) and emmer/spelt (*Triticum dicoccum/spelta*) were also registered. Many of the cereals were badly preserved and fragmented, which made further identification impossible. Naked barley (*Hordeum vulgare* var. *nudum*) was only found in one sample (posthole 274404) in house 2. The presence of naked barley in combination with pale persicaria (*Persicaria lapathifolia*) usually corresponds to an older material (Bronze Age/Early Iron Age), whereas the combination of hulled barley and fat-hen (*Chenopodium album*) is more common for an Iron Age composition (Viklund 1998). However, the low number of seeds in this sample makes any interpretation of the combinations found too speculative for further explanation.

In two of the houses (3 and 4) traces of gathered plants (nuts and berries) such as blackberry (*Rubus fruticosus*) and hazelnut shell fragments (*Corylus avellana*) were found, which would have complemented the diet at the site. The most common weeds/ruderals from the area are fat-hen (*Chenopodium album*), false cleavers/cleavers (*Galium spurium/aparine*), pale persicaria (*Persicaria lapathifolia*), chickweed (*Stellaria* sp.), as well as others like timothy (*Phleum* sp.) and dock/sorrels (*Rumex* sp.).

The presence of corn spurrey (*Spergula arvensis*) in one of the samples in house 14 is interesting as it is not frequently found in the other houses within the area. While fat-hen, for example, thrives in nitrophilous, manured soils, corn spurrey grows in nutrient poor, acidic, and coarse-grained soils, perhaps suggesting an absence or limited amount of manuring at this point (Viklund 1998).

Nearby wetland areas are indicated by the presence of true sedges and spike sedges (*Carex* sp. and *Eleocharis* sp.). Additionally, in two of the houses (3 and 13), fragments of seaweed were found, with 4 ml measured in house 13. The presence of seaweeds indicates a close connection to the coast and the use of seaweed within the community. It is not uncommon to find such remains in Norwegian coastal sites, and the use of seaweeds was quite diverse – as fertilizer, fodder, flavouring and preservation of food, fuel and in textile processing and metalworking (Mooney 2018).

Bone fragments were only found in house 4 and are too minimal to provide any useful information for interpretation.

House 1 contains the largest amount of archaeobotanical remains in the area, with 152 identified macrofossils. The identified cereals are more diverse than in other houses, and represented by hulled barley (*Hordeum vulgare* var. *vulgare*), oats (*Avena sativa*), and emmer/spelt (*Triticum dicoccum/spelta*). The concentration in some of the samples is quite high, with over 21 seeds/litre sediment (Figure 12.3), whereas it rarely exceeds six seeds/litre sediment in the rest of the houses. The charred plant material in house 1 consists of species that could indicate at least three different activities: the cultivated plants are usually connected with cooking and household activities; the weeds and ruderals could relate to cereal processing; and some of the weeds/ruderals together with wetland species could have been collected as animal fodder or for other purposes.

An interesting observation about some of the houses in this area (houses 2, 10, 11) is that traces of turf/peat were observed in the floated material (chapter 13). These houses have no, or very few, botanical remains. The presence of considerable amounts of slag-like fragments, burnt clay pieces, and turf/peat in combination with low numbers of plant and bone remains could suggest an area with limited household activity. A possible interpretation is some kind of production or other types of activity, or a combination of these with limited household activities.

ID 216874, Area 1

Twenty-five houses were studied in Area 1, covering the period between 400 BC and AD 500, but with most dated to the interval 200 BC – AD 200. Apart from a few exceptions (houses 15, 16, 30 and 42), the average amount of preserved botanical remains in the houses is low. Unfortunately, the seed concentrations cannot be calculated for all the samples in this area as some of them arrived pre-floated at MAL, and information about their volume before floatation is missing. The median concentration for the rest of the samples is between 0 and 2 seeds/litre sediment, with a number of outliers between 4 to 7 seeds/litre (Figure 12.3). Further exceptions are much higher, with 21 - 24 and even over 100 seeds/litre sediment. Posthole 3838 in house 16 contained 132 seeds/litre sediment, and it may be safe to assume that it was situated close to either a grain storage area or an area where crops have been processed. The large amount of arable weeds in the sample would suggest the latter is the more probable interpretation.

The volume after floatation in many of the samples was very small – between 1 and 5 ml – indicating a small preserved organic fraction. The amount of charcoal varies considerably, from almost invisible charcoal fragments to about 75% of the floated sample volume. From this, we can conclude that the burning activities occurred with varying intensities in the different houses and from area to area within each house.

The preservation of the plant macro remains in the area is poor. Some of the small-seeded plants like weeds/ruderals and meadow and pasture plants are severely damaged and only their inner part was preserved, making identification to species impossible. Just over half of the cereal grains are also unidentifiable and fragmented (Figure 12.1), and the barley grains could not always be determined to subspecies level.

Interestingly, almost all of the houses in Area 1 contained cultivated cereals (Figure 12.7). These were dominated by barley (*Hordeum vulgare*), mainly in its hulled form (*Hordeum vulgare* var. *vulgare*), but naked barley (*Hordeum vulgare* var. *nudum*) was also identified. It is possible that hulled barley was most prevalent, but this should be interpreted with caution as many of the barley grains are determined only to

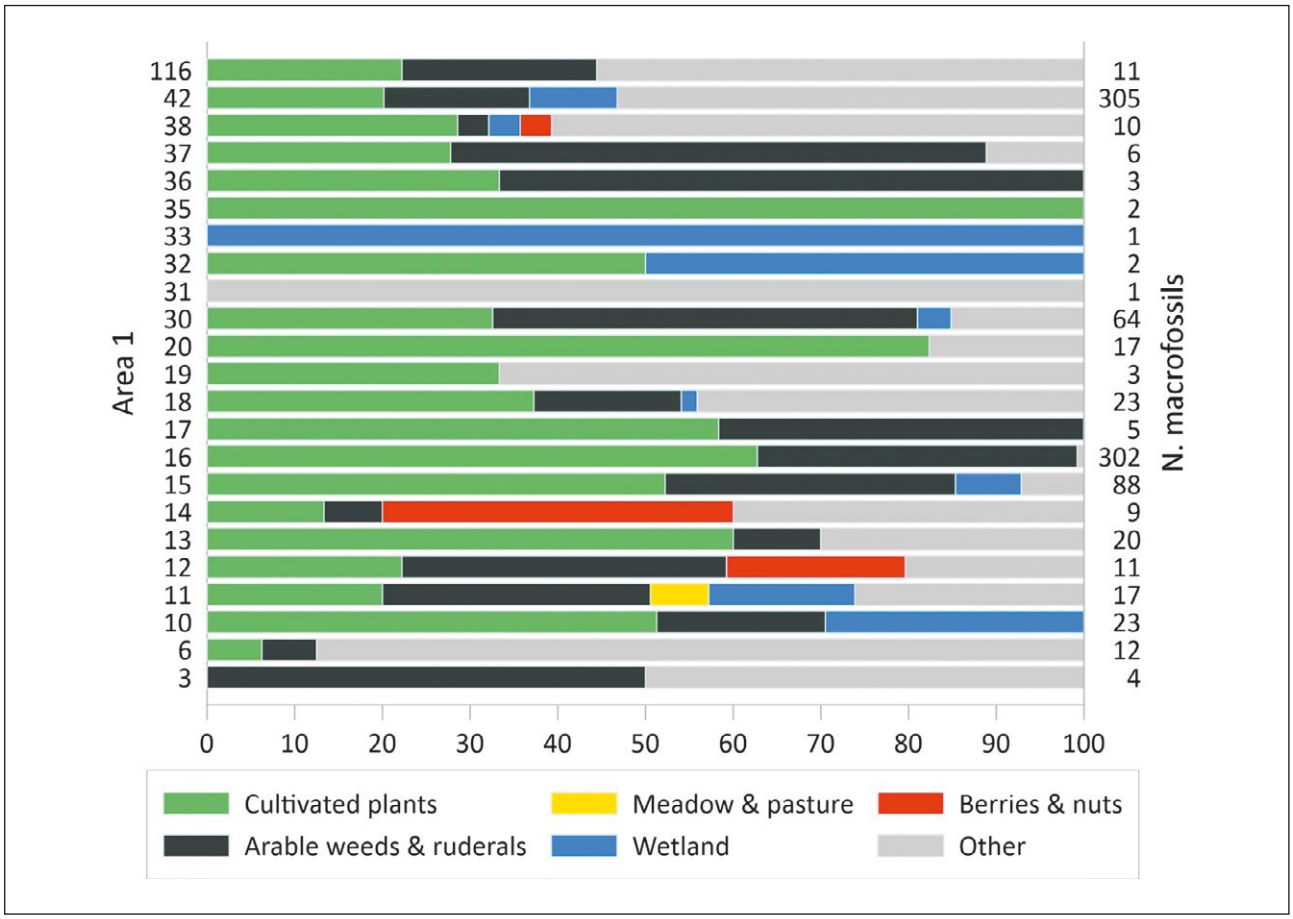

Figure 12.7. *The relative proportion of plant ecological groups per house in Area 1. Houses with no identifiable remains have been excluded for clarity, as have samples from outside of houses. House numbers are on the left, number of macrofossils per house on the right. See Table 12.1 for total macrofossil numbers.*

species level. Single finds of wheat (*Triticum* sp.) and emmer/spelt (*Triticum dicoccum/spelta*) were identified in two samples. This is, however, insufficient evidence to say whether or not any wheat taxa were cultivated. Even if wheat was cultivated, it would most likely only be as a secondary crop. Single finds of wild oats (*Avena* sp.) and rye (*Secale cereale*) were registered, but their limited amounts suggest that they most probably occurred as weeds in the other crops.

Sixteen flax seeds (*Linum usitatissimum*) were found in a sample from house 16, which could be evidence for its cultivation and use in the area. Flax is cultivated for its oil and fibres, as well as for its use as an ingredient in food.

The presence of hazelnut shells (*Corylus avellana*) indicates that some gathered plants (nuts and berries) were also part of the population's diet.

The amount and diversity of the weeds/ruderals and other wild plants was quite large in the houses of Area 1. Common chickweed (*Stellaria media*), fat-hen (*Chenopodium album*), pale persicaria (*Persicaria lapathifolia*) and corn spurrey (*Spergula arvensis*) dominated the assemblage. Other taxa were often found in smaller amounts, including black bindweed (*Fallopia convolvulus*), bedstraw (*Galium* sp.), dock/sorrels (*Rumex* sp.), cinquefoils (*Potentilla* sp.) and buttercup (*Ranunculus* sp.). The large amount of weeds and ruderals in combination with cereals provides evidence for household activities, such as the processing or cleaning of crops in the areas where they were found. Fragments of bones were detected in more than half of the houses, and their presence could be used as further evidence for household activities, including cooking areas.

Small amounts of true sedges (*Carex* sp.) were found in almost half of the houses. These species grow in wetland areas and are usually considered as evidence for the close proximity of wetlands. They could also have been used as animal fodder or collected for other purposes, such as basketry and cordage making (Soltvedt and Henningsmoen 2016).

Spruce needles were found in about one-third of the houses, including more than 200 fragments in house 42. Spruce expanded into the area of Oslo fjord around 1200 years ago (Høeg et al. 2019), and so these finds are not unexpected. A number of spruce needles

were thus submitted for radiocarbon dating. However, the dates from one sample from Area 1, and two from Area 6, gave suspiciously young results; younger than 324 BP. As there is strong evidence that the site is older than this, it is reasonable to conclude that these spruce needles are a later contamination, most likely due to bioturbation and the in-mixing of modern material by rodents. These results show the complexity of analysing and interpreting archaeobotanical samples, and especially the choice of material for dating and the importance of dating multiple macrofossils from any structure.

ID 216874, Area 2

Eighteen houses were studied in Area 2, roughly dated to between 400 BC and AD 200. The preservation of the botanical material differs between houses, ranging from no preserved macrofossil remains or just single items, to quite rich plant material. In this area, the variation in the number of samples from each house is particularly noticeable, and the houses with the best preservation had at least eight samples, with some having as many as fifteen or twenty samples. However, a number of the samples arrived pre-floated at MAL, and it was not possible to calculate their seed concentrations. In the un-floated material, concentrations were generally low, between 0 to 2 seeds per litre sediment in several houses (1, 9, 25, 26, 28, 34, 39, 46 and 49), but between 8 and 14 seeds in others (house 2, 4, 8 and 27) (Figure 12.3).

Thirteen of the eighteen studied houses had preserved cereals, although these were often only represented by a few fragmented or whole cereal grains which could not be further identified. The vast majority of grains identified to species are barley (*Hordeum vulgare*), and, in houses 2, 4, 24, and 27, hulled barley (*Hordeum vulgare* var. *vulgare*). Only one grain of naked barley was found in the area, in house 4. Single grains of undifferentiated wheat species (*Triticum* sp.) and emmer/spelt (*Triticum dicoccum/spelta*) were registered in one sample from house 8. A relatively large amount of cereals was found in house 27 along with an almost negligible quantity of arable weeds. This corresponds to an area where crops were stored, already processed and cleaned from weeds, and prepared for consumption.

Very few finds of collected/gathered plants were found, and they were only represented by a few hazelnut (*Corylus avellana*) shell fragments and a single berry seed (*Rubus* sp.).

The diversity of the weeds/ruderals and other wild plants is considerable in this area. The most common weed was fat-hen (*Chenopodium album*), followed by common chickweed (*Stellaria media*), pale persicaria (*Persicaria lapathifolia*), black bindweed (*Fallopia convolvulus*), corn spurrey (*Spergula*

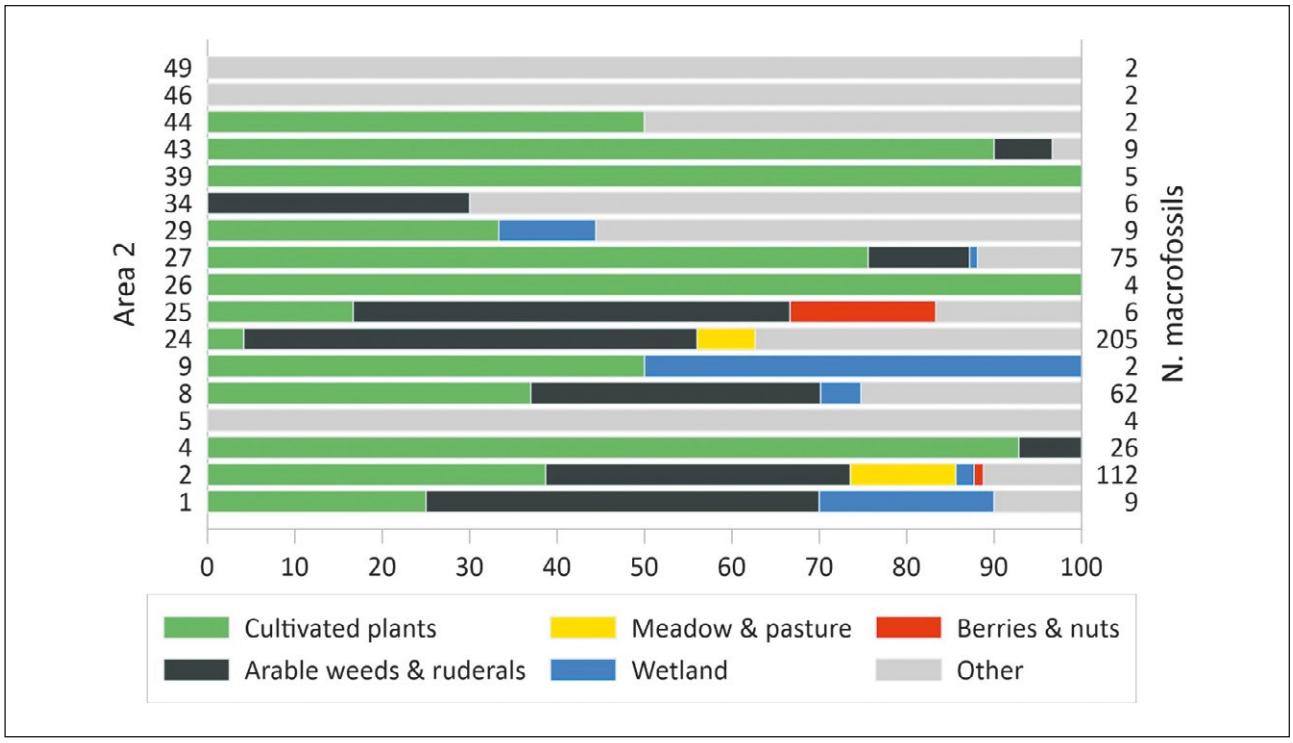

Figure 12.8. *The relative proportion of plant ecological groups per house in Area 2. Houses with no identifiable remains have been excluded for clarity, as have samples from outside of houses. House numbers are on the left, number of macrofossils per house on the right. See Table 12.1 for total macrofossil numbers.*

arvensis) and bedstraws (*Galium* sp.). Most of these plants are nutrient-requiring/nitrophilous and this gives some indication that a permanent field system with manuring was in use (Viklund, 1998). These species are typically associated with spring-sown crops, and this corresponds well with barley cultivation. The presence of both low-growing plants, like field pennycress (*Thlaspi arvense*) and corn spurrey (*Spergula arvensis*), and high-growing ones, such as fat-hen (*Chenopodium album*), bedstraws (*Galium* sp.) and pale persicaria (*Persicaria lapathifolia*), indicates that the harvest was performed close to the ground. Some wild species may also have been purposefully collected for human consumption and/or animal fodder.

An interesting observation for this area is the large amount of meadow and pasture plants in houses 2 and 24. This includes ribwort plantain (*Plantago lanceolata*), catchfly/campion (*Silene* sp.), greater plantain (*Plantago major*) and dock/sorrels (*Rumex* sp.). Their presence in these numbers (Figure 12.8) suggests that these plants might have been gathered as fodder, and that these structures may have included stable or barn spaces. It also testifies to a high probability of the surrounding landscape having pasture lands.

Wetland plants, mainly true sedges (*Carex* sp.) but also spike-sedges (*Eleocharis* sp.), were found in small numbers in six houses. Their limited numbers do not allow for any conclusions regarding the presence of wetlands nearby, but their occurrence may indicate collection for fodder or other purposes.

The presence of small quantities of spruce (*Picea abies*) needles in four houses is considered as later contamination (see above on dating problems).

Bone fragments were found in one-third of the houses, and especially large amounts were preserved in the ovens of houses 2, 27 and 39 (with most in house 2). This, when combined with the presence of cultivated plants, is strong evidence of certain areas being connected with cooking activities and the preparation of food. However, an alternative interpretation, that sees these bone fragments as residue from the surrounding area that had been been thrown in the ovens, should not be excluded.

ID 216874, Area 3

Only five houses were analysed from Area 3, dated to between 200 BC and AD 40. The seed concentration was only calculated for the six samples floated in Umeå, which produced concentrations between 0 and 10 seeds per litre sediment. The preservation of the remains is comparatively good, and only one seed was unidentifiable. A large proportion of the cereal grains (Figure 12.2) was, however, fragmented and had lost any characteristics which would have enabled further identification. Most of the cereals are determined as barley (*Hordeum vulgare*), with a few identified to the subspecies level as hulled barley (*Hordeum vulgare* var. *vulgare*). A single find of emmer/spelt wheat (*Triticum dicoccum/spelta*) was also detected.

The overall picture of the area shows that the cultivated plants dominate (Figure 12.9). Weeds and ruderals are found in slightly smaller amounts, and almost no other plants were preserved in the samples. Weeds are represented by fat-hen (*Chenopodium album*), pale persicaria (*Persicaria lapathifolia*), false cleavers (*Galium spurium*), *Solanum* sp., and cinquefoils (*Potentilla* sp.). Interestingly, within the houses the cereals are mostly found in different postholes from the weeds. This is especially visible in house 22 where more features were sampled, and could indicate a division of the internal space of the house into areas for cooking, storage, stable/barn, and spaces for processing cereals, etc.

Wetland species are indicated by single finds of true sedges (*Carex* sp.) in houses 7, 22, and 119.

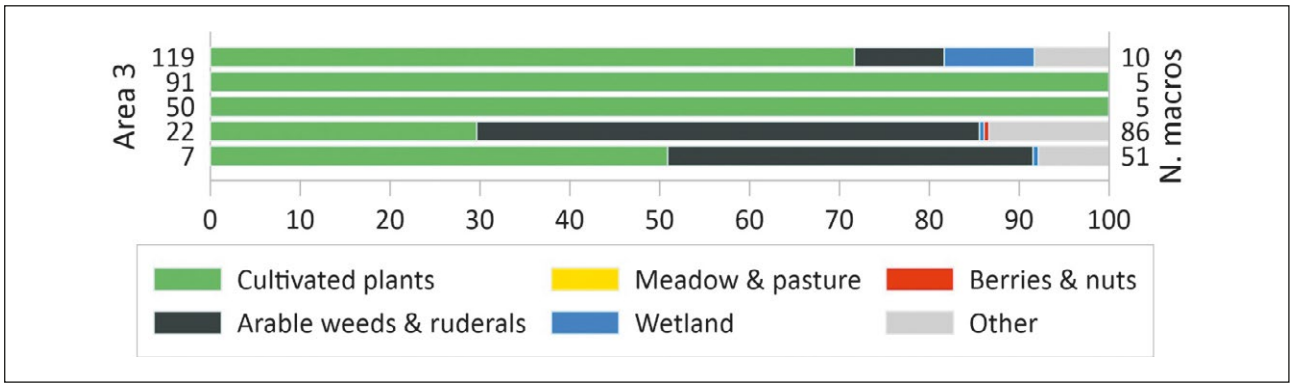

Figure 12.9. *The relative proportion of plant ecological groups per house in Area 3. Houses with no identifiable remains have been excluded for clarity, as have samples from outside of houses. House numbers are on the left, number of macrofossils per house on the right. See Table 12.1 for total macrofossil numbers.*

ID 216874, Area 4

Twenty-one houses were studied from Area 4, dated broadly from 400 BC to AD 100. The preservation of the botanical material is comparatively good, although some of the houses (21, 62, 71, 74, 111) totally lack botanical remains, and others include just one or two macrofossils (houses 63, 68, 73, and 94). Despite these low numbers, fourteen of the houses contain cereals (Figure 12.10). The lack of remains in several houses leads to a very low median seed concentration (Figure 12.3), with 90% of the samples having concentrations of less than 11 seeds per litre. In several of the houses at least one sample has a high concentration, varying from about 20 to over 100 seeds per litre sediment, (posthole 61774, in house 99, has the highest macrofossil concentration at Dilling with 178 seeds/litre). The average proportion of unidentified seeds for the area is about 23% (Figure 12.2). Some of the houses contain large amounts of charred remains (houses 56, 64, 99, 87, 78, 104), but usually all the botanical finds are concentrated to one or two postholes.

Cereals in Area 4 are characterized by their diversity. Again, barley (*Hordeum vulgare*) is the dominant crop, and it is represented by its two subspecies hulled (*Hordeum vulgare* var. *vulgare*) and naked barley (*Hordeum vulgare* var. *nudum*). Of the two species, hulled barley is more common, being found in four houses (53, 64, 99, 104), whereas naked barley which is only found in two (87, 99). The quantities of hulled barley grains are greater than those of the naked ones. In three houses (84, 85 and 99) and in two samples outside of the houses, wheat (*Triticum* sp.) grains were identified. In some samples, they were not determined to species level, but in others further identification was possible. Three of the houses (84, 98, and 99) in the area contained emmer/spelt wheat (*Triticum dicoccum/spelta*), and in house 99 it is the most abundant crop. The only finds of einkorn/emmer wheat (*Triticum monococcum/dicoccum*) at Dilling were found in two of the houses (85 and 99) in this area, and in house 99 the einkorn/emmer wheat was found in the same posthole as the naked barley. Einkorn and emmer wheat, together with naked barley, are more typical for earlier periods from the Neolithic to the Bronze Age (Viklund 1998). This find can thus be either connected to earlier phases of the settlement, or an indication that these crops continued to be grown in later periods at a limited scale.

Another cultivated plant found in the area is flax (*Linum usitatissimum*), which was registered in four houses (78, 87, 99, 104), and in significantly larger amounts in house 104, where it is the dominant crop. Houses 78, 87, and 99 overlap each other spatially, and are considered as different phases of one house. This suggests a particular space in Area 4 where flax was stored or processed.

The presence of hazelnut (*Corylus avellana*) shells and bog bilberry (*Vaccinium* cf. *uliginosum*) in a few

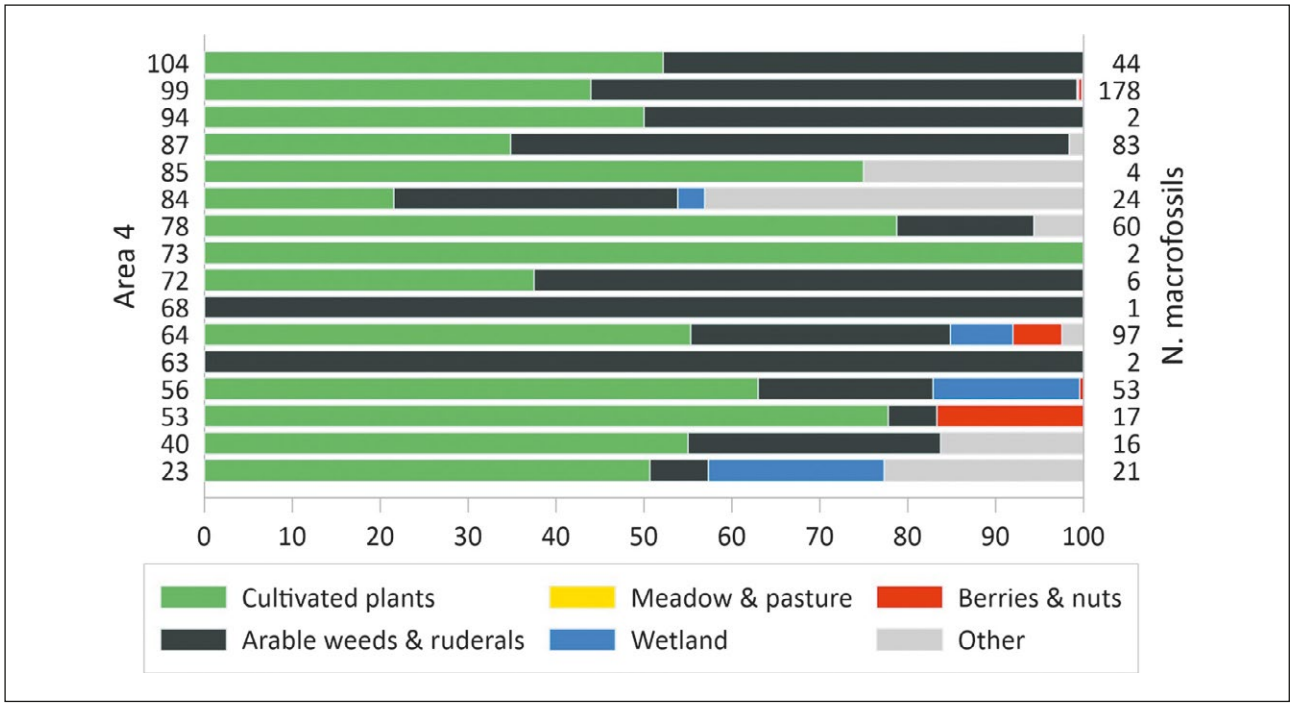

Figure 12.10. *The relative proportion of plant ecological groups per house in Area 4. Houses with no identifiable remains have been excluded for clarity, as have samples from outside of houses. House numbers are on the left, number of macrofossils per house on the right. See Table 11 for total macrofossil numbers.*

of the houses indicates that gathered plants were part of the diet in this phase of the site as well.

One fragment of a spruce (*Picea abies*) needle was found in house 84.

Several different species of weeds and ruderals were identified in the area, most often in samples where cultivated plants were also present. This could either hint at areas where cultivated plants were stored, in a so-called unclean state before their final processing, or areas where crops were processed and cleaned. The prevailing species is fat-hen (*Chenopodium album*), and more than 100 seeds were identified in house 99, which could indicate its use as fodder or for human consumption (Viklund 1998). A high diversity of other common weeds/ruderals and other wild plants was found in small amounts. These include common chickweed (*Stellaria media*), pale persicaria (*Persicaria lapathifolia*), black bindweed (*Fallopia convolvulus*), corn spurrey (*Spergula arvensis*), bedstraws (*Galium* sp.), cockspur (*Echinochloa crus-galli*), hemp-nettle (*Galeopsis* sp.) saltbush (*Atriplex* sp.), knotgrass (*Polygonum aviculare*), mouse-ear chickweed (*Cerastium* sp.), black nightshade (*Solanum nigrum*), violet (*Viola* sp.), clover (*Trifolium* sp.), buttercup (*Ranunculus* sp.) and cinquefoils (*Potentilla* sp.).

Wetland species include true sedges (*Carex* sp.) and spike sedges (*Eleocharis* sp.), and are found in five houses (23, 56, 64, 84, 99). The amount of the true sedges (*Carex* sp.) in house 56 is comparatively high, and could indicate a particular use of the plant or available wetland areas nearby (see below).

In some of the houses, many slag-like fragments and pieces of burnt clay were found, which could indicate other types of activities and production areas. Their presence could also be interpreted as evidence for the destruction of houses by fire.

ID 216874, Area 5

Twenty-two houses were studied in Area 5, mainly spanning the interval 200 BC to AD 100/200.

The preservation of the botanical material from Area 5 is generally poor, and about half of the houses provided either no plant remains (houses 65, 77 and 92) or a limited numbers of seeds (Figure 12.11). The small number of samples (up to four) in some of the houses will have influenced these results, with the chance of finding areas within a house where plant macro remains would potentially be preserved being more limited. However, other houses which were extensively sampled (69, 70, 76, 89 and 97) provide good data (Figure 12.11) which could act as a model for many of the other houses in the area, or potentially throughout the site. The average concentration in the samples is between 0 and 6 seeds per litre sediment. There are also 11 samples with concentrations of 20 or above seeds/litre, and single samples in houses 69, 70, 96, and 97 have concentrations of more than 50 seeds per litre (Figure 12.3).

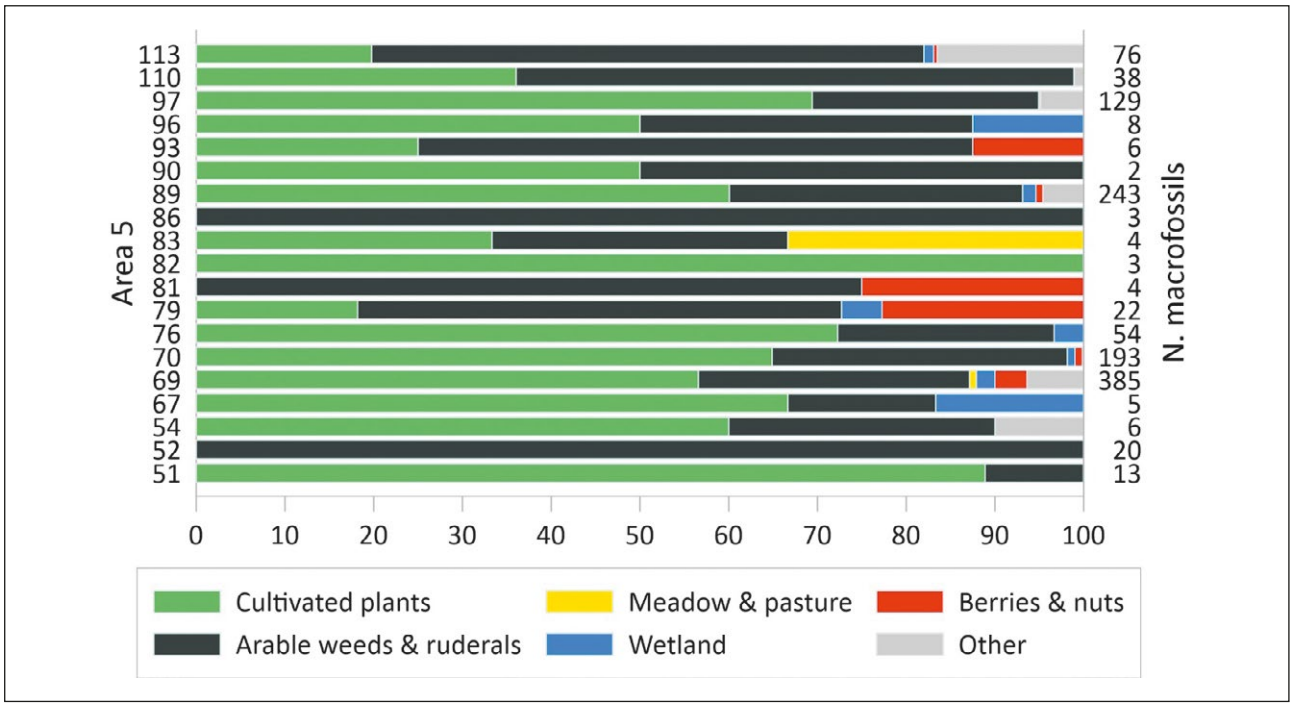

Figure 12.11. *The relative proportion of plant ecological groups per house in Area 5. Houses with no identifiable remains have been excluded for clarity, as have samples from outside of houses. House numbers are on the left, number of macrofossils per house on the right. See Table 1 for total macrofossil numbers.*

Area 5 includes a large number and proportion of unidentified seeds (Figure 12.1 and Figure 12.2), indicating poor preservation conditions. Houses 69 and 70 include especially high proportions of unidentified macrofossils, most of which are highly fragmented remains from small-seeded plants, or where only the inner part was preserved. A large proportion of the cereal grains were classed as unidentified cereals and cereal fragments (Figure 12.1). One possible explanation could be that the plants within the houses were exposed to high temperatures, leading to the destruction of the material. This is supported by the large amounts of slag-like fragments and burnt clay pieces found.

In most cases where postholes were sampled in layers, either only the top layer contained plant remains, or this layer contained most of the plant remains within the feature. This suggests that seeds probably came from the cultural layer/floor around the posthole, as postulated by Engelmark *et al.* (1997).

Cereals dominate the cultivated plants, with more than half of the houses containing them (Figure 12.11). Roughly 51% of the large number of cereal grains was quantified as whole grain equivalents from fragments (Figure 12.1). The main cereal crop is barley (*Hordeum vulgare*), but most of the macrofossils were not possible to identify to subspecies level. Where further identification was possible, the hulled barley subspecies (*Hordeum vulgare* var. *vulgare*) was dominant both in number of finds (Table 12.1) and the number of structures in which it occurs. It is interesting that single grains of naked barley were found in houses where hulled barley was also present (houses 69 and 113). Usually, naked barley is connected with earlier periods, but it continued to be grown and used later, albeit in more limited amounts (Engelmark and Viklund 2008). The finds here could also represent traces of different house phases. Single finds of emmer/spelt wheat (*Triticum dicoccum/spelta*) were made in house 69, and single finds of oats (*Avena* sp./*sativa*) were made in houses 69, 70, 76, and 97. With such small numbers, any inference on their cultivation would be speculative, especially in the case of oats, which could grow as a weed amongst the cereal crops. However, as houses 69, 70, and 97 overlap and are considered different phases of one and the same house, the crops found could represent the remains of different phases of occupation. Oats have occasionally appeared in archaeological samples from the end of the Bronze Age (Grabowski 2011) and Viklund argues that they were used for consumption, regardless of whether they were cultivated or occurred as weeds in the crops (Viklund 2004).

Other cultivated plants found in the area are the oil/fibre plants flax (*Linum usitatissimum*) and gold-of-pleasure (*Camelina sativa*). Flax was found in houses 89, 93, 110, and 113, and gold-of-pleasure in 69, 70, 89, and 97. The largest amounts of both flax and gold-of-pleasure were found in one and the same sample (52134) in house 89, together with a lot of cereals. These finds provide evidence for the cultivation and use of both plants, especially in the case of house 89, where it marks an area of household activities (e.g. cooking, everyday activities, storage). Finds of flax and gold-of-pleasure in the same context were also noted at Uppåkra, near Lund, in Sweden, and this was interpreted as evidence for similar processing strategies for both plants. Their common characteristic is their high oil content, and it is quite probable that they have been cultivated and used for oil production (Larsson 2013). Oil-rich seeds could also have been added to food for flavouring and to increase its nutritional value (Hristova et al. 2019).

A small number of seeds/fruits from raspberry (*Rubus idaeus*) and bog bilberry (*Vaccinium* cf. *uliginosum*), as well as shell fragments of hazelnut (*Corylus avellana*), were found throughout Area 5. Their presence confirms the use of gathered plants and shows that they were still part of the diet of the population.

One seed from hops (*Humulus lupulus*) was identified in house 97. Whether it was cultivated or brought to the house for food or other purposes is unclear, but it is known to have been used in connection with beer brewing, as flavouring agent and preservative, since medieval times (Stika 2011, Verberg 2020, Viklund 2011).

The weeds and ruderals are dominated by common chickweed (*Stellaria media*), fat-hen (*Chenopodium album*), and pale persicaria (*Persicaria lapathifolia*). Although fat-hen is the dominant weed in areas 2, 4 and 6, this is not the case in Area 5, and in some houses (e.g. 70) it was found in very limited numbers. This difference could be explained in a number of ways, such as a change in soil properties over time and/or space, differences in the choice of cultivated plants, or as a result of variation in the use of the plant. Fat-hen could have been used as either fodder and/or food (Mueller-Bieniek et al. 2020). Other weeds/ruderals and wild plants from the area are found comparatively often, but in small amounts. These include corn spurrey (*Spergula arvensis*), bedstraws (*Galium* sp.), cockspur (*Echinochloa crus-galli*), hemp-nettle (*Galeopsis* sp.), saltbush (*Atriplex* sp.), knotgrass (*Polygonum aviculare*), field pennycress (*Thlaspi arvense*), mouse-ear chickweed (*Cerastium*

sp.), black nightshade (*Solanum nigrum*), violet (*Viola* sp.), buttercup (*Ranunculus* sp.), vetches (*Vicia* sp.), seeds from the bean (Fabaceae)[8] and grass/cereal (Poacea) families, and dock/sorrel (*Rumex* sp.). This varied assemblage demonstrates the great diversity of weeds and ruderals in the study region.

Representatives of wetland plants, mainly true sedges (*Carex* sp.) but also spike sedges (*Eleocharis* sp.), were found in nine houses, usually as single finds. *Carex* was found in large amounts in house 89 and in one posthole not belonging to any house (48488). In both cases, it was found in combination with a lot of arable weeds, mainly common chickweed (*Stellaria media*). It is hard to say whether these species were deliberately collected for fodder or other purposes (e.g. food), or whether they were given to animals as a by-product of the cleaning other crops. Their occasional co-occurrence with finds of cereals and oil plants could mean that they were harvested with the crops and could be considered as by-products after crop processing.

Fragments of bone were found in many of the samples. They were often concentrated in the ovens, which provides information on the location and use of the cooking areas where household activities were performed. The plant species found in the ovens/fireplaces did not differ substantially from the species found in the postholes. However, these samples did contain more cultivated plants than arable weeds, suggesting areas connected with the final processing of cereals and food preparation.

The archaeobotanical finds in the houses of Area 5 show traces of both cereal and oil plant cultivation, and indications of animal fodder, gathered plants, and the possible cultivation of hops, all of which gives a broad picture of the plants used at the site.

ID 216874, Area 6

Eleven houses were analysed from Area 6, including three possible pit houses (100, 101 and 103). The houses are dated to between 400 BC and AD 100. The general preservation of plant remains is extremely poor, even in houses with a lot of samples, such as house 75, which has 15 samples (Figure 12.12). House 88 contained no macrofossil remains, and house 103 only a single *Rumex* sp. seed. The average concentration of seeds in the samples is from 0 to 2 seeds per litre sediment. A few samples (in houses 59, 60, and 101) have higher concentrations, between 7 and 22 seeds per litre sediment (Figure 12.3).

Seven houses contain cereals, just over half of which (ca. 53%) are fragmented (Figure 12.1). Both naked (*Hordeum vulgare* var. *nudum*) and hulled barley (*Hordeum vulgare* var. *vulgare*) were detected, but in very limited numbers. Naked barley is represented by only one grain in house 61, and some of the barley grains were not defined to subspecies level. A single find of a flax seed was registered in house 60. The cultivated plants found suggest that hulled barley was the most common crop, but the flax find gives a hint of more diverse cultivated flora in the area (Figure 12.12).

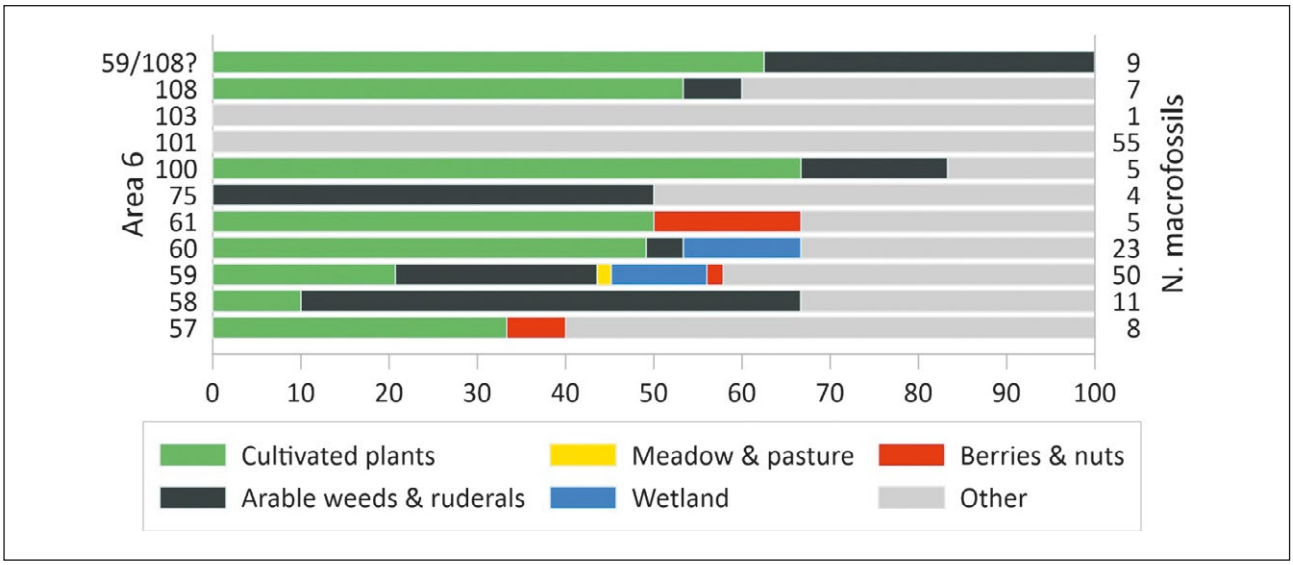

Figure 12.12. *The relative proportion of plant ecological groups per house in Area 6. Houses with no identifiable remains have been excluded for clarity, as have samples from outside of houses. House numbers are on the left, number of macrofossils per house on the right. See Table 1 for total macrofossil numbers.*

8 Note that the 'bean family' does not indicate edible beans, but a large group of plants covering thousands of species, only some of which are edible.

Gathered plants are only represented by hazelnut (*Corylus avellana*) shell fragments, and this is the most commonly gathered plant at the whole site.

Spruce (*Picea abies*) needle fragments were registered in more than half of the houses, with over 50 pieces in a sample from house 101. Two spruce needles sent for radiocarbon dating produced very young dates and indicate that there is a risk of modern contamination — at least with respect to the spruce needles found in these features. Unusual small finds of other taxa should therefore be interpreted with caution, as there is a possibility of them having been redeposited by rodent activity.

Weeds and ruderals, as well as other wild plants, are found in limited amounts, with fat-hen (*Chenopodium album*) being most prevalent, albeit in small numbers. Other plants found include false cleavers (*Galium spurium*), sun spurge (*Euphorbia helioscopia*), saltbush (*Atriplex* sp.), common chickweed (*Stellaria media*), pale persicaria (*Persicaria lapathifolia*), hemp-nettle (*Galeopsis* sp.), black nightshade (*Solanum nigrum*), cinquefoils (*Potentilla* sp.), buttercup (*Ranunculus* sp.) and seeds from the bean family (Fabaceae). The weeds and ruderals are rarely found in the same samples as cereals, suggesting a spatial division of the houses.

The meadow/pasture plants catchfly/campion (*Silene* sp.) and greater plantain (*Plantago major*) were only found as individual seeds in house 59. Although tentative, their presence may suggest collection of these plants, and this suggests that the area around these postholes could have been used as a stable/byre or barn.

As in Area 5, samples from ovens/fireplaces contained mainly cereal grains, and thus point towards possible household/cooking activities. Cooking activities could also be one possible explanation for the highly fragmented and badly preserved cereals. However, a reasonably large number of slag-like fragments were found in samples throughout the area and this, in combination with the poor preservation of plant remains, could indicate some form of production activity.

Wetland plants, such as true sedges (*Carex* sp.) and spike sedges (*Eleocharis* sp.), were found in some samples in houses 59 and 60. Their amounts are, however, too low to support any further interpretation about their use.

Samples from eleven pits situated outside of the houses were also analysed. Most of them completely lacked botanical material or contained just a few weed/ruderal seeds. Only one pit (708447) included cereals, identified as barley (*Hordeum vulgare*), and another pit (716436) contained a considerable amount (75) of spruce needles (*Picea abies*). It is quite common that pits contain no, or very limited, botanical remains if they are not used as refuse pits. Very often pits were initially dug or used for one purpose, and then subsequently reused as refuse pits. Furthermore, it is very difficult to define their function only on the base of their botanical finds. This is especially so for interpretations of their primary function, all evidence for which may have been lost as a result of later activities (Hristova et al 2017).

A well from outside of the houses was almost completely empty of both charred and uncharred macrofossil remains. Wells can provide excellent preservation of subfossil organic material if the sediments remain waterlogged after deposition. Basal layers can represent periods of active use, often followed by sediments recording reuse (perhaps as a waste pit, latrine or water hole for cattle), abandonment and subsequent filling from the weathering of the sides, or cleaning/disturbance of the surface around them (Buckland et al. 2018, Larsson 2015). However, if the well sediments dry out, or especially if there are repeated wetting and drying phases, the chances for plant preservation are very limited, especially in a subfossil state. When wells are re-used as refuse pits, charred material and other settlement evidence is often found, and it can thus be concluded that these wells were most probably not re-used, but were simply filled once their usefulness had passed.

Development through time

The most intensive period of occupation at Dilling was between 200 BC and AD 200, and this is clearly visible in the archaeobotanical finds from the dated houses (Figure 12.13). This was also the period when agricultural activities were at their most intensive, and it is the only period when the cultivation of oil/fibre plants was practised. The single find of hops (*Humulus lupulus*) is also dated to between 200 and 0 BC, further supporting this interpretation.

A number of plants indicating disturbance are present from about 400 BC, and barley cultivation is potentially well established in the area before this. Interestingly, naked barley (*Hordeum vulgare* var. *nudum*) first occurs quite late at the site, around 350 BC to AD 200. Naked barley, together with einkorn (*Triticum monococcum*) and emmer (*T. dicoccum*), are considered typical for earlier periods in Scandinavia (up to the Late Bronze and Early Iron Age) after which they are slowly replaced by hulled barley (*Hordeum vulgare* var. *vulgare*) (Viklund 1998). This result could be a taphonomic effect, resulting from the fact that subspecies identification was only possible

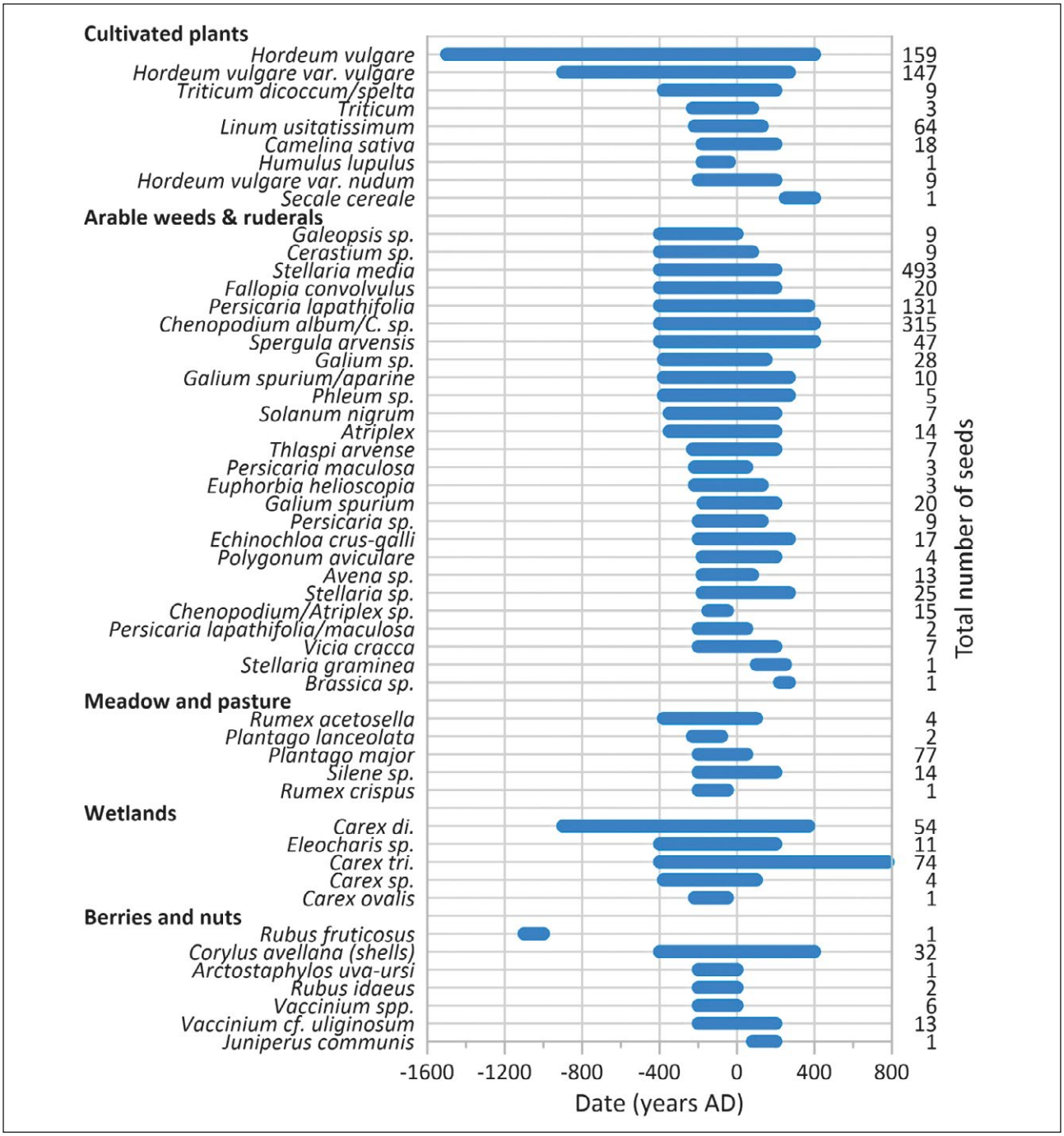

Figure 12.13. *The inferred presence of culturally important plants over time at Dilling. Only data from samples in dated houses is included, the bars indicating potential presence from the first to the last occurrence of each taxon. The total number of macrofossils of each taxon in the dated houses is shown on the right.*

for a small proportion of the barley seeds due to poor preservation. On a complex site like Dilling, however, other more speculative explanations are also possible, such as site-specific cultivation specialisation or traditions, or the continuous cultivation of both subspecies. The overlapping periods and complex dating of some of the houses may also contrive to confound a simple interpretation.

Rye (*Secale cereale*) is the last of the cereals to appear at the site, after AD 200. Rye is typical for later periods in Scandinavia, and it was never a substantial part of the crop cultivation in the region (Viklund et al. 2013).

Surrounding landscape

A number of inferences about the surrounding landscape can be drawn from the macrofossil assemblage, which is characterized by considerable diversity (Table 12.1). The taxa found indicate an open, cultivated landscape, with areas of meadow and/or pasture. This

scenario peaks along with the most intensive agricultural and occupational period between 200 BC and AD 200 (Figure 12.13) (see chapters 2 and 15). This is also a period when changes in the woodland vegetation are observed in the charcoal results (see chapter 11), with the dominance of birch and the decline of ash associated with the development of a light, open, cultural landscape. Many of the most abundant arable weeds, such as fat-hen (*Chenopodium album*), prefer nutrient-rich soils and indicate manuring after 400 BC (Viklund 1998; chapter 13). Small amounts of wetland plants were found in all excavated areas, but their relative abundance was highest in Areas 5 and ID 216873. In the latter, these finds were connected more with the Migration Period, when significant amounts of seaweeds were also found. An increase of wetland plants, in combination with the results from geoarchaeological analyses (chapter 13), may suggest changes in the climate, with it becoming wetter, and an increase in the use of wetland resources, after AD 250.

CONCLUSIONS

The archaeobotanical material from Dilling provides an overview of plant use and palaeodiet, as well agricultural practices and household activities, during the Iron Age of southeast Norway. Some aspects of the surrounding environmental conditions and natural vegetation were also observed. Despite the absence of exceptionally rich individual assemblages, the extensive and well-documented sampling provides a rare opportunity to reconstruct a past subsistence economy diachronically and in detail. The combination of botanical remains and other finds, such as bones and slag-like fragments, enhances our understanding of the potential functions of distinct areas within the site. Overall, the composition of archaeobotanical remains points to an agricultural settlement with a farming community.

Among the crops, barley (*Hordeum vulgare*), particularly its hulled variety (*Hordeum vulgare* var. *vulgare*), emerges as the staple crop, widely distributed across the entire site. Naked barley (*Hordeum vulgare* var. *nudum*) and other cereals such as emmer/spelt (*Triticum dicoccum/spelta*), einkorn/emmer (*Triticum monococcum/dicoccum*), oats (*Avena sativa/Avena* sp.), and rye (*Secale cereale*), are less common at Dilling. Whilst some wheat species may have been cultivated, they will have played a secondary role in the diet of the population. The most diverse range of cereals was observed in Area 4, where different types of wheat were found in the same assemblages. Oats and rye, on the other hand, occur rarely in the samples and often as isolated grains. There is thus insufficient evidence for establishing whether they were cultivated. Oil/fibre plants, represented by flax and gold-of-pleasure, were cultivated at the site. Their highest concentrations were found in Areas 4 and 5, suggesting that a particular zone was allocated for their storage and/or processing. Furthermore, gathered plants such as hazelnuts and different kinds of berries significantly enriched the diet of the people at the site.

The diversity of weeds/ruderals and other wild species is quite large at Dilling, and especially so in some areas. The most common species are fat-hen (*Chenopodium album*), common chickweed (*Stellaria media*), and pale persicaria (*Persicaria lapathifolia*). Most of the weeds/ruderals are nutrient-requiring/nitrophilous species, which suggests the use of a permanent field system with manuring (Viklund, 1998). These species are also typical weeds among spring-sown crops, and this corresponds well with barley cultivation. Both low-growing (short) plants like field pennycress (*Thlaspi arvense*) and corn spurrey (*Spergula arvensis*), and high-growing (tall) ones, such as fat-hen (*Chenopodium album*), bedstraws (*Galium* sp.) and pale persicaria (*Persicaria lapathifolia*) were found, and it can thus be inferred that the harvest was performed close to the ground (Engelmark 1989). A number of wild plant species may have been collected purposefully for human consumption or animal fodder. This includes plants which have been found in the intestines of European bog bodies, and these are among the most common species found at Dilling. They include fat-hen, pale persicaria, corn spurrey, and black bindweed, and their occurrence in large assemblages is interpreted as indicating their importance as part of the prehistoric human diet (Behre 2008). A similar explanation could be suggested for the finds at Dilling.

In Iron Age houses, the most common wetland plants include true sedges and spike sedges (*Carex* sp. and *Eleocharis* sp.), and these are often considered as indicating the close proximity of wetland environments. These species are regularly encountered in the parts of Iron Age houses interpreted as having been stables or byres (Viklund, 1998), and their presence is often associated with their use as fodder or as the remains of animal dung. Their presence could, however, also be attributed to various other uses, including as bedding or roofing material, or for crafting straw objects such as carpets and baskets. Fragments of seaweeds were also found in Area ID216873, and this could have been used as fodder, building material, fertiliser or as a food preservative (Mooney 2018). The

occurrence of seaweed also indicates a connection between the site and the sea or coastal regions.

Finally, the Dilling project demonstrates how extensive and detailed sampling can, in combination with laboratory analyses, provide excellent information on past human activities at a site even when the topsoil has been lost and the preservation of organic remains is poor. The large archaeobotanical and geoarchaeological datasets now available from Dilling will hopefully provide a reference and inspiration for further research in the region and beyond.

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