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Wild West Frisia : the role of domestic and wild resource exploitation in Bronze Age subsistence

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9. The Dutch and European context

9.1 INTRODUCTION

West Frisia is deemed a good case study for coastal communities in north-western Europe along the southern North Sea coast, as was hypothesized in Chapter 1, and concluded in Chapter 8. In this chapter, it is assessed whether the elements of Bronze Age farming reconstructed for West Frisia are indeed comparable to those observed in other regions in the Netherlands and Europe.

The Dutch and European regions were all chosen for their close proximity to water of varying salinity, and since West Frisia also borders both freshwater and saltwater environments. For the comparison with these other regions, the same methods are employed as those used for the analyses of the different aspects of the West Frisian subsistence economy (cf. Chapter 4-7).

The main West Frisian sites used are Bovenkarspel, Enkhuizen, Medemblik, Westwoud, Hoogwoud, and Schagen. For crop husbandry and plant gathering, in addition, data from the sites Twisk, Hoogkarspel Watertoren, and Hoogkarspel Tolhuis is employed, whereas for animal husbandry and hunting, data from the sites Andijk, Zwaagdijk-Oost, and Hoogkarspel is added.

It is assumed that the preservation of remains from the different chosen sites is comparable due to their general location on clayey soils. Results based on data from sites where soils deviate from this pattern, are interpreted with caution. Interpretation is done on a general level since sieving practices were different at every site, resulting in the fact that the quantitative differences in remains may not be comparable. If and when sieving experiments become available for these sites in the future (cf. Chapter 5), an even more detailed comparison between regions is possible. Finally, throughout this chapter, sites are mentioned by their primary location of excavation, only followed by a second, specific toponym when confusion with other locations is likely.

9.2 THE RESEARCHED AREAS: THE NETHERLANDS

In the following section 9.3, it is investigated whether Bronze Age farmers from other Dutch areas practiced subsistence in a similar manner as in West Frisia or whether they possessed their own unique practices. For this comparison, several aspects were important to consider. First, because West Frisia is considered a case study for coastal communities (Chapter 1; section 9.1), sites needed to be located in close proximity to water. The term coast usually reflects an environment close to the sea, but in this comparison, coasts of both freshwater and saltwater bodies are considered, since West Frisia is surrounded by both types (Chapter 2). Second, the preservation of remains needed to be similar or at least comparable to the West Frisian situation, which means that mostly sites located on clayey soils were considered. Sites from upland Pleistocene sandy locations were not included, since preservation of bone and waterlogged plant remains at these sites is generally very poor. Conclusions based on differences between sites of these different deposits (sand vs. clay) could not reliably be drawn since taphonomy could have had diverse effects on the archaeological record within these different soil types. More in-depth methodological research is required before such comparisons are made (Chapter 11). Third, enough botanical and zoological remains needed to be present at the sites to be able to discuss the research topics listed in section 8.8. Finally, areas which were connected to West Frisia through waterways were also considered, since water cannot only influence subsistence practices, but can also form a route via which contact between different communities may have taken place over longer distances (Valentijn in prep). In this manner, possible similarities between different areas may be explained.

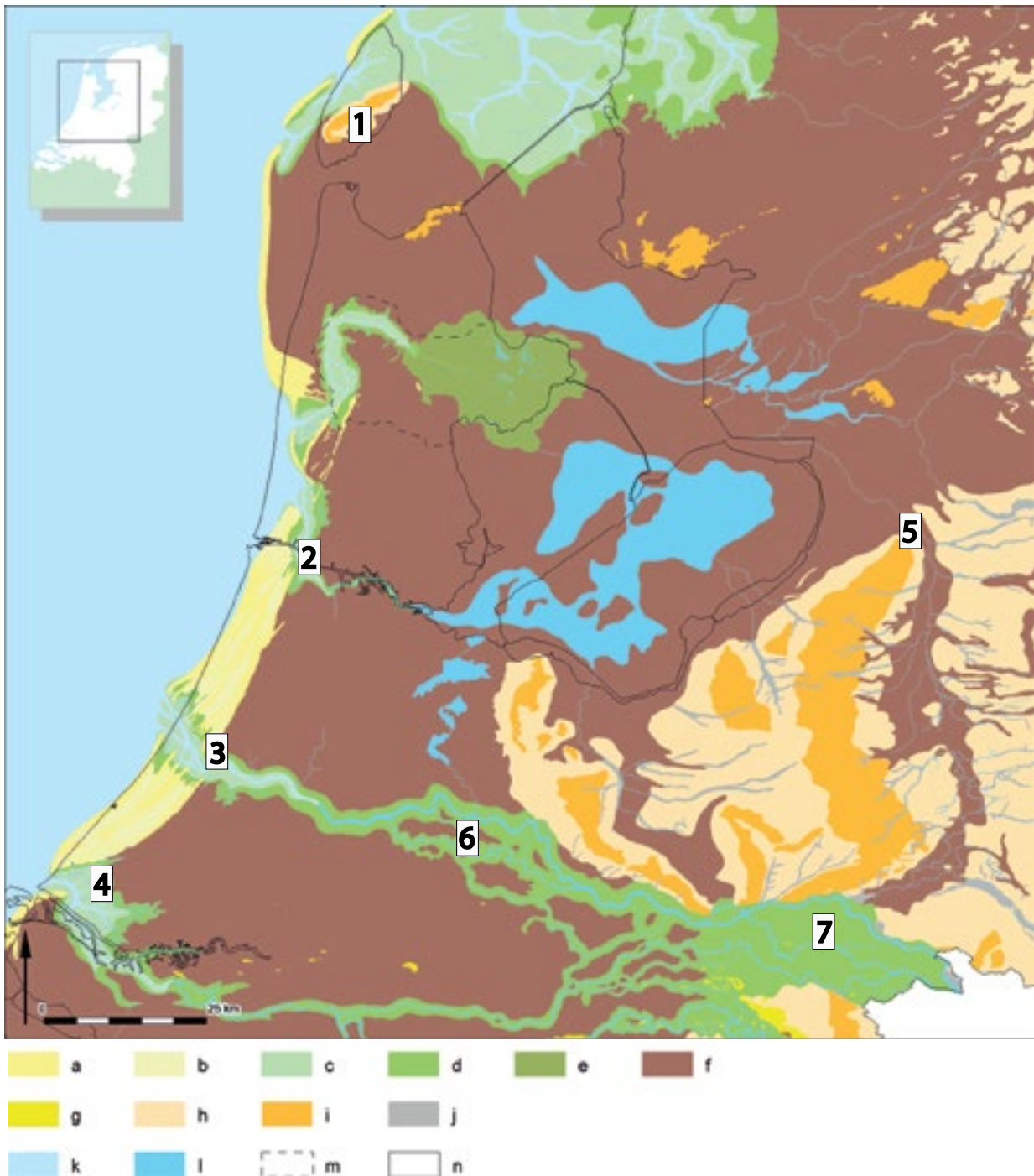


Figure 9.1. Overview of the Dutch regions researched to form a comparison with West Frisia; map according to Van Zijverden forthcoming. a: low dunes; b: beach-plain and dune valleys; c: intertidal areas: sand- and mudflats; d: fluvial flood plain and marine salt marsh areas; e: former mudflats (now freshwater environment); f: peat; g: river dunes; h: Pleistocene sand areas above 0 m -NAP; i: ice pushed moraines and drumlins; j: fluvial areas and brook valleys; k: outer water: mainly brackish and marine areas, North Sea, tidal channels and lagoons; l: inner water: mainly freshwater areas, river channels and lakes; m: outline of the recent Netherlands; n: outline of the recent area of West Frisia; 1: Texel; 2: Kennemerland, 3: Noordwijk, 4: Haaglanden, 5: Hattermerbroek, 6: River area - west, and 7: River area - east.

Table 9.1. Specific information of the sites from each researched Dutch region.

Region	Site and toponym	Date	Remains	Reference
1. Texel	Texel	MBA/LBA	Botanical, zoological	Woltering 2001; van Zeist 96/97
2. Kennemerland	Alkmaar – Canadaplein	BA	Zoological	Clason 1978
	Velsen – Hofgeesterweg	BA	Zoological	Kleijne 2014; Oversteegen unpublished
	Velserbroekpolder – VB-P63	MBA	Zoological	Kleijne 2014; Cavallo unpublished
	Velsen – Calamiteitenboog	MBA	Botanical, zoological	van Heeringen <i>et al.</i> 2014
	Heiloo – Vlooiendijk	LBA	Zoological	van Haaster, Dijk and Lange 1997
	Uitgeest – Waldijk I	LBA	Botanical, zoological	Koning <i>et al.</i> 2008
3. Noordwijk	Noordwijk – Bronsgeest	EBA	Botanical, zoological	van Heeringen <i>et al.</i> 1998
4. Haaglanden	The Hague – Bronovo	MBA (1500-1100)	Botanical, zoological	Bulten & Boonstra 2013
	Voorburg – Leeuwensteijn	MBA	Botanical, zoological	Hagers <i>et al.</i> 1992
5. Hattemerbroek	Hattemerbroek	MBA/LBA	Botanical	Hamburg <i>et al.</i> 2011
6. River area - west	Zijderveld – A2	MBA	Botanical, zoological	Knippenberg & Jongste 2005
7. River area - east	Meteren – De Bogen (28-1)	EBA/MBA	Botanical, zoological	Meijlink <i>et al.</i> 2002, Kranendonk & Bloo 2002
	Eigenblok	MBA	Botanical, zoological	Jongste & van Wijngaarden 2002
	Lienden – Woonwagenkamp	MBA	Botanical, zoological	Schoneveld <i>et al.</i> 2002
	Tiel Medel – Bredesteeg	MBA/LBA	Botanical, zoological	van Hoof & Jongste 2005

9.2.1 The sites

Figure 9.1 summarizes the location and names of the regions under review. All sites were, as said, chosen based on their location with regard to water and connection possibilities with West Frisia. Specific information on the different sites – some regions comprise multiple sites – is summarized in Table 9.1. Varying levels of presence and preservation of remains were encountered at the different sites, which resulted in a varying level of detail in the description

of general Bronze Age subsistence in the different Dutch regions. In the following section 9.3, each subsistence strategy is discussed in the same order as Chapter 4-7 including data from all researched Dutch regions when enough information for a region is available. When more than one site was present in a region, sites are first discussed separately before drawing conclusions on the entire region. For each subsistence strategy, the results from the different regions are compared with the West Frisian situation.

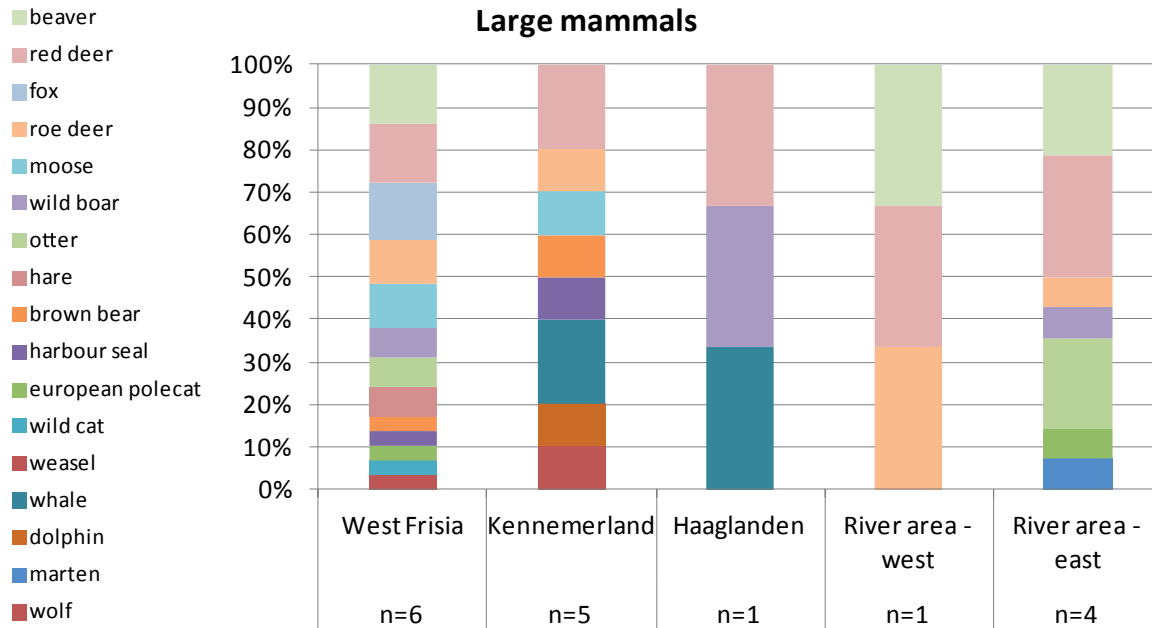


Figure 9.2. Frequencies of large mammals from different Dutch regions in comparison with West Frisia.

9.3 COMPARISON OF DUTCH SITES WITH WEST FRISIA

9.3.1 Hunting

Wild animal composition

Wild animal remains were found in fairly low numbers in most regions, except for Texel and Hattermerbroek (Figures 9.2-9.5). All the remaining sites could be compared with regard to the presence of mammal, bird, and fish species. However, a comparison between sites based on the frequency of occurrence of species was only possible for large mammals due to the different excavation techniques and unknown taphonomical processes present at the sites (*i.e.* lack of sieving experiments performed at these sites). Still, some species (*e.g.* hare, polecat, etc.) may remain under-represented. Similar to West Frisia, all sites are represented by a broad spectrum of fish, bird, and large mammal species (Figures 9.2-9.5), which means that a wide range of hunting skills and knowledge was present in every region. Hunted large mammals which appear in more than one region include, in decreasing order of frequency,

red deer, roe deer, beaver, wild boar, brown bear, moose, harbour seal, otter, European polecat, and whale (Figure 9.2, 9.3). Other species (*e.g.* fox, hare, wild cat, and weasel, found in West Frisia) appear to be more restricted to one area, or perhaps represent rare finds (such as dolphin and wolf).

West Frisia stands out because of its wide range of wild animal species. However, this area is relatively large and composed of a wide range of habitat types (*cf.* Chapter 2) spanning an area of 40 km from the North Sea in the west to the freshwater inland lakes in the east. When this aspect is considered, it becomes clear that different parts of West Frisia might very well be comparable to the other regions. The regions close to the North Sea, such as Kennemerland and Haaglanden, contain similar species to the western sites of West Frisia (*i.e.* Hoogwoud and Schagen), whereas other elements of the West Frisian fauna list are comparable to more inland locations such as the river area.

Bird remains, although not often found, also show similarities between regions. At most sites, similar bird groups to those observed in West Frisia are exploited (Figure 9.4), even though not all species are

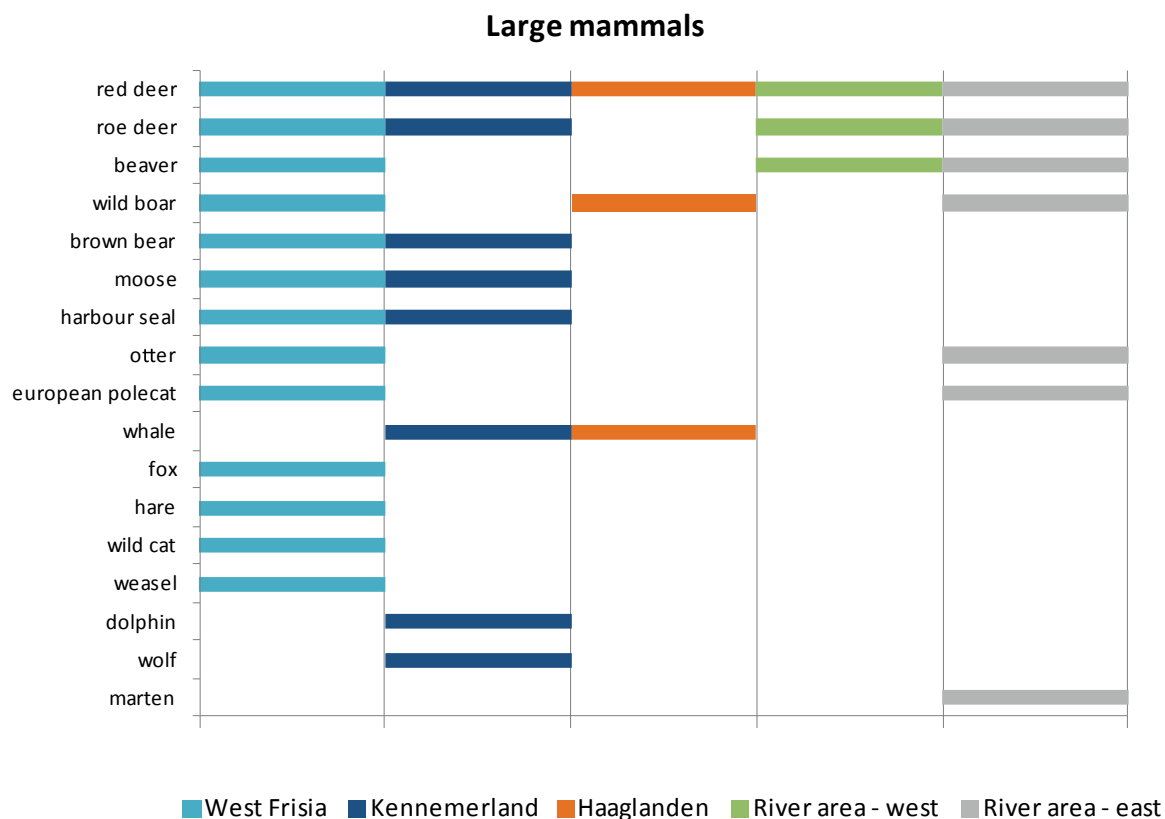


Figure 9.3. Presence/absence of large mammal species in the different Dutch regions in comparison with West Frisia.

necessarily the same; birds from other Dutch regions also include water fowl (such as geese and ducks), corvids (*i.e.* jackdaw), and owls (*i.e.* little owl). Remains from fish are equally scarce as the remains of birds, but also here, some observations can be made. The most frequently uncovered species include the freshwater fish perch, bream, catfish, common rudd, roach, pike, eel, silver bream, tench, and ide. Migratory fish, such as thinlip mullet, salmon, and sturgeon are also prevailing. Saltwater fish finally, include mostly cod, flatfish, flounder, and sea bass. The remaining fish species are almost all exclusively found in the West Frisian area (Figure 9.5).

Fish remains appear at first sight to be most diverse in West Frisia, similar to the discussion of large mammals. However, bearing in mind the size and location of West Frisia, fish remains from Haaglanden and Kennemerland may be considered more comparable to western West

Frisia, whereas fish remains from the river area are more similar to the east of West Frisia, reinforcing the idea that the different parts of West Frisia are similar to different Dutch regions.

Hunting locations

Hunting locations were researched in the same manner as for West Frisia, namely by composing pie diagrams of the habitat preferences (Figure 9.6) of the animals found on the settlements in the different regions (see previous paragraph).

Large mammals

Small mammals were not included here, because their presence on a site combined with the limited size of their habitat will not inform about the landscape in its wider sense: a preference for an open habitat could already be fulfilled by the settlement itself.

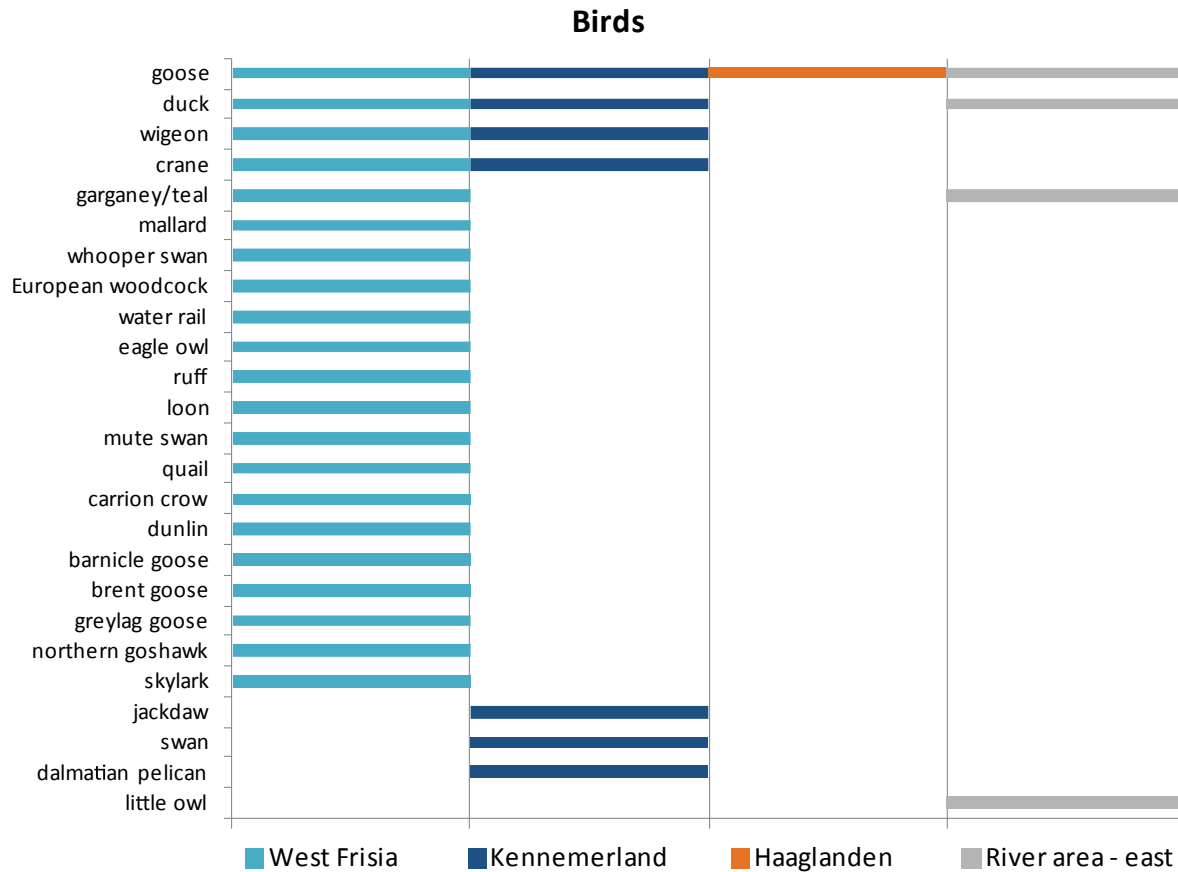


Figure 9.4. Presence/absence of bird species in the different Dutch regions in comparison with West Frisia.

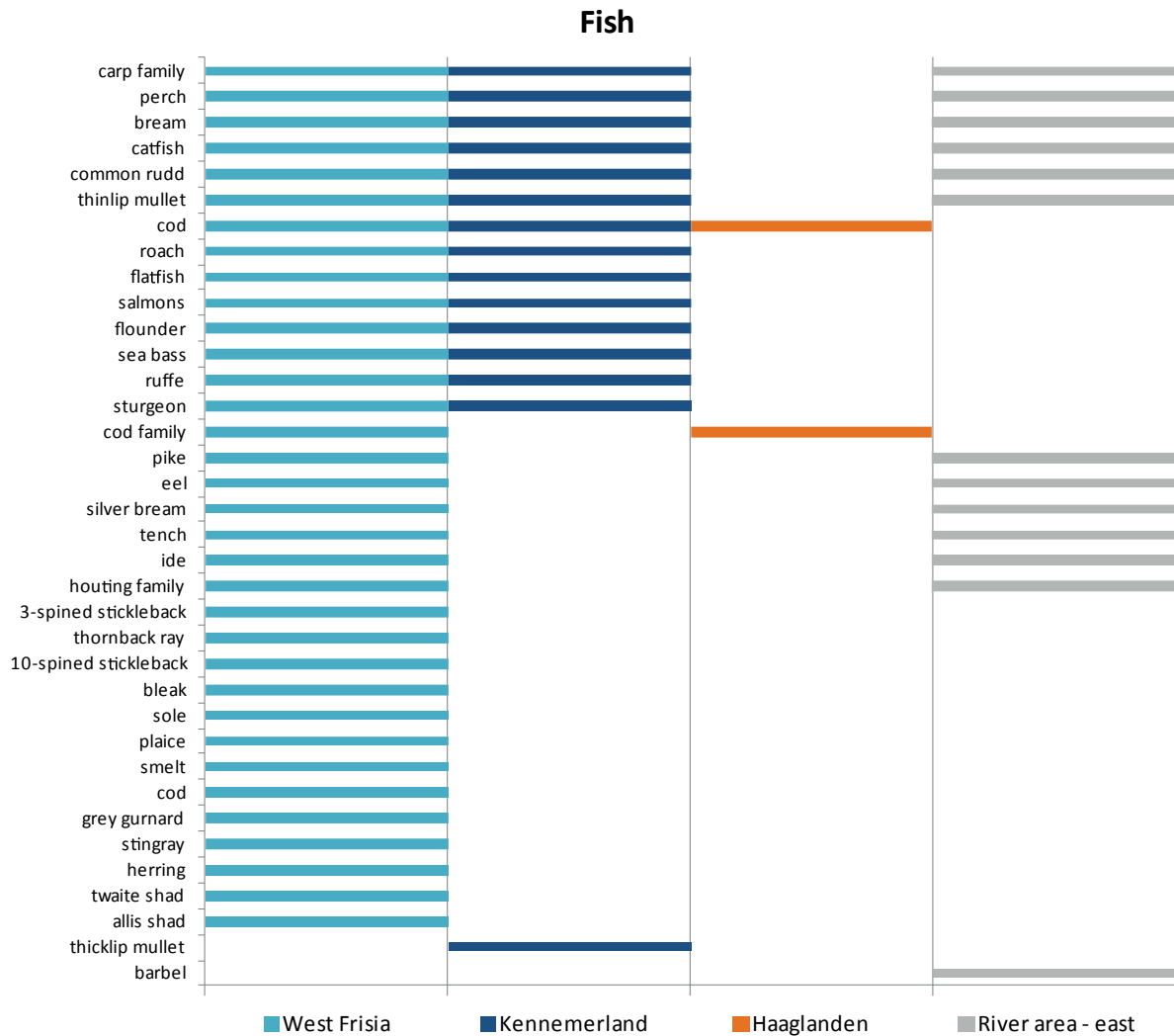
All animals are most likely caught in the near surroundings of the settlement, because all reflect habitat types presumably located near the sites. The Hague Bronovo site, located near the coast, has yielded the remains of a whale, and the area of Velsen Hofgeest/Hofgeesterweg, also located near the coast on the edge of the Oer-IJ estuary, has yielded the remains of a whale, a seal, and a dolphin (Kleijne 2014). The river area did not generate any remains from marine mammals, but beaver and otter were found, reflecting the abundant water present in this area. All regions show the presence of forest in the surroundings, reflected by red deer, but even more so by wild boar. In Kennemerland and the river area, more types of forest dwelling animals were found, such as wolf, moose, marten, and brown bear. Open areas would also have existed in the surroundings of these areas, reflected by roe deer, wild cat, polecat,

and fox. Hare, indicative of open fields, was not found, but this does not mean that no open grassland existed. Surely, the presence of humans and their livestock will have ensured a (partially) open landscape in all investigated areas.

Birds

Not all sites yielded bird remains, and if they did, many were not identified to species level. Of the two sites that did contain identifiable bird species, pie diagrams were constructed (Figure 9.7).

Although it was concluded that birds do not add significant information to a landscape reconstruction due to their high (daily) mobility (Chapter 2, section 2.4.2), some information may be drawn from the species represented in the diagrams above. The jackdaw and little owl, found in Kennemerland



Figures 9.5. Presence/absence of bird species in the different Dutch regions in comparison with West Frisia.

and Eigenblok respectively, can both be considered as resident bird species and both provide general indications for grassland (jackdaw: also shrubland). This complements the image obtained for large mammals, where grassland was not among the habitat preferences.

Fish

A general aquatic landscape reconstruction could be performed for most areas (Figure 9.8 and Figure 9.9), since almost every site yielded (enough) fish remains, except for The Hague Bronovo and Zijderveld. In The Hague, which is not represented by a pie

diagram, only the remains of cod were uncovered, indicating saline conditions and the open sea. This of course, is no surprise given the location of this site (Figure 9.1). The other sites could be analysed for both the water types and salinity levels present in the surroundings of the settlements.

Almost all areas show a combination of stagnant to slow moving water, open water, fast flowing water, and a connection to the sea, but all in different ratios. Velsen – Hofgeesterweg in addition, shows evidence for the open sea, something which is to be expected so near to the Oer-IJ estuary and the

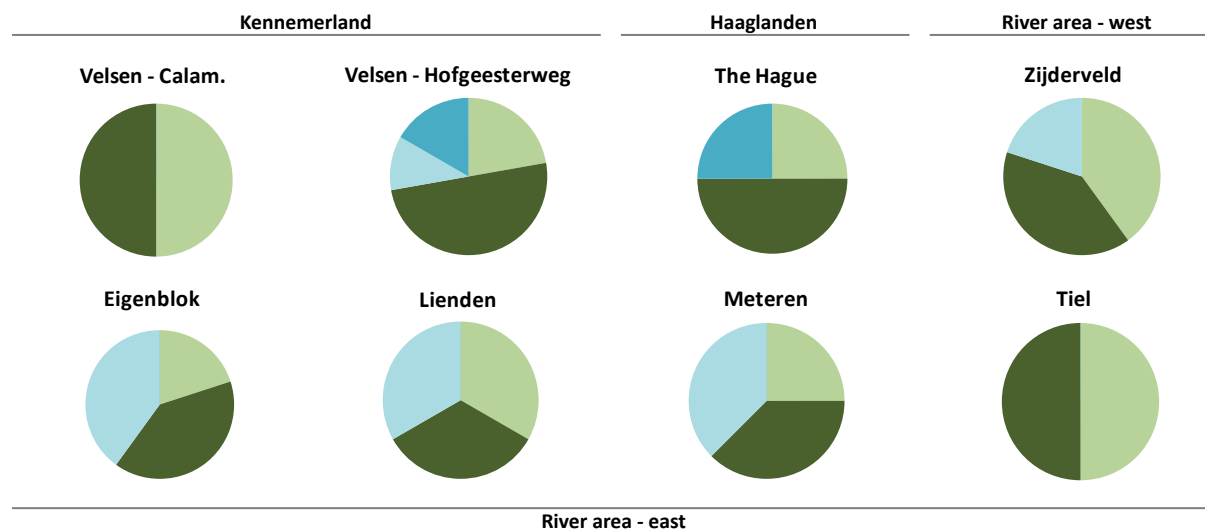


Figure 9.6. Pie diagrams of the habitat preferences of large mammals of the different sites. Velsen – Calam. refers to Velsen – Calamiteitenboog.

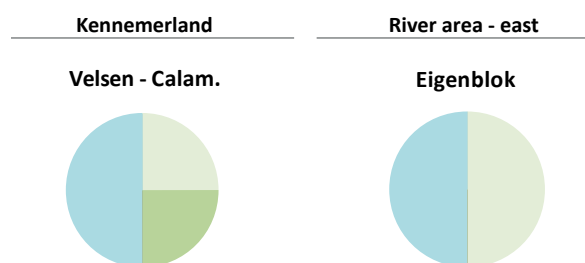


Figure 9.7. Pie diagrams of the habitat preferences of birds of the different sites. Velsen – Calam. refers to Velsen – Calamiteitenboog.

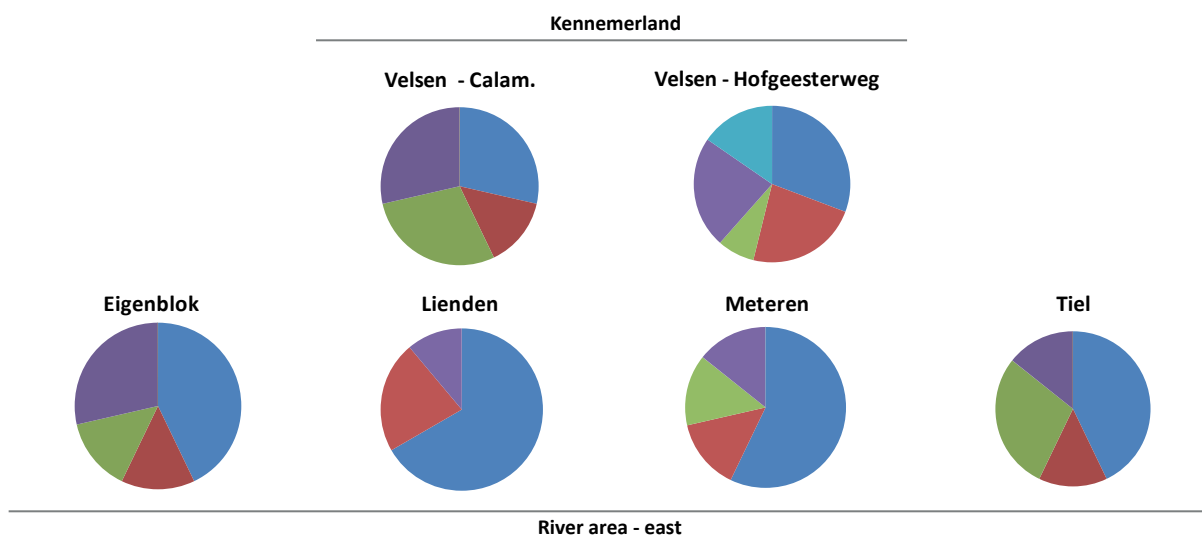


Figure 9.8. Pie diagrams of the water type habitat preferences of fish of the different sites. Velsen – Calam. refers to Velsen – Calamiteitenboog.

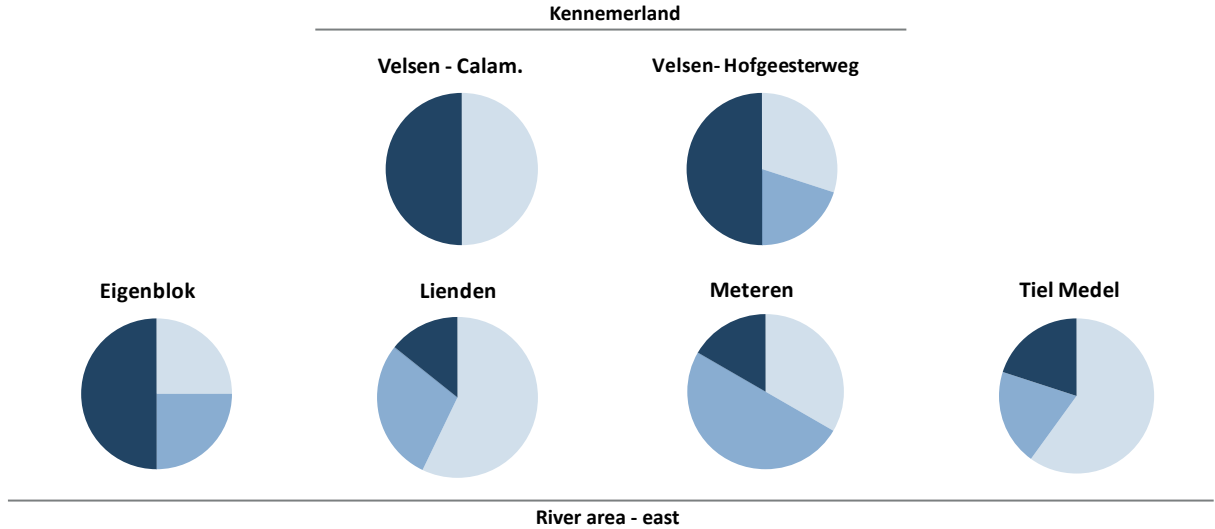


Figure 9.9. Pie diagrams of the maximum salinity tolerances of fish of the different sites. Velsen – Calam. refers to Velsen – Calamiteitenboog.

North Sea. The other site in Kennemerland, Velsen – Calamiteitenboog, does not yield fish which prefer only the open sea, but does show the presence of the migratory fish salmon and thicklip mullet. These fish can both be found in the estuary and upriver during migration. Therefore, the salinity tolerance of fish in the region of Kennemerland is high.

The river area sites show a varying degree of preference for fast flowing (river) water, but it is surprisingly absent in Lienden, which was supposedly situated very close to a river. All sites in this area do however possess fish with a preference for a connection to the sea (*i.e.* migratory fish). The remaining habitat preferences are for stagnant to slow moving waters, open water, and fast-flowing waters. The salinity tolerances of the fish species in the river area become increasingly lower the further away the sites are located from the North Sea coast. This observation increases the likelihood that fish were not (visibly) exchanged between the groups at the river area and ones on the coast or, alternatively, that people travelled to the North Sea to fish: fishing occurred locally. In Tiel – Medel, located east of Eigenblok, even the remains of a barbel were found, a fish which is entirely intolerant of salinity. The only saline tolerances found in the river area are those of migratory fish species.

The fish composition in the investigated areas Kennemerland and the river area is to a certain extent comparable to the situations in West Frisia, similar to what was observed in Figure 9.5. Velsen appears to be comparable to a combination of the images seen of western and eastern part of West Frisia, with both saline and freshwater influences being observed. However, the fish species at this site do seem to reflect the nearby sea less than fish at the West Frisian sites Hoogwoud and Schagen. The river area is very similar to the sites in the east of West Frisia. In West Frisia however, fish species preferring fast flowing water are nearly absent, due to the lack of large rivers in this area.

The combinations of large mammal species on the settlements indicates that man was inhabiting a mosaic landscape with elements of dry, wet, open, and forested areas. The fish species in turn reflect a varied aquatic landscape in the settlement surroundings. This variety of habitats ensures that a large and diverse set of resources is available around the settlements. These settlements all seem to be positioned at prime locations for habitation and exploitation. West Frisia stands out in this respect, because it has both freshwater and saline environments in relatively close proximity, setting it apart from any other area in the western Netherlands, including the river area.

Hunting practices

In almost every region, direct evidence for hunting was encountered. In The Hague Bronovo (Waasdorp 1991, 329; Bulten *et al.* 2013, 95), Noordwijk (Heeringen *et al.* 1998, 34-5), Kennemerland (Kleijne 2014), and Hattermerbroek (Hamburg *et al.* 2011, 368), flint arrowheads were found at the settlements. In Hattermerbroek – where no zoological remains were found due to preservation conditions – the uncovered arrowhead still provided actual evidence of hunting. The arrowhead had been used as part of active hunting gear confirmed by the fact that tar and shafting marks were present on the object. In addition, the remains of dry skin and longitudinal marks may indicate slaughtering animals as a secondary use (Knippenberg *et al.* 2011, 368).

At the researched sites from the river area, such arrowheads were not discovered. In Eigenblok however, a bronze arrowhead was present, as well as an arrow shaft polisher (Gijssels *et al.* 2002: 289, 327), both indicating the use of arrows at this site.

Near Noordwijk finally, in Noordwijkerhout – De Zilk, a wooden bow was found dating to 3500 ±100 BP (2000-1700 cal BC), placing it firmly in the Early Bronze Age (van der Wal 1952; Lanting *et al.* 1999). All these finds are representative of active hunting practices and underline the lasting importance of hunting during the Bronze Age. Passive hunting techniques, such as trapping or netting were not found or identified at any of the settlements. However, as discussed in Chapter 4, it is very rare to uncover such equipment because of the off-site locations where it is normally used, as well as the poor chances at preservation because it is often made of perishable organic material.

Still, a combination of active and passive hunting techniques will have been employed by Bronze Age farmers in order to capture the species observed in Figures 9.3-9.5.

Indications for seasonality and catching techniques

All identified mammal species as well as most bird species could have been present near the sites throughout the year. They are therefore usually not

helpful when interpreting seasonality. Nevertheless, some small exceptions do exist. In Lienden, in the river area, two parts of red deer skull were found with a piece of antler still attached. Since red deer shed their antlers in early spring, they must have been caught before that time, most likely in autumn or winter. At Zijderveld, a similar find belonging to a young red deer was encountered, indicating a similar catching time. Besides these large mammals, one bird species found in the Kennemerland region also provided indications for seasonality. Here, the presence of widgeon indicates capture from October to March.

Comparatively, West Frisian wild large mammal species were also most likely caught from late summer to early spring (Chapter 4, section 4.4.3), and bird species were caught throughout the year. At several sites, it was possible to reconstruct fish catching techniques and seasonality based on the original sizes of the fish caught. At The Hague Bronovo site, the remains of a 60-80cm cod were found, indicating that it was probably caught in open sea, since usually only small cod appear close to the shore.

At Velsen – Calamiteitendoog, which is located close to the North Sea coast, the remains of a salmon around 44 cm long were uncovered. Since salmon are migratory, they can be easily caught in large numbers in both an active and passive manner. These fish only appear near the shore in (late) summer when they enter river systems to spawn. Therefore, the salmon from Velsen was most likely caught during that time. In the river area, several size reconstructions were possible. Fish species from Lienden vary in size from 10-50 cm for smaller cyprinids (including silver bream and perch) to 20-120 cm for pike. In addition, a catfish measuring around 125 cm was found here. The larger specimens in particular will have been caught during spawning, since they appear close to the surface and banks of the waterways during that time. For pike and catfish, this occurs from February-May and May-June, respectively. In Meteren – De Bogen, several fish size reconstructions were also possible. Various cyprinids (including ide and common rudd) were small, ranging from 10-50 cm. Several pike however, were reconstructed varying from 40-110 cm in length, indicating capture in spring and early summer.

Besides size reconstructions, migratory fish species, present at all sites in the river area, also provided information on seasonality. Among them are both anadromous and catadromous fish. One of the catadromous species found at Eigenblok, thinlip mullet, would have been caught between March and August. The anadromous species, houting (found in Eigenblok and Tiel – Medel), can only be found in freshwater as an adult when spawning, which occurs from October to December. Therefore, this fish was probably caught around autumn/early winter. The presence of barbel in Tiel – Medel, finally, is only present in lower lying river areas (such as in the Netherlands) from October to March. The remaining species found in the river area are all present year-round.

Use of wild animals

Wild animals, especially fish, would ultimately have been used for consumption. Mammals however, can also provide raw materials in the form of hides or pelts and antlers. In every region, except Hattemerbroek, (red deer) antlers have been uncovered which have been processed into tools (Van Dijk *et al.* 2002: 367, 378-9, 397; Bulten & Boonstra 2013, 135; Kleijne 2014). Since these antlers are not always shed prior to capture (see previous paragraph), it is possible that deer were primarily caught for their antlers (and skin), since these raw materials were unavailable at the settlement, besides the (additional) use of deer meat for consumption.

There was no evidence for skinning on any of the sites, but these marks are subtle on bones and not always included in standard archaeozoological investigations. However, the presence of many fur animals such as wild cat, fox, marten, polecat, and beaver on many of the sites does indicate the potential of these animals to provide the Bronze Age farmer with another source of raw material unavailable at the settlement. Birds finally, could have provided feathers and eggs, but these uses remain invisible in the archaeological record.

To summarize, all the areas researched show that hunting of mammals, birds, and fish would have occurred year-round and must have formed an integral and integrated part of the subsistence

economy. This overview has made clear that West Frisia is no exception to this rule, but that it perhaps has more indications for hunting because of the good local preservation conditions.

9.3.2 Animal husbandry

Domestic animal composition

The general composition of the remains of domestic animals at all the researched Dutch Bronze Age sites is very comparable (Figure 9.10). Every site has evidence of cattle, sheep/goat, and pig, usually complemented with dog and horse. These species do occur, however, at different ratios throughout the Netherlands and throughout the Bronze Age. In the Middle Bronze Age, the livestock is generally dominated by the remains of cattle, with varying additions of other species (Figure 9.11). In Kennemerland (Velsen) however, sheep/goat bones are relatively much more dominant than at the other sites, which are more strongly dominated by cattle. Dog and horse are found as well, but in very low numbers.

In the western river area (Zijdeveld), cattle remains are present in overwhelming majority, with only 15 bones uncovered of the remaining domestic animal species. In the eastern river area, cattle is still the dominant species uncovered, but both sheep/goat and especially pig form a large portion of the livestock remains. Both species are more frequent in the assemblage in comparison with Middle Bronze Age West Frisia. In addition, it is interesting to note that in every Middle Bronze Age area, the remains of a different domestic animal species are more frequently present in the assemblage after cattle.

In the Late Bronze Age, shifts in the composition of uncovered domestic animal remains occur (Figure 9.12). Both remains of sheep/goat and pig seem to become less frequent in the eastern river area (Tiel-Medel) and Kennemerland. In Kennemerland, horse and cattle furthermore seem to become more prominent. In Late Bronze Age West Frisia, remains of sheep/goat actually become more frequent in the assemblage, at the expense of cattle. Overall however, it appears that in the Late Bronze Age, sites become more comparable in their domestic animal

Bronze Age comparison domestic animals

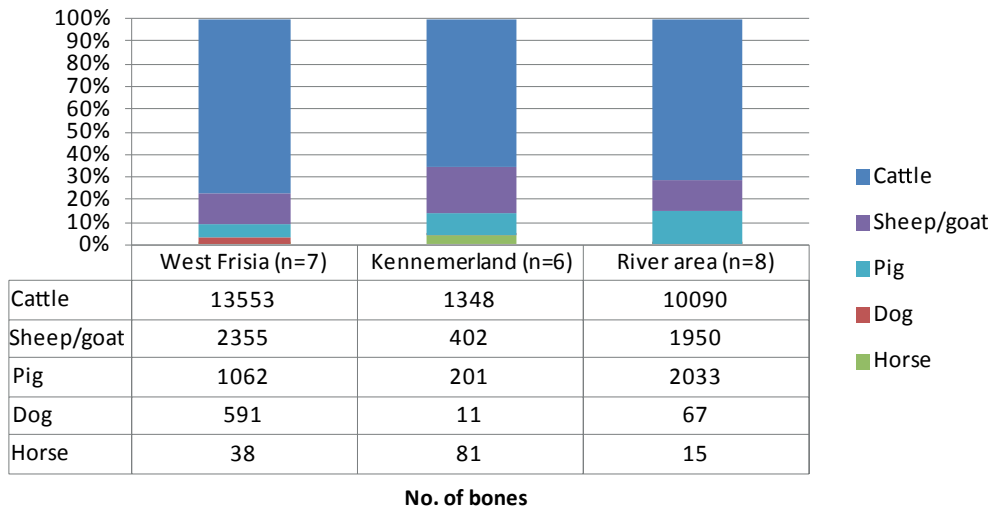


Figure 9.10. Ratios of domestic animal species in the Bronze Age in the different regions of the Netherlands compared with West Frisia.

Middle Bronze Age comparison domestic animals

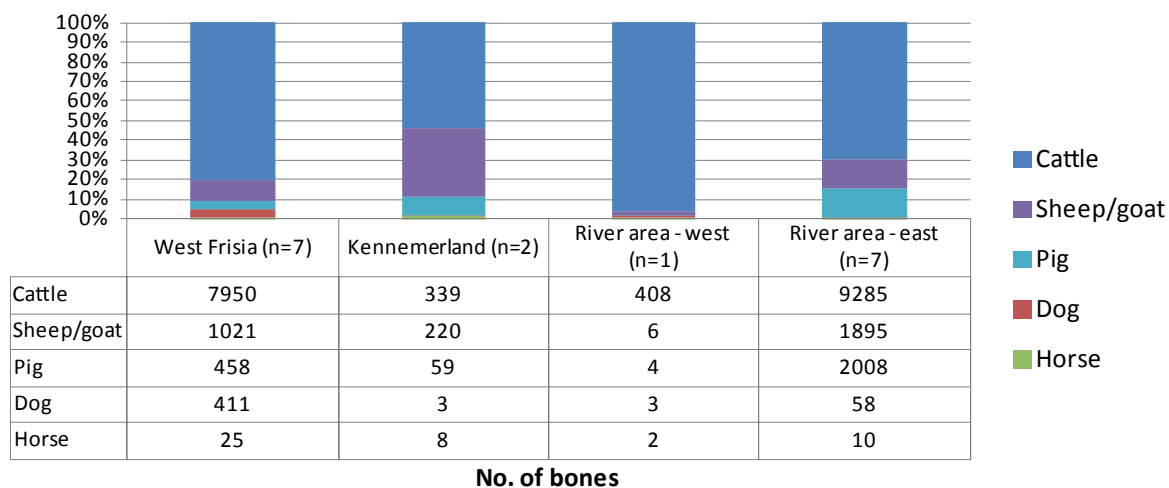


Figure 9.11. Ratios of domestic animal species in the Middle Bronze Age in the different regions of the Netherlands compared with West Frisia.

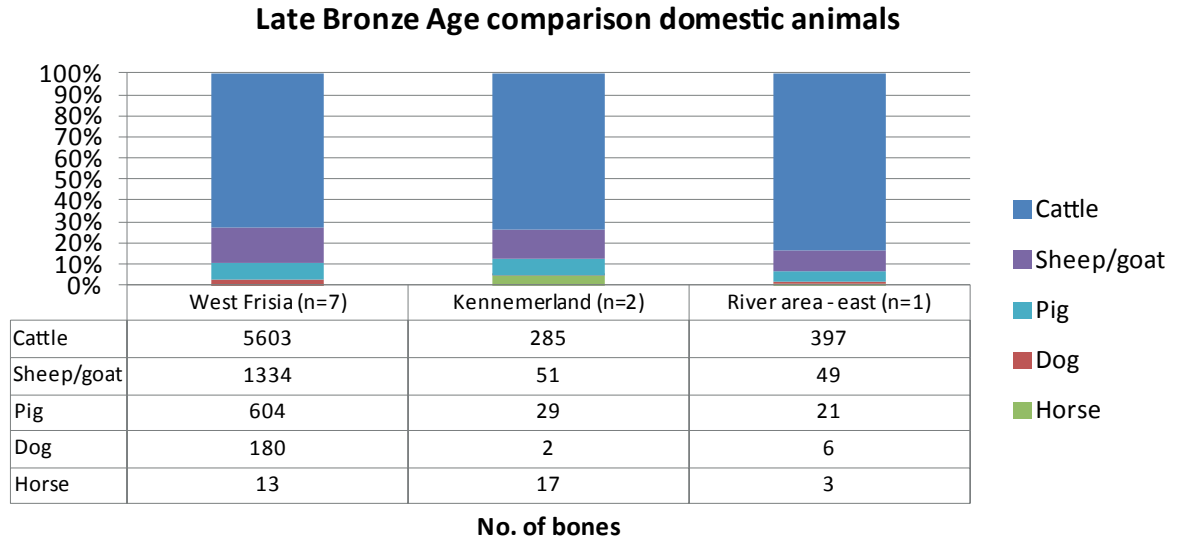


Figure 9.12. Ratios of domestic animal species in the Late Bronze Age in the different regions of the Netherlands compared with West Frisia.

composition, with cattle remains being dominant, and other species being present only in low numbers.

Animal breeds

In the river area and Kennemerland, both cattle and sheep were horned. The other areas did not yield the required bones to make these kinds of identifications. None of the regions possessed evidence for hornless individuals, which underlines what an interesting and valuable discovery the hornless cattle skull found in Enkhuizen Haling is (Chapter 5; van der Jagt 2014, 59). The absence of horns is a dominant trait, and there are no other indications for polled individuals in West Frisia, although numerous cattle and sheep skulls have been uncovered. West Frisian farmers must therefore either have obtained this individual or one of its progenitors from another area, or a spontaneous mutation must have occurred. Based on the data available, it does not seem that hornless cattle were present in the areas researched, or more examples would have surfaced of this dominant trait. It must be kept in mind though that the absence of remains from areas such as Hattermerbroek hinders further investigation towards the possible origin of polled livestock. However, since it already has been established based on isotopic evidence that West Frisian livestock was imported from the eastern

Netherlands (cf. Brusgaard 2014; Chapter 5: sections 5.4.3, 5.4.4), it may very well be possible that polled livestock came from these areas as well. Future research in areas such as Hattermerbroek would be especially interesting to confirm this hypothesis (Chapter 11).

Location of livestock

Hoof prints can provide an indication for the locations on a settlement visited by livestock, but usually only cattle prints are preserved/recognised. No clear stable partitions in house plans were uncovered in any of the researched regions, so the presence of cattle in the houses could not be securely identified. However, hoof prints can provide some insight into the movement of cattle in other areas of the settlement. In Kennemerland, several areas with cattle hoof prints were uncovered. These were mostly centred around large pits, which could be interpreted as watering holes (Kleijne 2014). In the river area, two sites have yielded large amounts of cattle hoof prints: Zijderveld and Eigenblok. The hoof prints at both sites were found scattered over the entire excavated area, but concentrated around watering holes and fences. It appears that at these sites, fences were used as a partition to keep unwanted cattle away from the houses. The location of the prints indicates

that cattle was kept outside, also in close proximity to the houses, although a particular time or season could not be established. Also, the fact that the prints were preserved at all means that conditions of these paddocks were (too) wet at least part of the time. This may mean that cattle was kept outside during less favourable times of the year as well, perhaps due to the necessity of keeping cattle close to guard them from theft or predators, or out of convenience when cattle needed to be handled on a regular basis.

In West Frisia, not many cattle hoof prints were uncovered, and certainly no stake rows to the extent observed in the river area. There may be several reasons for this absence. First of all, the absence of prints and stakes could be explained by the loss of the original Bronze Age surface by deep-ploughing practices, removing all but the deepest features. Another reason could be that most cattle might not have been kept at the wettest parts of the environment or during the wettest time of the year, since higher and drier areas in the surroundings of the settlements were also available (cf. Chapter 8, section 8.4). Finally, stake rows, although sometimes encountered over short distances, might not have been the main means of separating areas. In West Frisia, many deep ditches were dug, which may have fulfilled the same purpose.

Slaughter practices

Livestock remains from three Middle Bronze Age river area sites were suitable for creating a mortality profile with the use of Faustitas (Appendix A1.7). Only cattle remains could be used for this analysis, since sheep/goat and pig remains did not reach the threshold number of 100 remains per species.

For every site it was checked whether a ravaging correction needed to be applied based on the ratio of distal and proximal humeri uncovered at a site, as well as the presence of pig and dog (Appendix A1.7). This was the case for Lienden and Meteren de Bogen; Eigenblok showed no distorted ratio. The resulting mortality profiles for each site, and the river area region at large, are shown in Figure 9.13.

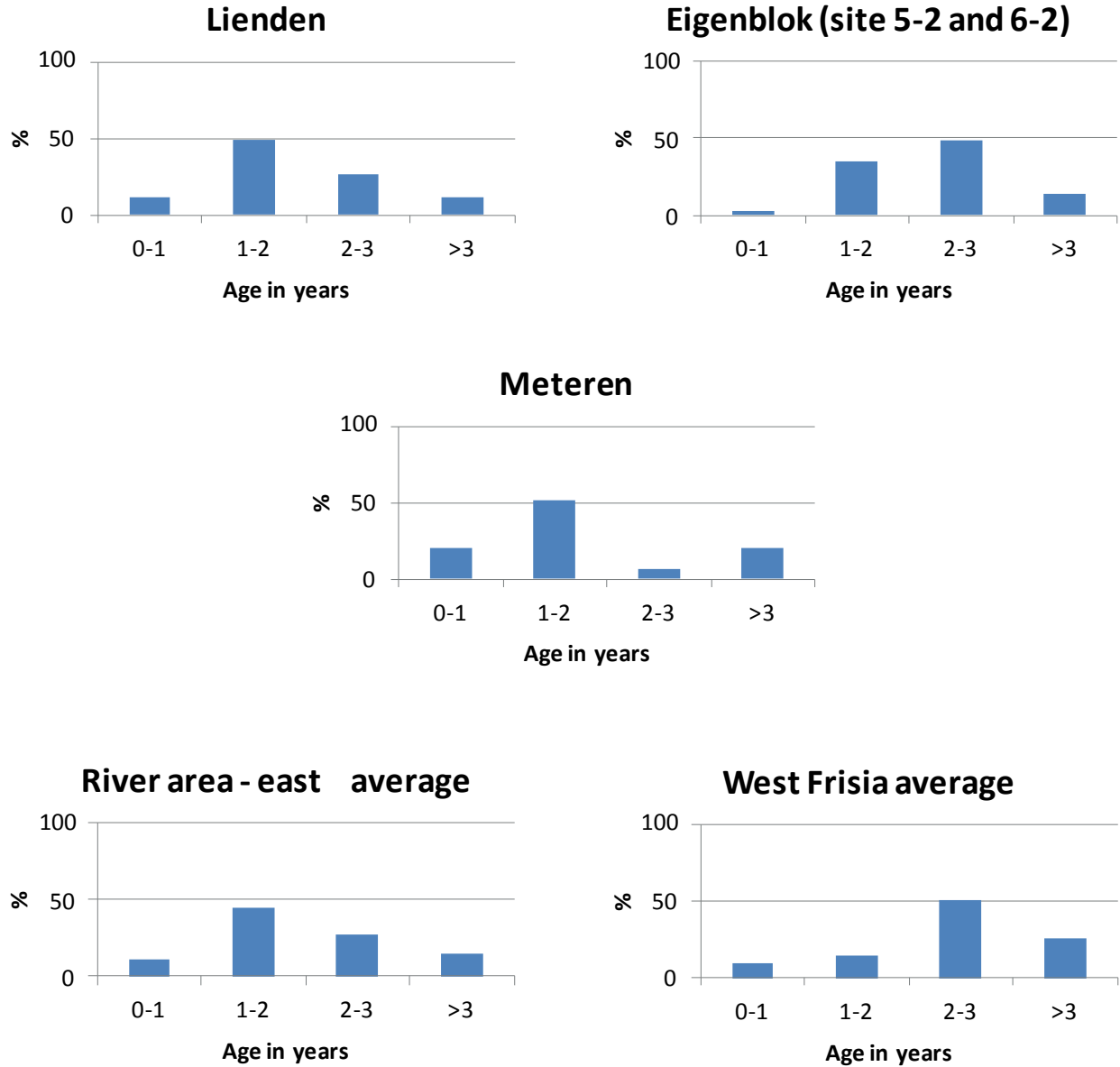
The individual sites show some variation, but cattle was mostly slaughtered between the 1st and 3rd year (Figure 9.13, top). On average, more animals in the river area died before they reached their 2nd year of life (Figure 9.13, lower left corner). In West Frisia on the other hand, cattle seems to have been slaughtered at a slightly higher age, 2-3 years old (Figure 9.13, lower right corner). In this respect, Eigenblok is similar to West Frisia, whereas Lienden and Meteren de Bogen resemble each other more closely.

Use of animals

The use of cattle was explored using the simulation of the programme Faustitas (Appendix A1.7). The resulting graphs including information on both individual sites and the river area at large are shown in Figure 9.14 and Figure 9.15. The growth rate of the herd, birth rate, as well as productivity values for meat and milk are included. The input for the simulation was kept the same as for West Frisia (cf. Chapter 5; Appendix A1.7), and included the assumption that herds must have a growth rate (L) higher than one, because they are self-reproducing units in the Bronze Age subsistence economy.

Similar to the slaughter ages from the previous paragraph, the Middle Bronze Age river area sites show some local variations here also, but overall, growth rate and birth rates between sites are comparable. The potential uses of the herd also show some fluctuations, but the potential for meat production seems consistently higher than for milk production.

When the average values of both the river area and West Frisia are compared, some further observations can be made. First of all, most values from the river area are higher in comparison with West Frisia, except for growth rate. The higher birth rate of cattle in the river area will have allowed for the slaughter of more animals and therefore a higher potential for meat production of the herd. The prevalence of pig remains in the river area during this time in comparison to West Frisia (Figure 9.17) is a further indication that meat production was a focus of animal husbandry in this area. In West Frisia, more mixed uses of herds exist (for both meat and milk production), as well as a generally lower birth rate and an on average higher age at slaughter.



Figures 9.13. Mortality profiles of the sites from the eastern river area in comparison to West Frisia. Lienden, Meteren – De Bogen, and West Frisia average have been corrected using the ravaging correction suggested by Munson (cf. Chapter 5, section 5.4.2). Original data from Lienden: n=251; Eigenblok: n=137; Meteren: n=115; River area – east: n=503; West Frisia: n=1251.

At many sites in the river area, cattle bones also show pathological evidence of other uses often related to traction or ploughing (Buitenhuis 2002; Van Dijk *et al.* 2002, 396; Cavallo & van Groenesteijn 2005, 137): intensive labour can affect certain bones of cattle, including their horn cores, toe bones, and pelvis, which

all become modified by rigorous activity. Unfortunately, it was not possible to reconstruct the sex of these animals, but the use of cattle for traction in general in the river area is confirmed. In West Frisia, many cattle also showed pathological indications for heavy labour.

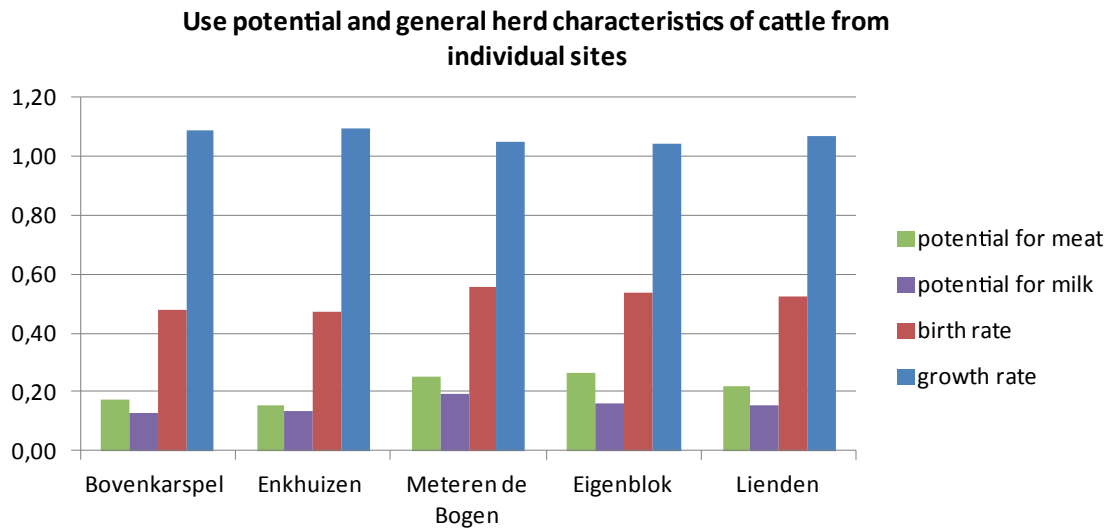


Figure 9.14. Use potential of herds and general herd characteristics of Middle Bronze Age sites from the eastern river area in comparison with West Frisian sites. Use potential is a relative value to evaluate the production potential of a herd for different uses (cf. Cribb 1985). The higher the value, the higher the potential. Birth rate indicates the number of young born per female per year and growth rate indicates the annual growth of the herd. Growth rate values higher than one indicate an increase of the herd, whereas a value lower than one indicates a decrease.

9.3.3 Crop husbandry

Crop composition

The crop composition at the different Dutch sites was investigated based on two groups of crops: major and minor crops. Major crops, including barley and wheat species, are assumed to contribute to the diet as major staple foods, whereas minor crops, including millet and linseed, are assumed to only marginally contribute to the diet. First, the major crops are discussed, after which the discussion of the minor crops will follow.

Major crops

The major crops cultivated in the Dutch Bronze Age sites researched are all species of wheat and barley. Wheat species include emmer, bread/durum wheat, and bread wheat; barley species include hulled and naked varieties of barley. An overview of the presence of the various crops in the different regions is provided in Figures 9.16-9.18.

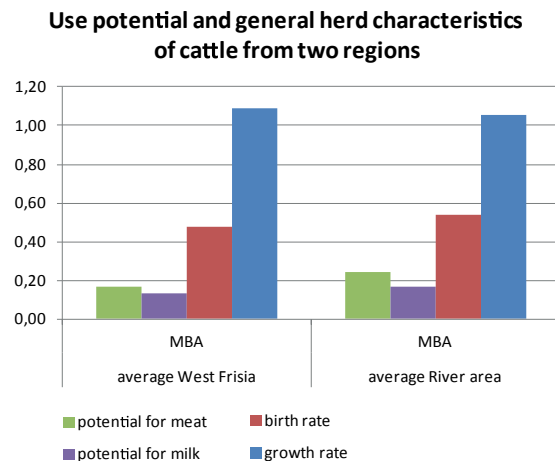


Figure 9.15. Use potential of herds and general herd characteristics of the Middle Bronze Age eastern river area region in comparison with West Frisia. Use potential is a relative value to evaluate the production potential of a herd for different uses (cf. Cribb 1985).

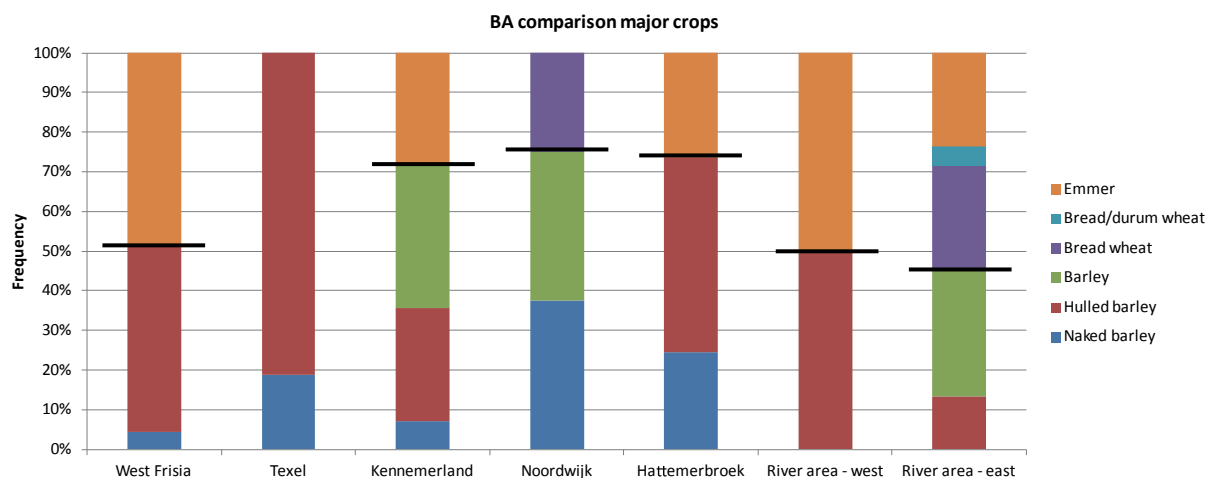


Figure 9.16. Ratios of major crop species in the Bronze Age in the different regions of the Netherlands compared with West Frisia. All information shown except from West Frisia (n=8) and the eastern river area (n=4) derives from one site.

Some variation in the frequencies of these different crops is visible in the researched areas. In Middle Bronze Age Kennemerland and Hattermerbroek, both hulled and naked barley are found, and hulled barley always more frequently than naked barley. In these same areas, emmer wheat is the second major crop, being just as common as hulled barley in Kennemerland, but slightly less so in Hattermerbroek.

Alternatively, in the river area, no naked barley is found in the Middle Bronze Age. Hulled barley is present, but in varying numbers. At Zijderveld (river area – west), few remains of crops were found in general. Only two charred grains of hulled barley, and one uncharred piece of chaff of emmer were uncovered. In the eastern river area, hulled barley is weakly represented, but the high amount of undifferentiated barley (*Hordeum vulgare*) signify the importance of this crop in general, matching that of the wheat varieties. Bread wheat, which is not encountered in any of the other regions in the Middle Bronze Age, seems to be the more dominant wheat species in Eigenblok, situated in the eastern river area. In the Middle Bronze Age, the major crop composition of Kennemerland, located to the south of West Frisia, and Hattermerbroek, located to the east, are comparable to the crop composition observed at

the West Frisian sites. Both areas are connected to West Frisia by either coastal dunes or large freshwater lakes during this time (Figure 9.1), which would have made exchange of crops possible. It was already postulated in Chapter 6, section 6.4.8.3 that crops may possibly have originated in the east of the Netherlands, since this area had already been established as a possible origin of several West Frisian domestic animals (section 9.3.2; Chapter 5: section 5.4.3, 5.4.4). Indeed, the crop composition of Hattermerbroek is very similar to West Frisia, so crops may have originally derived from this location. In the Late Bronze Age, some shifts in crop composition can be seen. At Texel, only barley was uncovered, mainly represented by the hulled variety. The eastern river area on the other hand, shows the dominant presence of wheat, which mostly consists of emmer wheat during this time, followed by bread/durum wheat. The latter crop may be a continuation from the Middle Bronze Age bread wheat found in this area. Barley (undifferentiated) only forms a small portion of the uncovered cereal grains.

West Frisia stands out because it has a mix of crops that were individually uncovered in Late Bronze Age; emmer wheat and hulled barley are prevailing, with a small contribution of naked

Middle Bronze Age comparison major crops

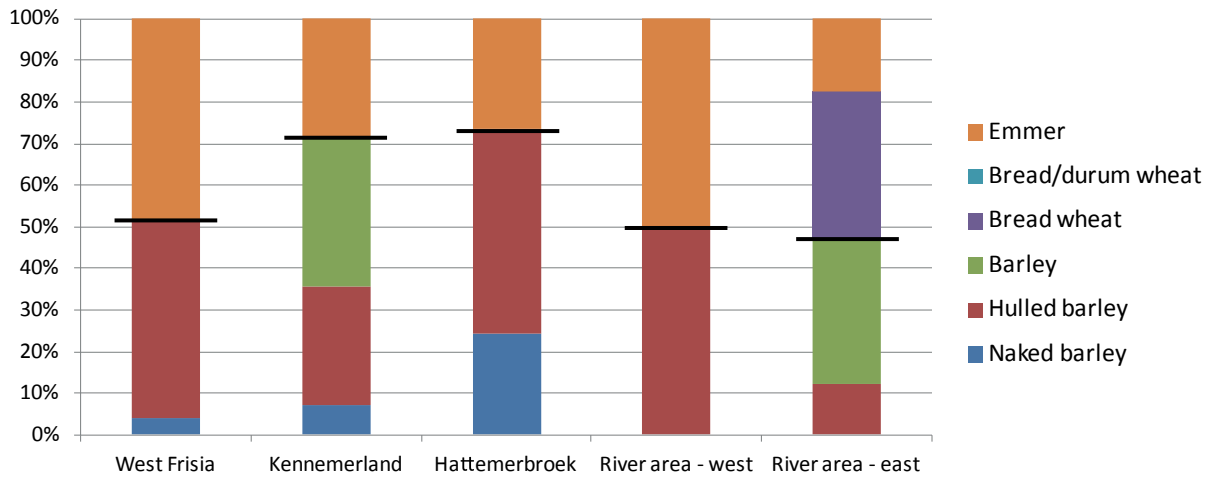


Figure 9.17. Ratios of major crop species in the Middle Bronze Age in the different regions of the Netherlands compared with West Frisia. All information shown except from West Frisia (n=8) and the eastern river area (n=4) derives from one site.

Late Bronze Age comparison major crops

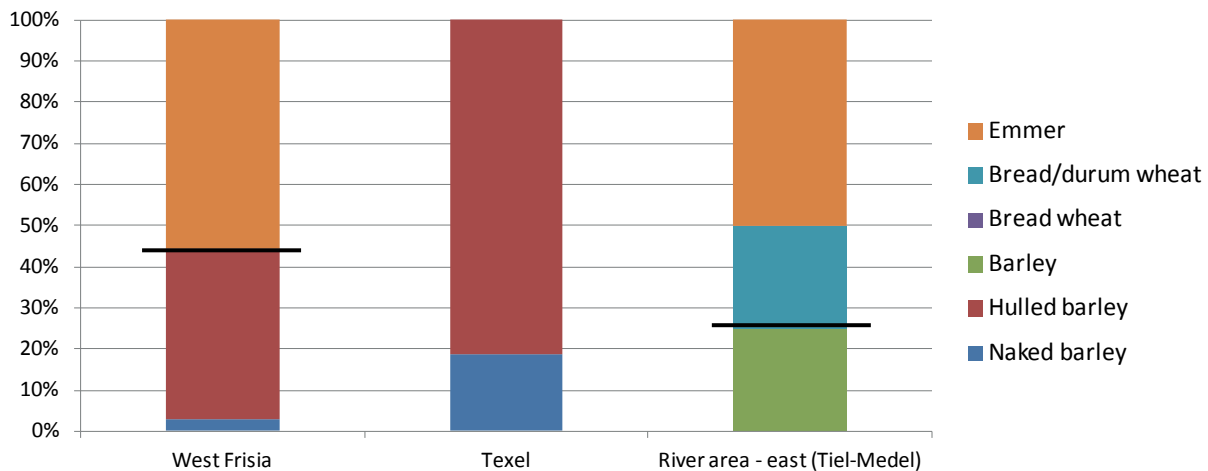


Figure 9.18. Ratios of major crop species in the Late Bronze Age in the different regions of the Netherlands compared with West Frisia. All information shown except from West Frisia (n=5) derives from one site.

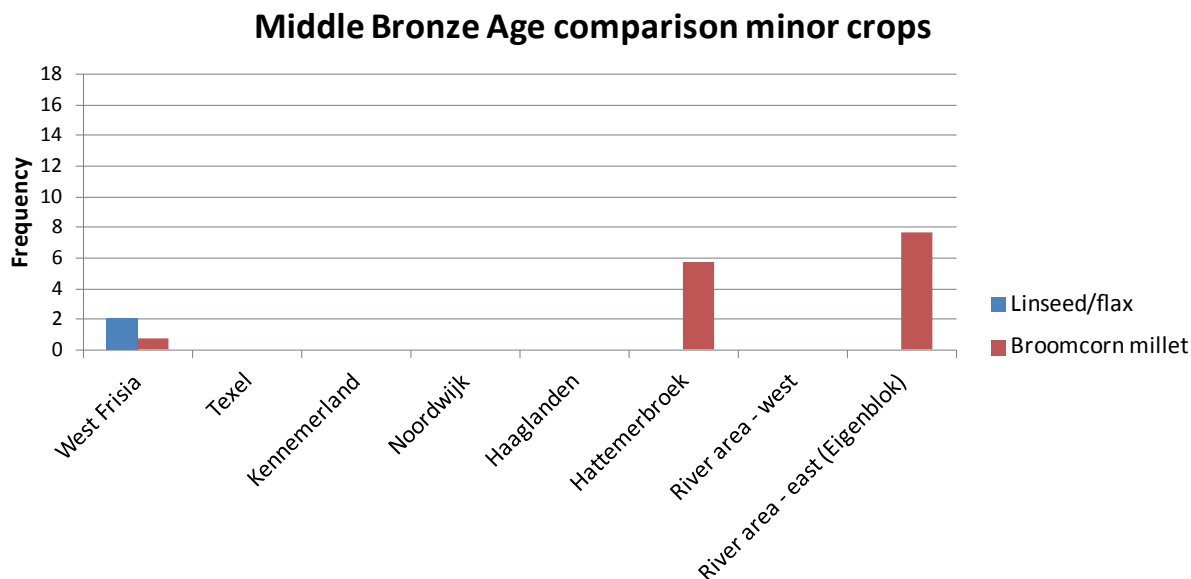


Figure 9.19. Ratios of minor crop species in the Middle Bronze Age in the different regions of the Netherlands compared with West Frisia. All information shown except from West Frisia (n=8) and the eastern river area (n=4) derives from one site.

barley. Bread wheat however, remains completely absent here.

Although only few sites are available for comparison, there appears to be a difference between more northern and southern sites in the Netherlands during the Bronze Age, based on their crop composition. Northern regions (including Texel, Kennemerland, and Hattermerbroek) exhibit a higher frequency of barley species of especially the hulled, but also of the naked variety. The southern sites (*i.e.* the river area) on the other hand, exhibit a more dominant presence of the wheat species emmer and bread/durum wheat, with the former becoming more dominant than the latter in the Late Bronze Age. West Frisia can be regarded as a combination of these northern and southern trends, exhibiting a continuing equal importance of hulled barley and emmer wheat in the Late Bronze Age.

Minor crops

The minor crops discussed here include linseed/flax and broomcorn millet. An overview of the presence of these crops in the different regions is shown in Figures 9.19-9.20.

In both the Middle and Late Bronze Age, only

broomcorn millet is identified, and only in some of the researched regions: Hattermerbroek and the eastern river area. At both sites, the frequency of broomcorn millet is higher than in West Frisia, the highest values being observed in the river area. West Frisia additionally yields linseed/flax, although remains are very scarce. In the Late Bronze Age, broomcorn millet is only present in the eastern river area and in West Frisia, and the frequency of this minor crop increases in both areas in comparison to the Middle Bronze Age. Linseed/flax, however, is still only uncovered in West Frisia during this time, which means it is the only site researched yielding this minor crop, which decreases in frequency in the Late Bronze Age.

The presence of linseed/flax in West Frisia may be a unique aspect of this area, but it must be kept in mind that the seeds of this plant preserve particularly poorly, which means that the differences observed may also be the result of taphonomical processes (cf. section 6.4.8.2). Broomcorn millet, however, does seem to be a consistently cultivated crop throughout the Bronze Age, increasing in frequency towards the end of this period.

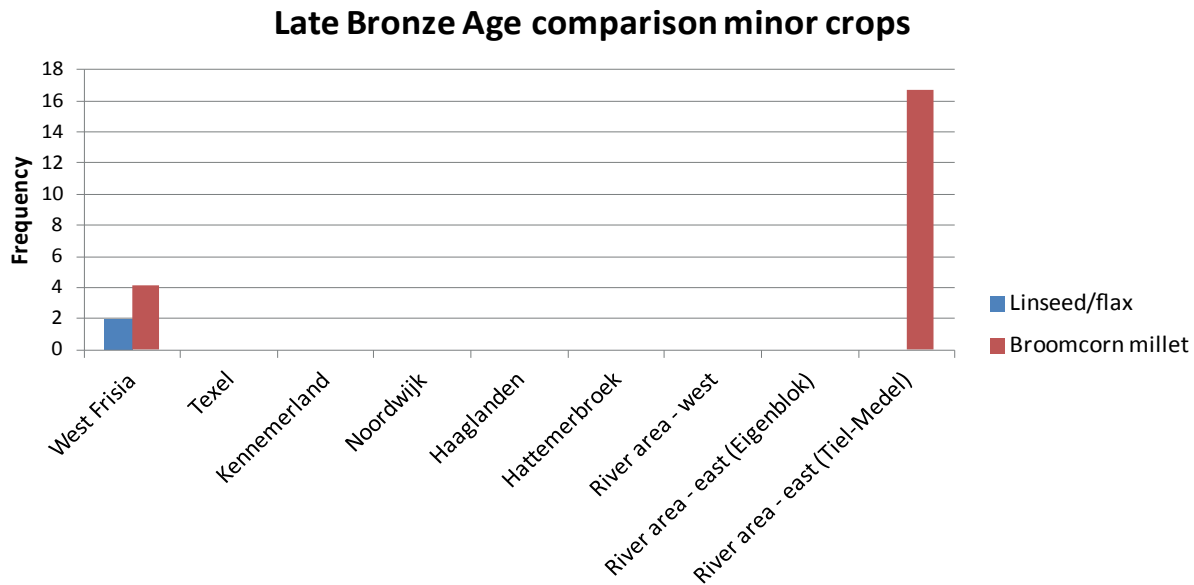


Figure 9.20. Ratios of minor crop species in the Late Bronze Age in the different regions of the Netherlands compared with West Frisia. All information shown except from West Frisia (n=8) and the eastern river area (n=4) derives from one site.

Arable fields

Plough marks are observed at many sites and in most regions. Only in Hattemerbroek, Zijderveld, and three sites in the eastern river area (Lienden, de Bogen, Tiel-Medel), no such marks are uncovered. Overall however, it can be assumed that crop husbandry was practiced locally in all areas. Similar to West Frisia, the arable fields themselves are hard to reconstruct because of discontinuous ard marks and/or excavated areas. Still, it is clear that in most areas the same field was used several times, since ard marks of different criss-crossed orientations appeared at the same location. The only information on the field conditions themselves is obtained through the preferences of crop weed species which occurred charred between crop remains from house contexts (including postholes, hearths, and house ditches). Due to limited number of charred remains from these selected contexts, only four regions are considered for this analysis. The quality of the fields of these different regions is summarized in Figure 9.21.

What becomes clear from Figure 9.21 is that fields in all areas were of excellent quality. They possessed exactly enough moisture, a pH of around 7, and a

moderate to high nitrogen content. No indicators for (seasonal) flooding were encountered amongst the crop weeds, and neither were salt indicators. Arable fields from Kennemerland and the eastern river area were most comparable to the West Frisian situation, although West Frisian fields had a marginally higher moisture content.

Crop husbandry practices

Crop husbandry practices which could be researched include ploughing and harvesting. In the eastern river area at Eigenblok, the cattle hoof prints were uncovered at several locations in concurrence with ard marks. Since the arable field growing conditions at this location were not very moist at all, this observation, in combination with the presence of air bubbles in micromorphological slides, provides indications that ploughing occurred under wet conditions, because hooves need to sink into the soil in order to preserve as prints.

The crop weeds mentioned in the previous paragraph were all investigated with regard to their seasonality: either being classified as a summer or winter annual. In addition, their maximum growth was recorded.

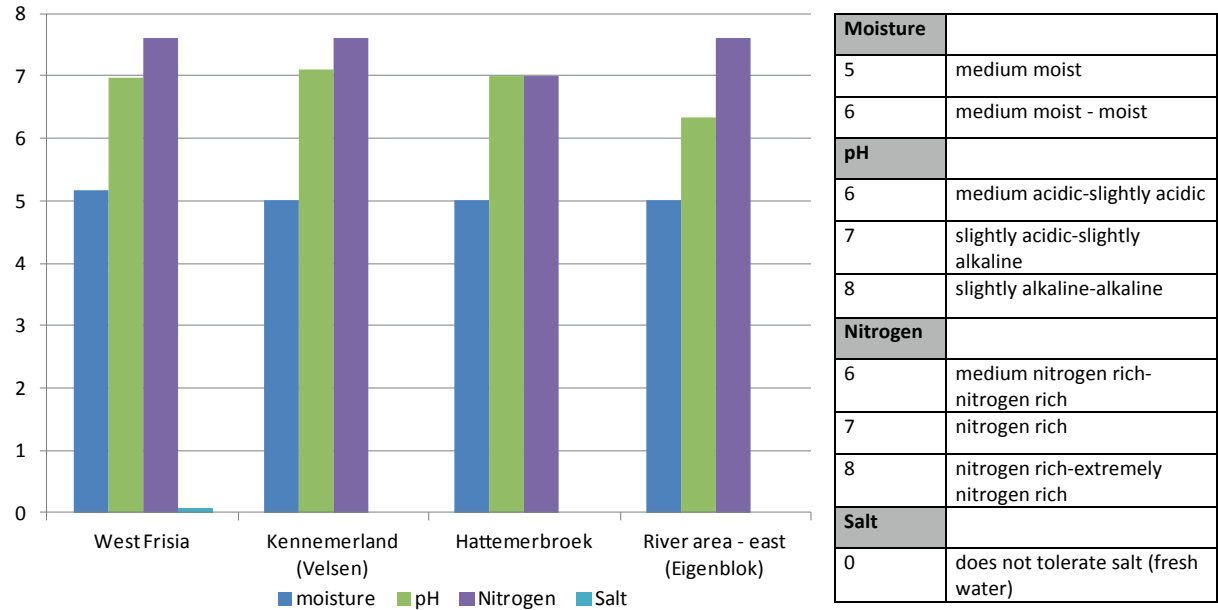


Figure 9.21. Abiotic growing condition preferences of crop weeds from different Dutch Middle Bronze Age sites in comparison with West Frisia. All information shown except from West Frisia (n=8) derives from one site.

These characteristics were employed to infer the sowing regime of the cultivated crops, as well as the height at which harvesting was performed. All crop weeds investigated indicated sowing in spring, similar to West Frisia. The average harvesting height could only be established for three areas, because only samples which contained more than one crop weed species were included. In Kennemerland, the most prevailing maximum height of the crop weeds was 40 cm, with a spread of 40-100cm. The eastern river area is characterized by a dominant maximum height of 50 cm, with a spread of 40-60cm (*Fallopia convolvulus* was not included in this range, because it is a binding weed). Both these areas are comparable to West Frisia, which also portrays a maximum crop height of 40-60cm. Crop weeds at Hattermerbroek however, had maximum heights of 70 and 100 cm. At this site, only one sample was available, so more research is required before firm conclusions may be drawn for this region. In general, it appears that in Kennemerland and the eastern river area, harvesting occurred at comparable heights to West Frisia. Possibly, since reaping occurred relatively low, straw may have been valued in these subsistence economies.

Harvest processing

Just two samples satisfied the prerequisites for an analysis of harvest remains, conform Stevens (2003; cf. Chapter 6, section 6.3.4): every other sample contained too few charred remains.

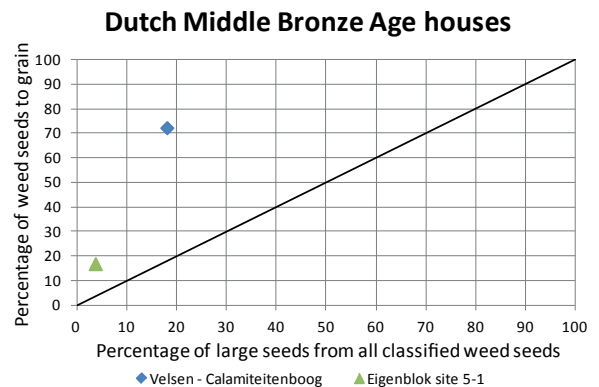


Figure 9.22. Spread of the Middle Bronze Age house data from the Kennemerland region (Velsen - Calamiteitenboog) and the eastern river area (Eigenblok).

The first sample derived from a posthole from a house plan at Velsen (Kennemerland), the second from a posthole from a house plan in Eigenblok. Both samples date to the Middle Bronze Age.

The results of the analysis are shown in Figure 9.22 and both samples fall into the category “household level organization”. Although only two samples could be included in the analysis, it does provide indications that in these areas in the Middle Bronze Age, households might not have been large, similar to most sites in West Frisia.

Storage

No clear indications for storage existed in West Frisia. The absence of underground silos, however, indicates that storage may have occurred above ground, most likely inside the house (cf. Chapter 6). In Kennemerland and Haaglanden, also no clear storage structures were identified. In the other researched regions, however, several separate storage structures were uncovered such as at Texel, Hattemerbroek, and the entire river area.

9.3.4 Wild plant gathering

Wild plant composition

Plant species which are accepted as having been collected, such as fruits, nuts, and berries, were all included in the analysis and derived from all contexts and states of preservation. Other wild plant species were only included when deriving from house contexts such as postholes, hearths, and house ditches, to increase the plausibility of their use by people. To elucidate the use of wild plants in the diet in other regions, and investigate the dietary breadth as accurately as possible, both charred and uncharred remains were considered. For this purpose, however, only the eastern river area yielded enough data. The analysis of which parts of edible plants were most likely collected was performed in the same manner as for West Frisia (cf. Chapter 7, section 7.4.2.1).

Wild fruits and nuts

Collected wild plants such as fruits, nuts, and berries, observed in the different regions, are summarized in Figure 9.23 and Figure 9.24, and include, in

decreasing frequencies, sloe plum, hazelnut, elderberry, blackberry, rosehips, and berries in general. Other collected plants, such as juniper berry and acorn, were only found in Noordwijk, and the eastern river area, respectively. The range of collected plants in West Frisia is present in a different composition and frequency, which sets it apart from the rest of the Dutch regions researched.

Collected plants in West Frisia include mostly berries, with elderberry being represented best, followed by blackberry and raspberry, the latter of which is only found in this region. In West Frisia, no sloe plum is uncovered, which is striking, and hazelnut is only found in low numbers. Although seemingly different at first, the absence of these fruits and nuts may very well be related to the fact that the appropriate vegetation type for these species has never been able to fully develop due to combined high impact by humans and animals (cf. Chapter 8, section 8.2.3).

The different compositions observed in the different regions seems to reflect that wild plants were collected when available in the near surroundings of the settlement, and that it was a local practice, similar to hunting.

In general, except for the absence of sloe plum, the composition of collected wild plants in West Frisia is most comparable to Kennemerland and Hattemerbroek.

Other wild plants

The yield of wild plant remains from house contexts from the different sites was generally low, although cereal grains from these contexts are usually equally rare. Therefore, only the regions Hattemerbroek, Kennemerland and the eastern river area were considered, since these yielded enough data for further analysis. A total of 46 wild plant species was uncovered in the house contexts of these regions, with 32 species being found in the river area (including Lienden, de Bogen, and Eigenblok), 21 species in Kennemerland (including Velsen Calamiteitenboog), and 12 in Hattemerbroek. Of these species, only the edible species (*i.e.* edibility score higher than 1; cf. Chapter 7, section 7.4.2) were included in this section, to investigate wild plant gathering for consumption.

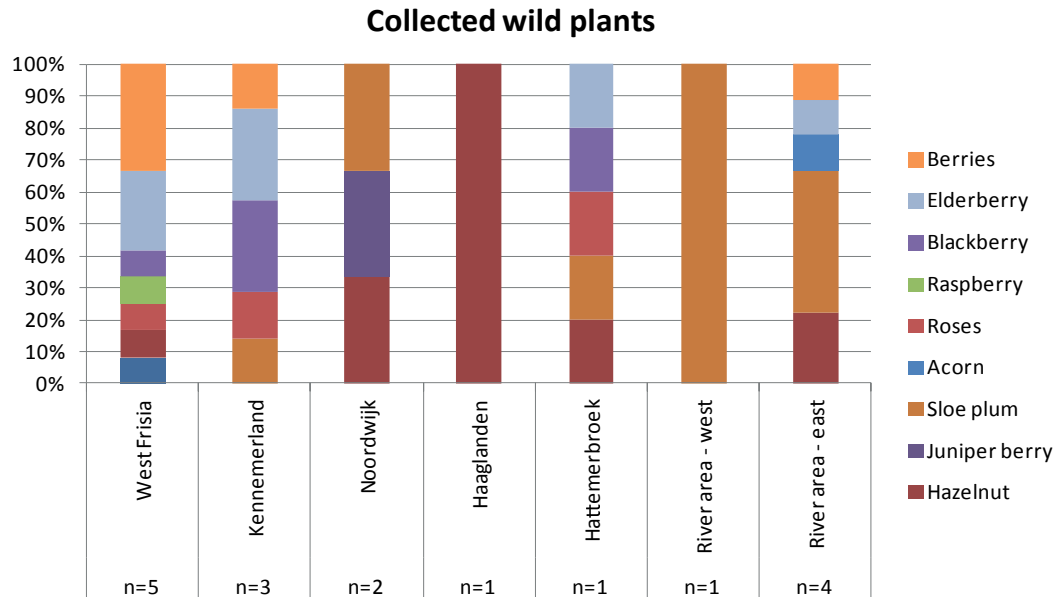


Figure 9.23. Frequency of collected wild plant species in the Bronze Age in the different regions of the Netherlands compared with West Frisia.

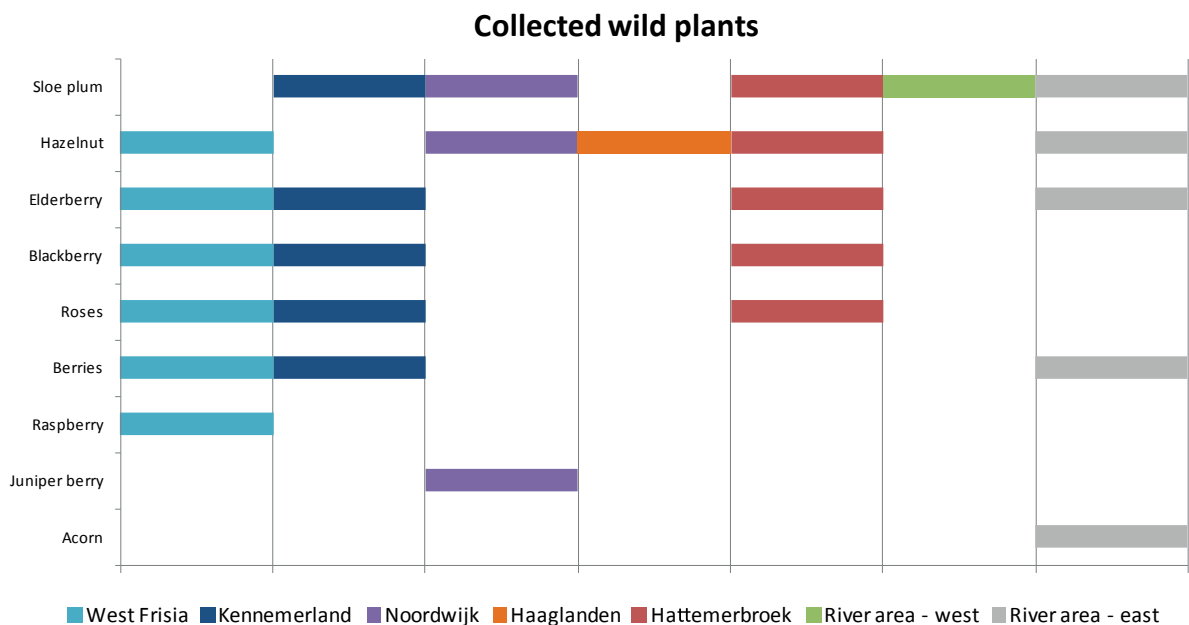


Figure 9.24. Presence/absence of collected wild plant species in the Bronze Age in the different regions of the Netherlands compared with West Frisia.

Other uses of the uncovered wild plants are included below in the section on use of plants.

The edible plants in the researched areas were not all preserved in the same manner. The eastern river area possessed favourable preservation conditions (compare with Chapter 7, Figure 7.4), yielding both charred and uncharred remains. Kennemerland and Hattermerbroek however, only yielded remains in charred form (compare with Chapter 7, Figure 7.5). The latter two regions are therefore limited in the amount of information they can supply about the dietary breadth, and their data can only be analysed to a certain extent. When only charred remains are uncovered, plant species which are very frequent can be relatively safely considered to have been collected for their seed (Table 9.2: category “seed”). However, when a plant species is only present in charred form and in low frequencies, it is impossible to assess whether it has been collected for its seeds or its vegetative parts (Table 9.2: category “unknown”). Low frequencies of charred remains can possibly signify both edible uses without a comparative measure in the form of uncharred remains (cf. Chapter 7, section 7.3.3). The data of the eastern river area, however, can be analysed completely and can then be compared to West Frisia in a more accurate manner (Table 9.2 and Figure 9.25).

What becomes immediately apparent from Table 9.2 is that indeed the regions of Kennemerland and especially Hattermerbroek provide very little concrete information on edible plant use due to the limited indications their charred data can provide. Some plants can however, be assumed to be collected for their seed, such as fat hen/fig-leaved goosefoot (*Chenopodium album/ficifolium*), hastate/spreading orach (*Atriplex hastata/patula*), manyseed goosefoot (*Chenopodium polyspermum*), sheep’s sorrel (*Rumex acetosella*), black nightshade (*Solanum nigrum*), and corn spurrey (*Spergula arvensis*), most of which have also been presumed to be collected for consumption based on the West Frisian data. Two species however, chickweed (*Stellaria media*) and seaside bulrush (*Bolboschoenus maritimus*), show either a mixed use or another use than was observed in the data from West Frisia. No plants in the regions Kennemerland and Hattermerbroek could be assigned

to being collected for their vegetative parts, but this will be due to the local preservation conditions.

The eastern river area allowed, as mentioned above, for a more detailed comparison with (the Late Bronze Age situation of) West Frisia, because remains were favourably preserved (Figure 9.25). When remains are predominantly preserved in low frequency in uncharred form, the vegetative part of the plant was most likely for consumption; when remains are most frequently preserved in charred condition, the seeds of the plants were most likely consumed (cf. Chapter 7, Table 7.7). From Figure 9.25 it is clear that the six wild plant species on the left were probably collected for the consumption of their seeds, whereas the seven species on the right were collected for their vegetative parts. The latter observation is partly confirmed by the species known from ethnobotany to be only collected for their vegetative parts (green boxes in Figure 9.25). This pattern is largely in concurrence with what is observed in West Frisia (Table 9.2). The only two differences observed are in the species stinging/annual nettle (*Urtica dioica/urens*) and common plantain (*Plantago major*). Common plantain was collected for its seed based on the West Frisian data, whereas it is used for its vegetative parts in the river area. Stinging/annual nettle does not match either edible use, since it shows only high frequencies of uncharred remains. If it was used for the consumption of seeds, high frequencies of charred remains would be expected as well, and if it was used for the consumption of its vegetative parts, the amount of seeds is too high. Therefore, a different use is proposed for this plant, which is further discussed in the section on use of plants below. Finally, the mixed use of chickweed observed in West Frisia is further emphasized by the differential use of this plant in both the river area (vegetative parts) and Kennemerland (seeds).

Overall, it appears that many of the same wild plant species were collected in the Bronze Age, and of these species, the same parts were used for consumption: a group of plants gathered for consumption of seeds could be identified, as well as a group for vegetative parts. Although many species are similar in all the regions researched, some variations in use between regions also exist, which may signify local differences

Table 9.2. Edible plant use of species deriving from house contexts from the different Dutch regions.

Region		West Frisia	River area - east	Kennemerland	Hattermerbroek
Preservation state		charred and uncharred	charred and uncharred	only charred	only charred
Taxa	English name				
<i>Chenopodium album/ficifolium</i>	Fat hen/ Fig-leaved goosefoot	seed	seed	seed	seed
<i>Atriplex hastata/patula</i>	Hastate/ Spreading orach	unknown	seed	seed	unknown
<i>Chenopodium polyspermum</i>	Manyseed goosefoot	unknown	seed	seed	-
<i>Echinochloa crus-galli</i>	Barnyard grass	seed	seed	-	-
<i>Rumex acetosella</i>	Sheep's sorrel	seed	seed	-	seed
<i>Solanum nigrum</i>	Black nightshade	seed/fruit	-	seed/fruit	unknown
<i>Vicia hirsuta/tetrasperma</i>	Hairy/Smooth tare	seed	-	unknown	unknown
<i>Spergula arvensis</i>	Corn spurrey	-	-	-	seed
<i>Mentha aquatica/arvensis</i>	Water/wild mint	vegetative	vegetative	-	unknown
<i>Capsella bursa-pastoris</i>	Shepherd's purse	vegetative	vegetative	-	-
<i>Lythrum salicaria</i>	Purple loosestrife	vegetative	vegetative	-	-
<i>Schoenoplectus lacustris</i>	Bulrush	vegetative	vegetative	-	-
<i>Aster tripolium</i>	Sea aster	vegetative	-	unknown	-
<i>Urtica dioica/urens**</i>	Stinging/Annual nettle	vegetative	vegetative/ other use	-	-
<i>Plantago major*</i>	Common plantain	seed	vegetative	-	-
<i>Stellaria media*</i>	Chickweed	mixed	vegetative	seed	unknown
<i>Rumex conglomeratus/crispus/sanguineus</i>	Sharp/Curly/ Red-veined dock	mixed	seed	unknown	-
<i>Polygonum aviculare</i>	Knotweed	mixed	-	unknown	unknown
<i>Bolboschoenus maritimus*</i>	Seaside bulrush	vegetative/ other use	-	seed	-
<i>Sinapis arvensis</i>	Charlock	-	-	unknown	-
<i>Althaea officinalis</i>	Marsh mallow	-	-	unknown	-
<i>Apium graveolens</i>	Wild celery	-	-	unknown	-

Green emphasis in left column=edible plant only collected for vegetative parts.

*= different edible use in every region; **=other use besides consumption likely.

in practice. Finally, the better the local preservation conditions are, for preserving both charred and uncharred remains, the broader the range of detected edible species becomes, and especially the range of plants collected for their vegetative parts. West Frisia remains the best site for interpreting these latter plant species, due to its excellent preservation conditions.

Gathering locations

The growing locations of the wild plant species uncovered from house contexts from the different sites provided information on gathering locations. Most wild plant remains derive from a variety of habitats, strengthening the likelihood of conscious

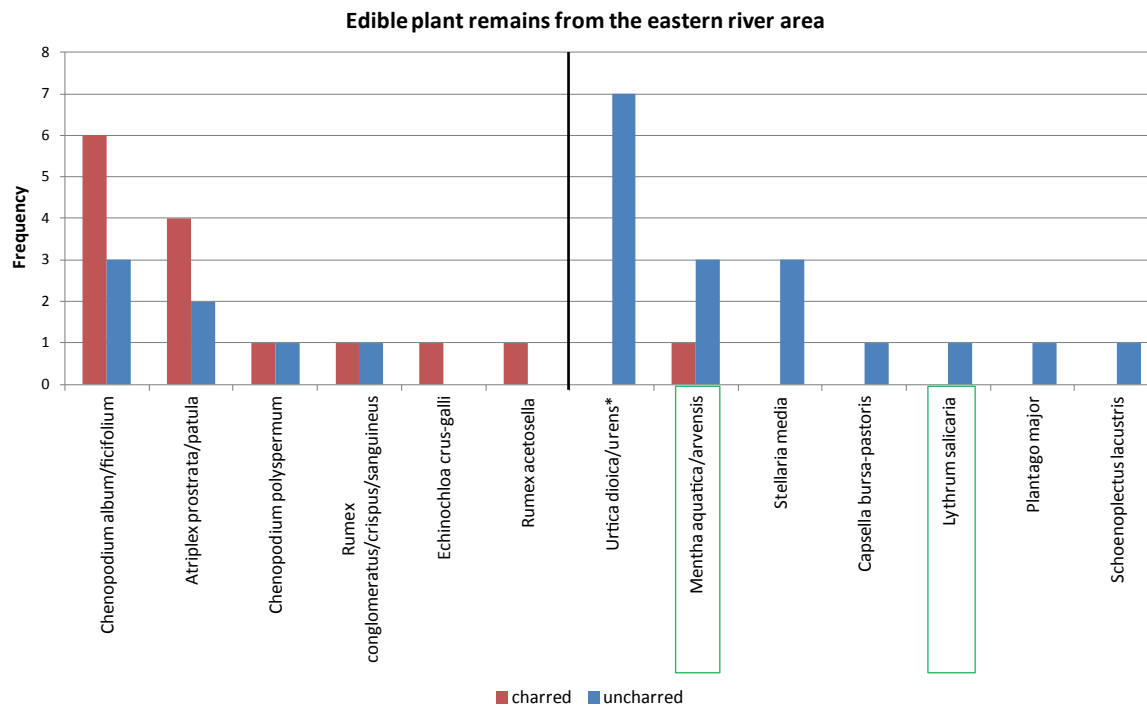


Figure 9.25. Frequencies of charred and uncharred seeds edible plant species from house contexts from the eastern river area. *=does not match with edibility expectations, probably other use; green boxes denote plant species collected for the consumption of their vegetative parts only (PFAF 2016).

gathering practices rather than random accumulation. Gathering locations which could be identified by the species include wet, dry, trodden, untrodden, saline, freshwater, forest, and arable locations. The remains from each site reflect the assumed landscape types present in the direct surroundings of that site, similar to what was observed through investigation of wild animal remains. The assemblage of charred plant remains from house contexts shows that people throughout the Dutch Bronze Age exploited their direct surroundings for the benefit of the subsistence economy.

Gathering practices

Chapter 7 has already shown that reconstructing gathering practices purely based on charred seeds and fruits greatly underestimates the actual extent of gathering throughout the year. All the remains from the sites are seeds, nuts, berries, and fruits, and indicate gathering from at least June to November (the seed-bearing period of most species), but plants

will also have been gathered at other times of the year. The entire spring and most of the summer period provide people with vitamin rich vegetative parts, whereas in winter, starch-containing roots and tubers can be collected (see next paragraph) as an addition to diet (Chapter 8, section 8.3.1). Apart from the periods signified by the uncovered seeds, it can be assumed that Bronze Age people from the researched areas gathered throughout the year. Wild plant gathering will have formed a constant and valuable addition to the subsistence year-round, also in other areas of the Netherlands.

Use of plants

Wild plant uses comprise both use as raw material and for nutritive purposes, which is discussed separately below. The information below is based on direct evidence, when raw material itself was uncovered on the sites, as well as on indirect evidence, with the possible uses of the uncovered species provided by ethnographic records (PFAF 2016).

Raw material

In Voorburg (Haaglanden), several wooden remains were found in a well, including an oaken hammer and wattle work, which was possibly the original lining of the well (Hagers *et al.* 1992, 77-9).

The region around Velsen (Kennemerland) has yielded several wooden objects, including an oaken bowl, wattle works made of alder and willow, rope made of juniper, a besom and a basket made of willow, and a fork made of alder wood (Willemsen 1991a and b). Remains from this area also included many wooden objects used for building. In Hattemerbroek, several wooden remains were found, although their function could not be reconstructed (Kooistra 2011, 474-5). In Zijderveld and Eigenblok, wooden remains were uncovered which were part of the construction of houses and storage structures (Brinkkemper *et al.* 2002: 509; Vermeeren 2005, 99-113). Eigenblok furthermore yielded some other examples of wild plants used as raw material; a charred piece of rope was uncovered, as well as the remains of charred wattle work made of alder. The wattle work was found together with charred grain, which led to the assumption that grain may have been stored in baskets (Brinkkemper *et al.* 2002: 508, 529). The other sites in the river area yielded several pieces of wood, but no clear artefacts could be discerned.

Based on the wild plant species, some indirect uses of wild plants could be discerned, which included use for fibre, dye, tannin, soap, oil, repellent, basketry, thatch, and bedding. The frequency with which *Urtica dioica/urens* was found indicated that it was possibly used for consumption and many other functions.

To summarize, several direct uses of wild plants could be identified in the different areas, but most uses seem to be based on wooden remains. Indirect uses based on ethnobotanical examples show a range of possible uses comparable to those observed in West Frisia, although most of these uses could not be confirmed by direct finds. Therefore, more attention must be paid to their possible presence in future research (Chapter 11).

Nevertheless, all of the above examples show the knowledge about and incorporation of wild plants in Bronze Age subsistence throughout the Netherlands.

Diet

Chapter 8 has already made clear that consumption of only fruits, nuts, and berries during the restricted time of autumn is not enough for adequate vitamin intake throughout the year. Even drying fruits and berries for use at a later time is not an option to maintain a good health, since this process decreases the vitamin C levels in fruits dramatically.

Besides the edible plants listed in Table 9.2, of which especially the vegetative plant parts will have added essential micro-nutrients to the Bronze Age diet, it is also interesting to note that at several sites some direct indications for the use of vegetative parts of plants, possibly for food, were also found. Hattemerbroek yielded the most diverse charred vegetative plant matter, including parenchyma (in the posthole of a house), roots, stems, and fruit. However, no species was identified. From this site, it was also possible to perform elaborate botanical and chemical residue analyses on food crusts in pottery (Kubiak-Martens & Oudemans 2011). The botanical residue analysis revealed that tubers or roots were cooked in the pot (Kubiak-Martens & Oudemans 2011, 455-6), reinforcing the proposed idea that the consumption of vegetative plant matter still played a role in the Bronze Age subsistence economy in other regions of the Netherlands besides West Frisia.

At other locations, charred vegetative tissue was also uncovered in postholes of houses, including the stems of large grasses (Noordwijk), and charred parenchyma, charred roots, and charred stems (Eigenblok and Meteren de Bogen). Although the species of these latter finds could not be identified and their use as edible plant could not be confirmed by residue analyses, it is worth being aware of these possible indications of wild plant consumption now that it is known to have happened during this time period. Possibly, (more) appropriate data will become available for analysis in the future.

9.3.5 Summary and discussion

The richness of remains in West Frisia has greatly aided the understanding of Bronze Age subsistence on a detailed level. By using this area as a starting point for comparison, several differences and similarities between the different Dutch regions have surfaced.

Overall, there seems to be a varying dominance of the different domestic animal and crop species available in the Bronze Age. The practices behind it however, appear largely the same. Crop husbandry practices are very comparable, although slaughter practices differ between West Frisia and the river area, with the potential for meat production being higher in the latter. In all regions, there is ample evidence for hunting and gathering, which will have exploited the locally available fauna and flora, and will have continued to aid subsistence throughout the Bronze Age. Similarities between the subsistence strategies of West Frisia and areas such as Kennemerland and Hattermerbroek may furthermore indicate connections with these neighbouring areas, although more research is required to confirm this.

Finally, it has again become clear that researchers should be very aware that low frequencies of wild plant and animal remains do not necessarily signify a lower importance for the subsistence economy, because the purpose of wild resource exploitation will have shifted with regard to previous periods.

The richness of the West Frisian botanical and zoological remains have revealed practices that would not have been easy, or even possible, to recognize or interpret in the other researched areas. This makes West Frisia invaluable for reconstructing Bronze Age subsistence, and concurrently means that extra care should be taken before drawing conclusions based on (more) incomplete datasets.

Table 9.3. Overview of the different Bronze Age periods in the Nordic countries (cf. Thrane 2013, 746) and the Netherlands with their respective dates (cf. Louwe Kooijmans *et al.* 2005, 28).

Nordic Bronze Age		Dutch Bronze Age
Nordic Early Bronze Age (NEBA)	1700-1100 BC	Middle Bronze Age (MBA)
period I	1700-1500 BC	Middle Bronze Age A
period II	1500-1300 BC	Middle Bronze Age B
period III	1300-1100 BC	Middle Bronze Age B
Nordic Late Bronze Age (NLBA)	1100-500 BC	Late Bronze Age/Early Iron Age (LBA/EIA)
period IV	1100-900 BC	Late Bronze Age
period V	900-700 BC	Late Bronze Age – Early Iron Age
period VI	700-500 BC	Early Iron Age

Table 9.4. Specific information of the sites from each researched European region.

Region	Site and toponym	Date	Remains	Reference
8. Denmark	Bjerre	NEBA (1500-1100)	Zoological	Nyegaard 1996
	Thy	NEBA (1700-1100)	Botanical	Kelertas 1997
	Lindebjerg	NEBA (1700-1500)	Botanical	Rowley-Conwy 1978
	Voldtofte/Kirkebjerg	NLBA (900-500)	Botanical, zoological	Rowley-Conwy 1983; Nyegaard 1996
9. Sweden	Ystad – Köpinge area	NEBA-NLBA (1500-500)	Botanical, zoological	Berglund 1991 and references therein
	Ystad – Bjäresjö area	NLBA (1100-500)	Botanical, zoological	Berglund 1991 and references therein
	Ängdala	NLBA (900-700)	Zoological	Nyegaard 1996
10. Switzerland	Hauterive-Champréveyres	LBA (1050-880)	Botanical, zoological	Jacquat 1989; Borrello and Chaix 1983
	Cortailod – Est	LBA (1010-965)	Zoological	Borrello <i>et al.</i> 1986

9.4 THE RESEARCHED AREAS: EUROPE

Three European areas are chosen for comparison with the Dutch Bronze Age, and West Frisia in particular, which are based on the same selections mentioned for the Dutch sites in section 9.2.

These areas¹³; include Denmark, southern Sweden, and Switzerland, all of which possess sites which are located close to a saltwater or freshwater coast, similar

to the selected Dutch sites. Danish and southern Swedish sites are all located in relatively close proximity to the (North and Baltic) sea, and are chosen for comparison with West Frisia and the Netherlands to investigate whether any similarities can be observed between the areas in terms of practices and available resources. Several indications already exist in West Frisia for possible contacts with these areas based on the presence of flint sickles from Helgoland (an island between Denmark and Germany) and bronze fibulae finds which resemble finds and decoration types from Denmark and southern Sweden.

Switzerland, with its lakeside settlements, on the other hand, is chosen as a contrasting area, as it is expected that at least the available resources will differ from West Frisia and the Netherlands. The practices at these Swiss sites, however, may be comparable to a certain extent with eastern West Frisia, because they are also located close to relatively large freshwater lakes, although in a different climate and geography.

13. coastal regions, which include the fenlands in East Anglia, Great Britain, and northern Germany, were not investigated, although they were promising areas for comparison with West Frisia. The reason for the exclusion of these areas in this study is that both these areas are currently being researched or have been researched in other PhD projects (Floor Huisman, Durham University: <https://www.dur.ac.uk/archaeology/staff/?mode=staff&id=13238>; Henrike Effenberger; "Pflanzenutzung und Ausbreitungswege von Innovationen im Pflanzenbau der Nordeuropäischen Bronzezeit und angrenzender Regionen"; Die Akademie der Wissenschaften und der Literatur, Mainz: <http://www.adwmainz.de/mitarbeiter/profil/henrike-effenberger.html>). Therefore, for more information on these areas, the interested reader is kindly referred to the (forthcoming) results of these (ongoing) projects.



Figure 9.26. Locations of the researched sites in Denmark and southern Sweden (region 8 and 9). a: location of an excavated site; 1: Thy; 2: Bjerre; 3: Lindebjerg; 4: Voldtofte/Kirkebjerg; 5: Ystad – Köpinge; 6: Ystad – Bjäresjö.

9.4.1 The sites

Before the sites are introduced, it must first be clarified that the Bronze Age in Nordic countries occurs at a later time than the Bronze Age in the Netherlands. The Nordic Bronze Age is subdivided in the Nordic Early Bronze Age (NEBA) and the Nordic Late Bronze Age (NLBA), and each of these is further sub-divided into three periods (Thrane 2013, 746), which are listed in Table 9.3. This skewed periodisation between the Netherlands and the Nordic countries, implies that the Dutch Middle Bronze Age occurs simultaneous with the Nordic Early Bronze Age, and the Dutch Late Bronze Age with roughly the first two periods of the

Nordic Late Bronze Age. As the NLBA lasts well into the Dutch Early Iron Age (EIA), some developments which are present in the NLBA might have to be compared to the EIA in order to form a fair comparison. Possible differences in timing of technological advances or spread of resources in both areas might therefore be related to time period, and this aspect will be taken into consideration during comparison.

Specific information on the (location of) the different regions and their sites is summarized in Figures 9.26-9.27 and Table 9.4.

Individual sites were again selected based on the presence of botanical and/or zoological remains and

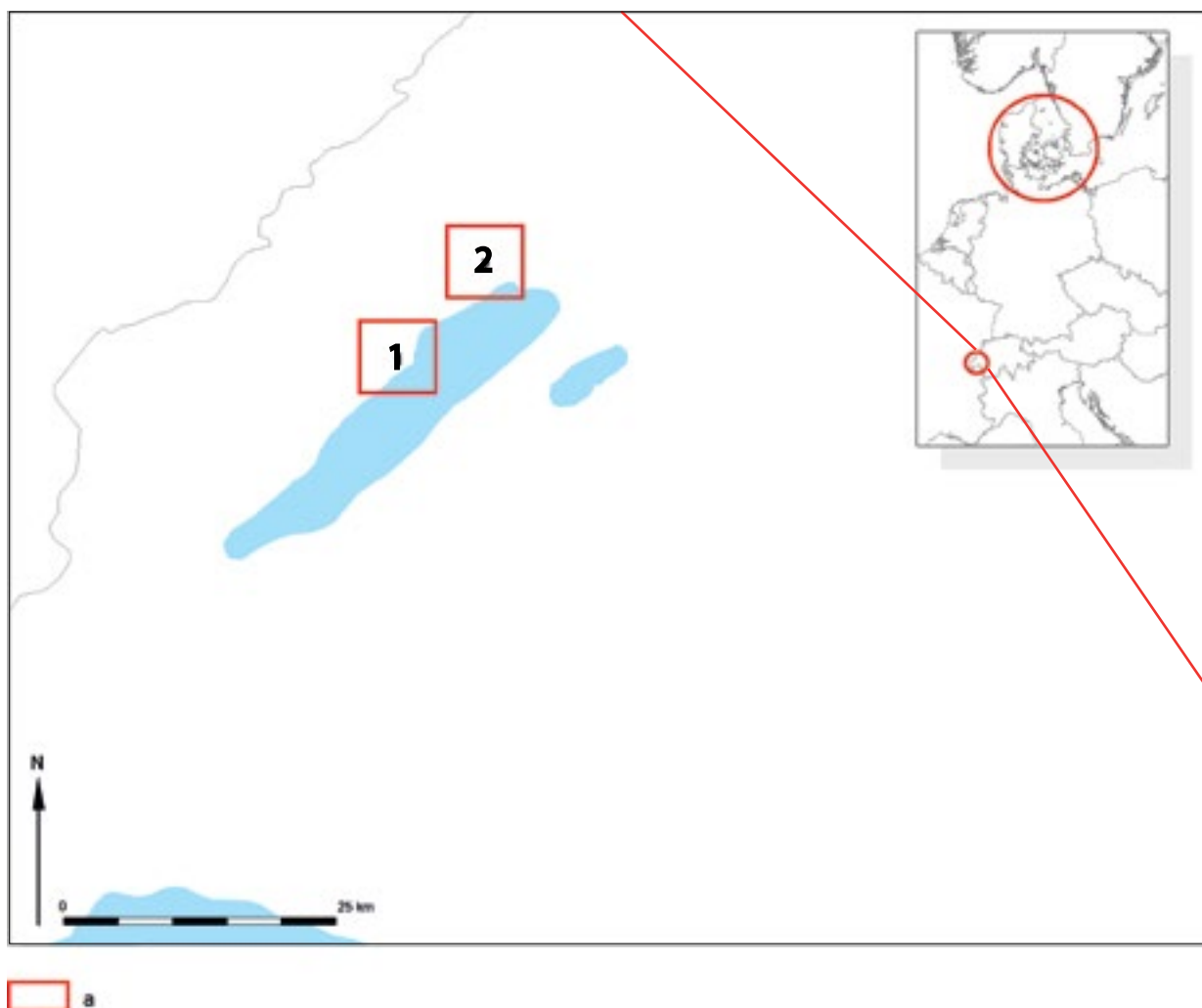


Figure 9.27. Locations of the researched sites in Switzerland (region 10). a: location of an excavated site; 1: Hauteville-Champréveyres; 2: Cortaillod-Est.

their potential to answer of the subsistence related questions listed in the previous chapter (section 8.8). Several different levels of presence and preservation of remains were encountered, which resulted in a varying level of detail in the description of Bronze Age subsistence in both different regions. Regions are discussed separately, and when more than one site is available for a certain subject, they are discussed separately before drawing conclusions on the entire region. Finally, in each discussion of the different subsistence strategies, a comparison with the West Frisian and also the Dutch situation (without West Frisia) is incorporated, where applicable.

9.5 COMPARISON BETWEEN EUROPEAN, DUTCH, AND WEST FRISIAN SITES

9.5.1 Hunting

Wild animal composition

In Figures 9.28-9.29, the wild mammal composition of the sites in Denmark (DK), Sweden (SE), Switzerland (CH), West Frisia (WF), and the other Dutch sites (NL) are summarized. Bird and fish remains were too scarce to be included in this analysis, but based on the local character of hunting practiced at the researched sites (see next paragraph),

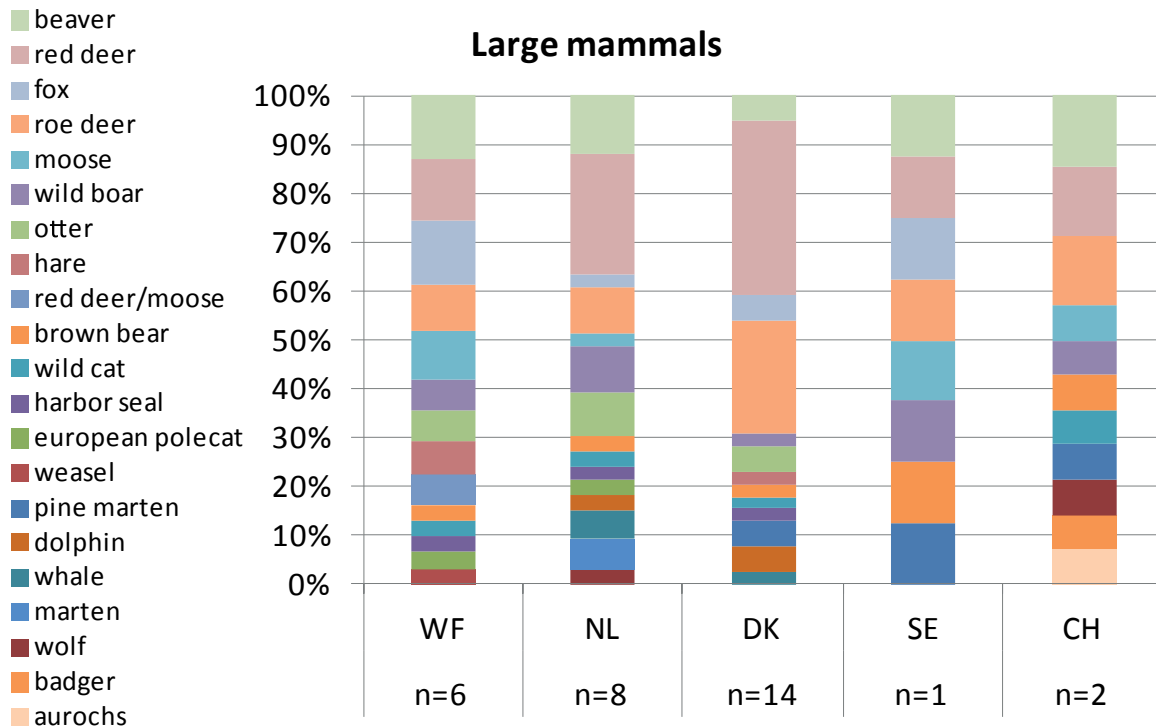


Figure 9.28. Frequencies of large mammals from the different European regions in comparison with West Frisia and the Netherlands.

it is expected that birds and fish would have come from the surroundings of the settlements.

Figure 9.28 gives insight into the most frequently uncovered species in each region. On the other hand, Figure 9.29 provides a quick overview of the different uncovered wild animal species per region by only showing their presence, which facilitates inter-regional comparison.

Both figures portray a wide range of wild large mammals found, although the number of remains is generally low. The large mammals red deer, roe deer, beaver, wild boar, and brown bear are uncovered in every region, with the first four species also being found most frequently at most locations. These species appear to belong to a “standard set” of hunted large mammals in the Bronze Age, which are found regardless of geographical location or climate. Other species which are present in many, but not all of the regions include fox, wild cat, moose, harbour seal, otter, and pine marten. Pine marten is not found in West Frisia or the Netherlands, which may be due to

the absence of an appropriate habitat for this species in these areas during the Bronze Age. The remaining wild animal species are only uncovered in one or two regions. The variety of large mammal species in West Frisia, and the Netherlands at large, is only really comparable to the Danish sites, but this may be related to the higher number of samples available from these areas. It is clear however, that the wide range of mammal species observed in every region again indicate that also in other European areas in the Bronze Age, hunting skills and knowledge required for the capture of these animals were still present.

Hunting locations

The animal species observed in the previous paragraph show capture in the (varied) close surroundings of the settlements (data not shown), with strong indications for the sea at coastal sites in Denmark, and a variety of landscape types – including grassland, shrubland, wetland, and forest – present at all the sites. At the Swedish site of Ängdala no marine mammals were found, although it is located near the coast. However,

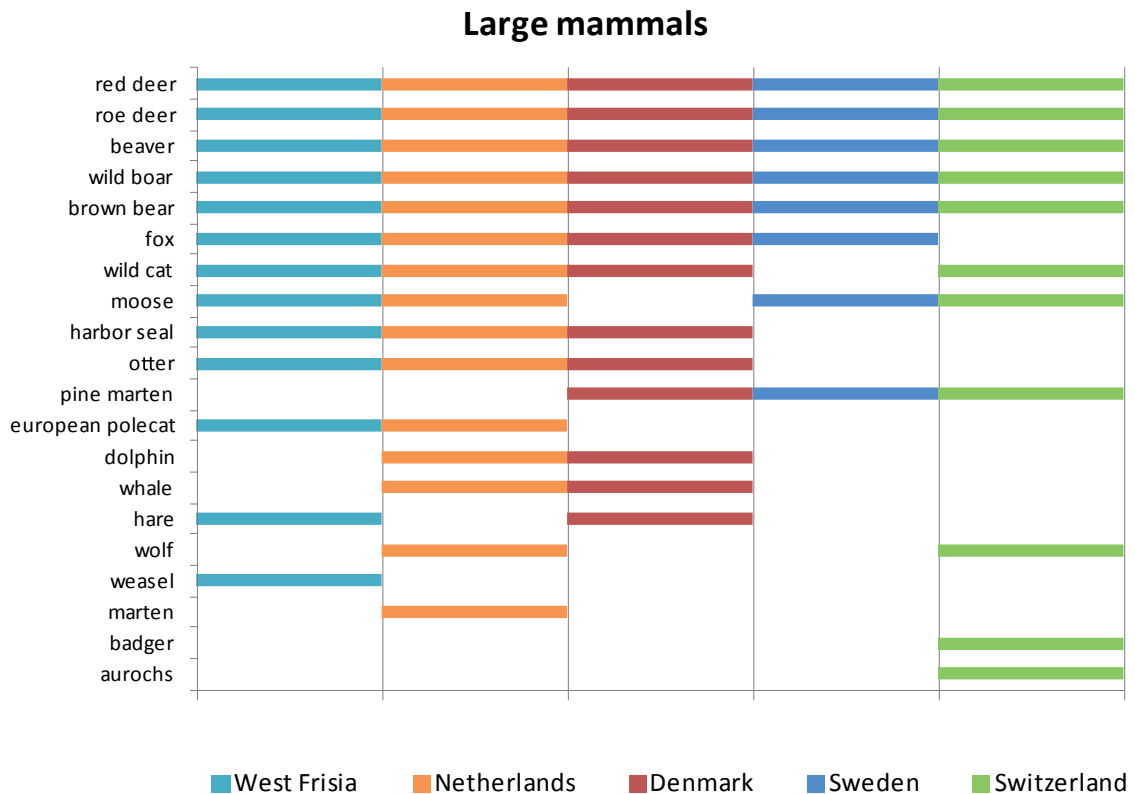


Figure 9.29. Presence/absence of large mammals from the different European regions in comparison with West Frisia and the Netherlands.

marine fish species were present (Nyegaard 1996, Table 86), indicating exploitation of this habitat type as well. Similar to the West Frisian situation, hunting appears to have been a relatively local practice. The wide variety of habitat preferences from the animal species present in each region and at each site again indicates that wild resources from various locations in the surroundings of the settlements were still exploited during this time, similar to in West Frisia.

Hunting practices

A few direct indications for hunting are found in Denmark, but not Sweden. As already mentioned in Chapter 4 (section 4.3.2), several wooden tread traps – indicating passive hunting – have been uncovered in bogs. Furthermore, bone, flint, and bronze arrowheads have also been uncovered at several locations (Nyegaard 1996, 148 and references

therein), indicating that active hunting was still occurring during this time.

Unfortunately, no clear evidence for the hunting of game were found at the researched sites in Switzerland, although the species found (*e.g.* wolf, brown bear) could not have been caught without the appropriate equipment. In Hauterive-Champréveyres however, a wooden net float was uncovered, identifying probable passive fishing practices.

Use of wild animals

In the Nordic countries, as well as in Switzerland, authors who discuss hunting in these areas in the Bronze Age postulate several reasons for why hunting occurred, although none emphasizes the importance of this practice due to the limited amount of remains. However, one of the reasons proposed,

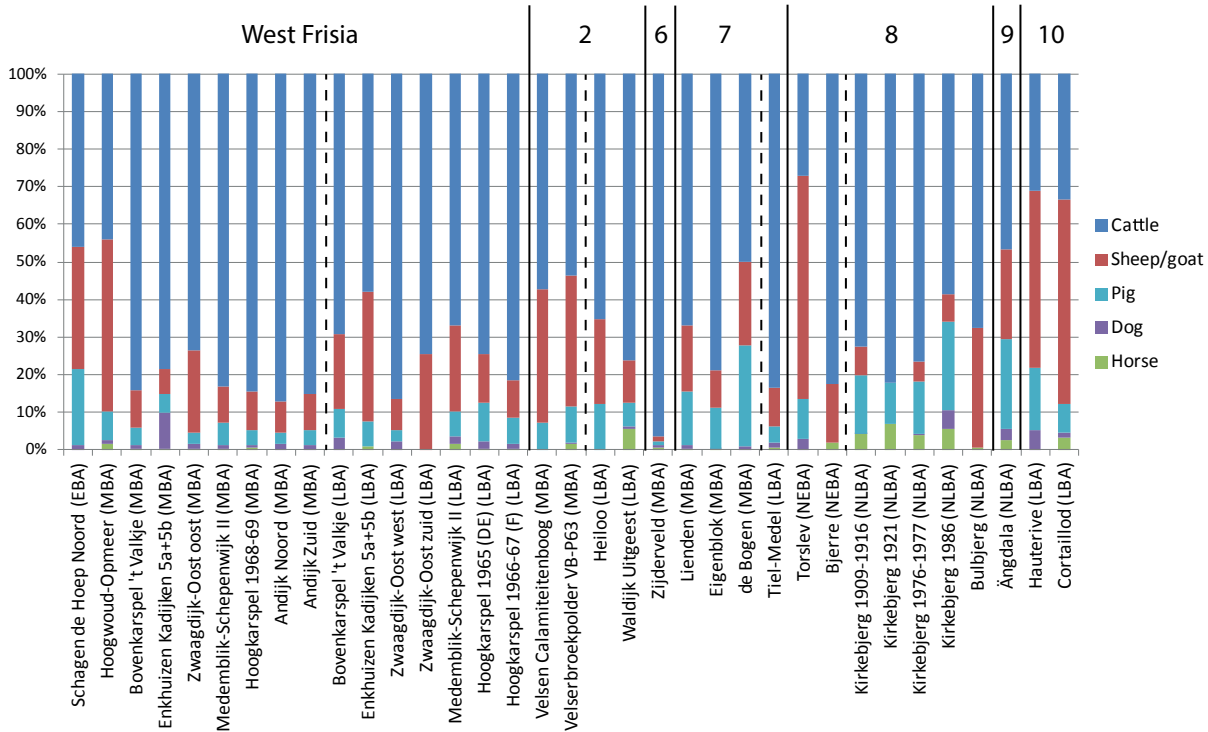


Figure 9.30. Comparison of the domestic animal compositions of the West Frisian, Dutch, Danish, Swedish, and Swiss sites. Numbers above the graph refer to the numbers of the different regions in accordance with Table 9.1 and 9.3. 2: Kennemerland; 6: River area – west; 7: River area – east; 8: Denmark; 9: Sweden; 10: Switzerland.

which is in concurrence with the reasons for hunting postulated in West Frisia (cf. Chapter 4, section 4.4.5.4), is that hunting was mainly carried out for the procurement of raw material. One type of raw material is the antlers of red deer, high frequencies of which have been found in Denmark, Sweden, and Switzerland (Nyegaard 1996, 147; Borrello *et al.*, 1986: 63, 66). The other type of raw material is pelts or skins of animals. In all three regions, many species may have been captured for their fur, including beaver, fox, otter, marten, wild cat, seal, hare, wolf, and badger. Of course, brown bear, moose, and deer skins could also have been targeted raw materials. Both Borrello *et al.* (1986, 66) and Nyegaard (1996, 152) indicate the potential of hunting for fur in the Bronze Age. Nyegaard further postulates that it is not unlikely that large parts of the population will still have been dressed in wild animal skins during this time (Nyegaard 1983, 102). The discovery of the Bronze Age wooden traps from several areas of Europe (Chapter 4, Figure 4.3) would concur with

this idea, since trapping results in minimal damage of the animal's skin during capture, as opposed to piercing by weapons.

The image obtained from the Nordic and Swiss examples is very comparable to the Dutch situation, since many fur animals are found at the various researched Dutch and West Frisian sites. Furthermore, the only clear example of Dutch Bronze Age clothing (*i.e.* the Emmer-Erfscheiden bog body; Chapter 8, section 8.3.2) is made from a mix of domestic and wild animal skins (van der Sanden 1996). Apparently, the importance of wild animals in the Bronze Age in general may have shifted from being a major source of food to a source of raw material and an additional source of meat to complete subsistence. Clearly, hunting was not abandoned during the Bronze Age in any of the researched areas, and it maintained its importance in the subsistence economy, although its main purpose may have become different than in previous periods.

9.5.2 Animal husbandry

Livestock composition

The five species of livestock kept in the Dutch Bronze Age (*i.e.* cattle, sheep, goat, dog and horse) are all also present in the researched international regions, although not always in the same ratios (Figure 9.30). Denmark, represented by four sites here, shows variation between two of its areas: Northern Jutland (including sites Torslev, Bjerre, and Bulbjerg), and the island of Funen (*i.e.* Kirkebjerg) (Figure 9.26).

In NEBA Northern Jutland (Torslev and Bjerre), cattle is observed and also a generally high percentage of sheep, with minor additions of pig, dog, and horse. Torslev especially shows a high percentage of sheep, but only few pig and dog bones, and no horse. At Bjerre, cattle remains are dominant, followed by sheep goat, and horse; no remains of pig or dog were found.

In the NLBA, Northern Jutland (Bulbjerg) still has a reasonable amount of sheep remains, but cattle remains now outnumber those of sheep/goat, and no dog and very few horse remains are found.

On the island of Funen (Kirkebjerg), a low amount of sheep remains was uncovered, even being completely absent in some areas. Pig bones however, were present at relatively high numbers, followed by horse bones, and finally dog. Towards the later NLBA (*i.e.* Kirkebjerg 1986), the amount of especially pig and horse, but also dog remains seem to increase further at the expense of sheep/goat and cattle.

Comparing Denmark to West Frisia reveals that in no particular area or time period, did the two areas match. The only slightly comparable sites might be the sites Torslev and Schagen de Hoep Noord, although Schagen is dated to an earlier period. In general, Danish sites never show the particular ratios of the different species of livestock kept at the West Frisian or other Dutch sites. Northern Danish sites show a higher amount of sheep bones than on the southern island of Funen, where pigs are the major domestic animal kept after cattle: situations which do not occur in West Frisia, or the Netherlands as a whole, except for Meteren de Bogen. Furthermore, horse remains are more frequently found on the island of Funen than

in West Frisia. Only the LBA site Uitgeest Waldijk shows comparably high frequencies of horse bones. A clear increase in sheep remains from the Middle to the Late Bronze Age, such as was observed in West Frisia, was not visible in Denmark. Areas here appear to be consistent in either their low or high sheep/goat share through time. Although each region seems to possess the same set of domestic animals, the average values for remains of livestock for each area (Figure 9.31) reveal that none of the regions are comparable with respect to prevalence of certain species.

The Swedish site Ängdala also differs from the West Frisian and Danish sites. Here, both sheep and pig are equally present after cattle.

This trend is also observed at a more extreme level at the LBA sites near lake Neuchâtel, Switzerland: Hauterive-Champréveyres and Cortaillod-Est. In this area, the number of sheep/goat greatly outnumber any other livestock species present, which are, in decreasing order, cattle, pig, horse, and dog. The (N) LBA average values for livestock remains (Figure 9.32) again show that none of the researched regions are directly comparable in terms of domestic animal species ratios.

Based on the comparison of West Frisian, Dutch, Danish, Swedish, and Swiss sites, it appears that during the Bronze Age, the same livestock species were kept, but different ratios of bones are observed in each region. Due to the good preservation conditions at most sites, these observations are deemed comparable. Nyegaard does, however, remark that the preservation conditions in Northern Jutland were not optimal (Nyegaard 1996, 148), meaning that the assemblages of particularly Bjerre and Bulbjerg should be met with caution. Still, high amounts of sheep/goat and even juvenile individuals of cattle are present at these sites, which means that, if anything, the original share of sheep/goat in the assemblage would have been even higher in Northern Jutland. The specific reasons for the observed differences between regions is hard to interpret and could be related to (a mix of) local environmental, subsistence economical, temporal, and social conditions.

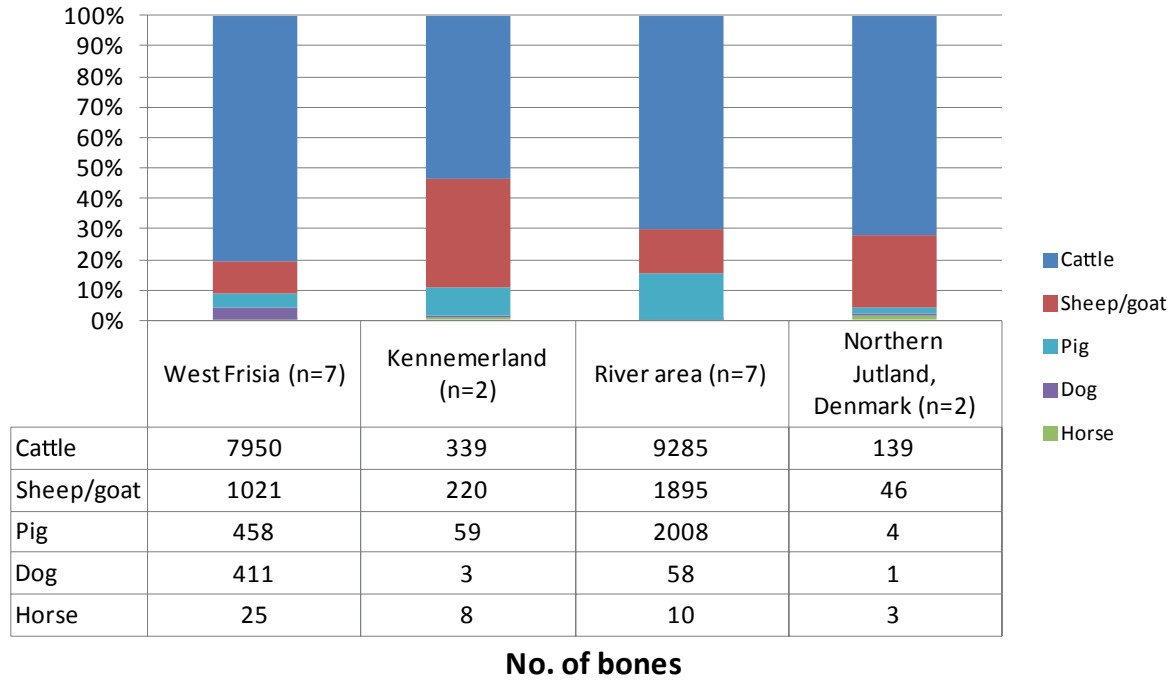
Middle Bronze Age comparison domestic animals

Figure 9.31. Ratios of domestic animal species in the Middle Bronze Age from Northern Jutland in comparison with West Frisia and the Dutch regions.

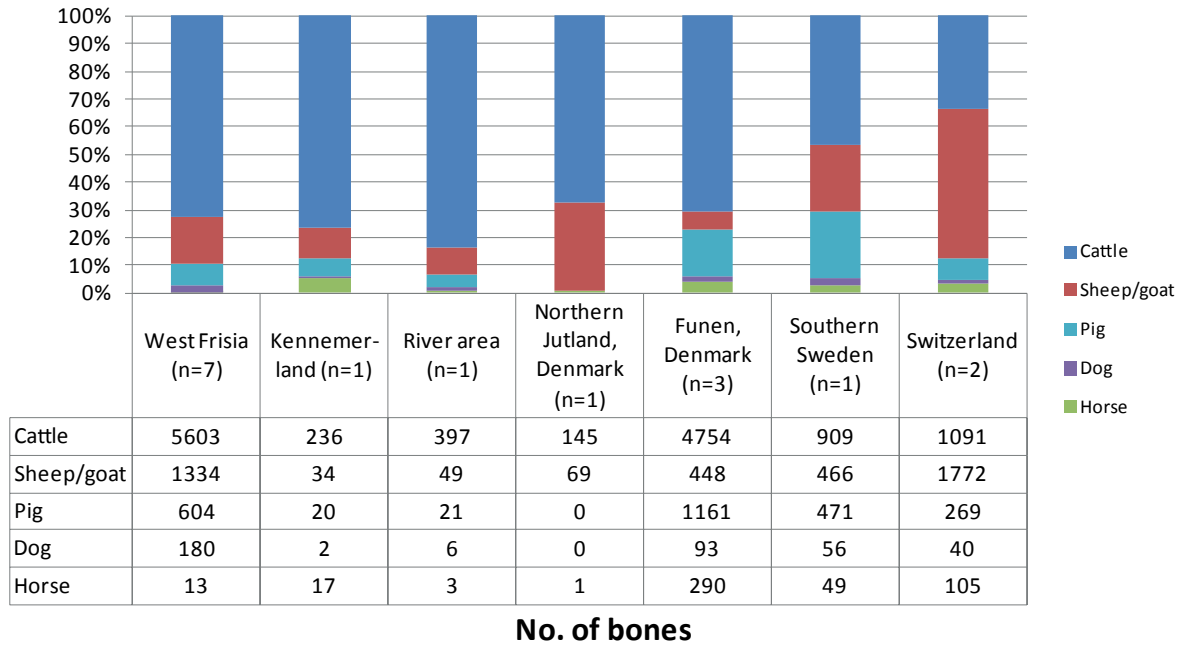
Late Bronze Age comparison domestic animals

Figure 9.32. Ratios of domestic animal species in the Late Bronze Age from the different regions of Europe in comparison with West Frisia and the Dutch regions.

Table 9.5. Ranges of shoulder heights of domestic animal species in West Frisia, Denmark, and Switzerland.

	West Frisia (Bovenkarspel)	Denmark (Kirkebjerg)	Switzerland (Cortailod-Est)
Cattle	102.4-111.6 cm	107-116 cm	102.3-106.9 cm
Sheep/goat	ca. 62.3 cm	57-69 cm	69.8 cm (goat)
Pig	ca. 82 cm	70-87 cm	73-77 cm
Dog	48-61 (65) cm	58-61 (68) cm	56-60 cm
Horse	??	ca. 133 cm	“small”

Animal breeds

Denmark and Sweden

Only the Danish site Kirkebjerg provided information on breeds and sizes of livestock. Although no evidence of polled (*i.e.* hornless) sheep/goat was found, the presence of some individuals with relatively short horns might indicate an intermediate form between horned and polled animals (Nyegaard 1996, 43). Cattle remains showed no signs of polled individuals. Therefore, horns did not provide clear indications for different breeds.

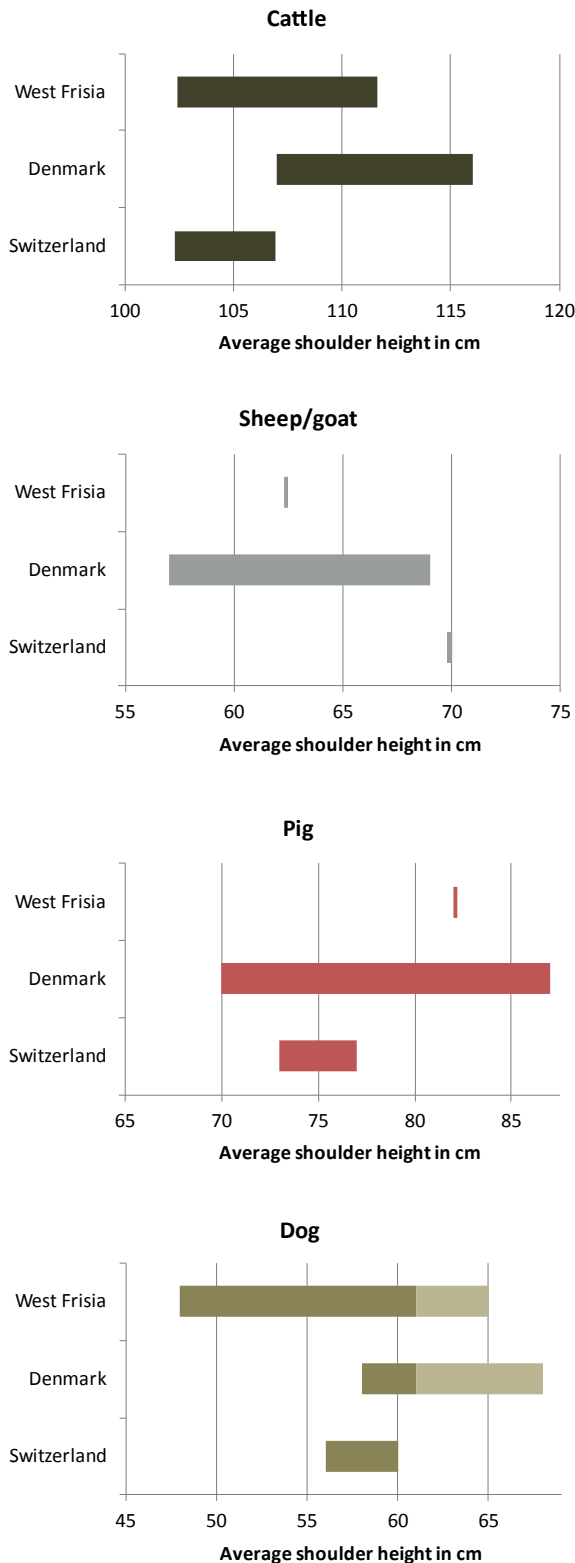
However, reconstructed shoulder heights, which were summarized in Table 9.5 and Figure 9.33 for all livestock species except horse, do provide clear indications for the possible presence of different breeds in the Bronze Age. From this table and figure, it is apparent that the shoulder heights of most Danish animals overlap with the values of West Frisian animals: especially the West Frisian values of sheep/goat and pig fall within the Danish ranges. Dogs and cattle however, seem to be of consistently larger size in Denmark than in West Frisia (Figure 9.33). The size difference of cattle between the two areas is also observed when the range of metapodial distal breadths between the areas are compared (Figure 9.34).

Dogs furthermore, are present in varying size and body type, ranging from medium dogs with a more frail stature to large and strong individuals, which are found in both Denmark and West Frisia. Nyegaard (1996, 53-4) interprets this difference in size and build as the necessity of different dog breeds for specialized functions, such as aiding people with shepherding or hunting. The latter

possibility is, however, rejected by Nyegaard due to the fact that he interprets the limited amount of wild animal species bones uncovered at Kirkebjerg as evidence for the minor role of hunting in the (Nordic Late) Bronze Age. The in-depth analysis of West Frisian wildlife has shown that this is not necessarily a valid assumption (cf. Chapter 4), and the possibility of specialized hunting dogs remains a possibility. Alternatively, people may have required strong guard dogs to protect their livelihood and flocks.

Switzerland

In Cortailod-Est, the remains of a hornless sheep were found. These types of sheep have been present in Switzerland since the Middle-Neolithic (Borrello *et al.* 1986, 50). Shoulder heights could not be calculated for all species. An exact size of the horses could also not be calculated, but in comparison to other Bronze Age horses, which are already of limited size by modern standards, they appear to be small (Borrello *et al.* 1986, 57). Shoulder heights of the remaining species are shown in Table 9.4 and Figure 9.33. Most species, except goat, appear to fall within the lower part of the ranges observed in West Frisia and Denmark. Furthermore, dogs in Switzerland are robust and strong, with strong jaws. Their size ranges from medium to large, and they are larger than the dogs in Switzerland dating to both the Neolithic and most of the Iron Age (Borrello *et al.* 1986, 56). However, these dogs are not as large as some of the specimens found in the other regions. Still, relatively stronger and larger dogs seem to be preferred in Switzerland as well, which could again be related



to the practice of shepherding (e.g. protecting the large sheep flocks), hunting, and/or guarding the settlement. Of course, as is often the case, a mix of these possibilities probably lies closest to the truth.

Overall, in addition to livestock composition ratios, all regions also seem to differ in their animal breeds. Denmark yielded examples of consistently larger cattle and dogs than West Frisia, whereas Swiss animal are mostly small. Sheep appear at all sites, but vary in their genes related to the possession of horns. Throughout the researched European sites, sheep horns range from full-size horns (West Frisia), small horns (Denmark), and complete absence of horns (Switzerland). This variation in sheep breeds is consistent with what is observed based on recent genetic studies (cf. Chapter 5; Appendix A1.5). Large (male?) goats seem to appear in both Switzerland and Denmark, whereas pigs are of similar size in Denmark and West Frisia, but are small in Switzerland. Dogs of varying size are found at all sites, possibly reflecting different specialized breeds. Horses finally, are consistently small in every region, reaching to the size of an average present-day pony.

Location of livestock

Denmark and Sweden

Only in Denmark, substantial evidence of keeping animals inside Bronze Age houses was found. In several areas of Denmark, direct and indirect indications exist. These indications are manifold, and range from the presence of actual stall divisions, to a difference in posthole distances in one part of the house. The absence of hearths in certain parts of the house as well as phosphate analysis are other indications (Nyegaard 1996, 13; Robinson 2003: 156, 159, 161). These barn parts are usually found in the eastern part of the house, but are also sometimes located in the central part (Robinson 2003, 160).

On the left: Figure 9.33. Comparison of the average shoulder heights of the different domestic animal species in West Frisia, Denmark, and Switzerland. Since shoulder heights of horse were only present in Denmark, this animal species is excluded. Lighter shades of colour in the graph of dog signify that an outlier value exists of one individual up to the maximum height observed.

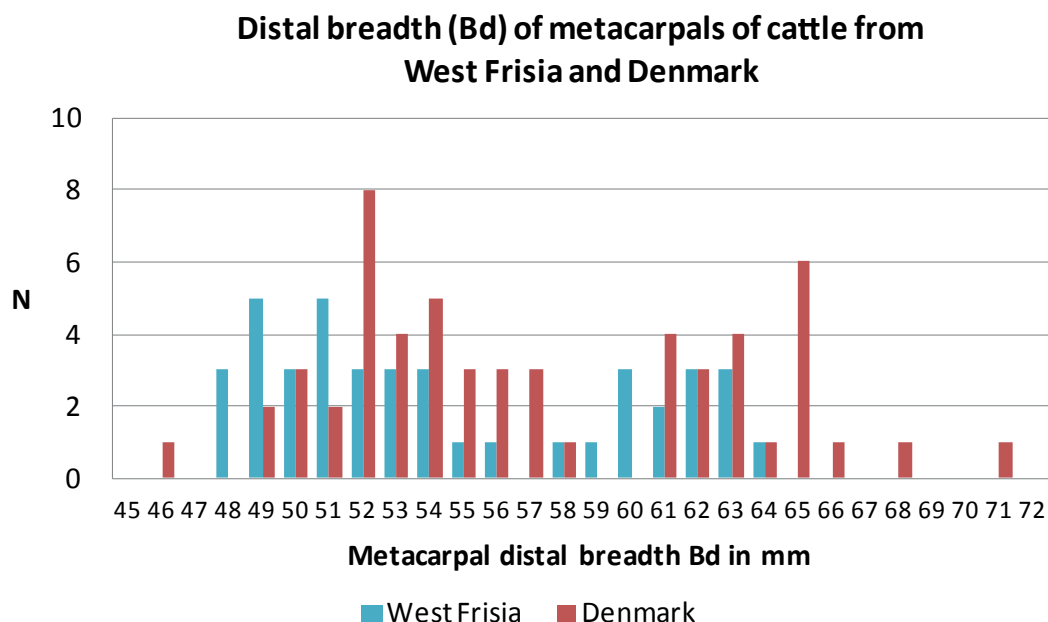


Figure 9.34. Comparison of the distal breadth of cattle metacarpals of West Frisia and Denmark (data from: IJzereef (unpubl.), and Nyegaard (1996, figure 15), respectively).

Besides houses with stall partitions, several burnt houses of the Pre-Roman Iron Age in Denmark provided examples of barns without clear separations for animals (Kveiborg 2009a-f; cf. Chapter 5, section 5.4.3). Instead of wooden stall partitions, some of these stables were probably separated by partitions of wicker, or, alternatively, animals were fastened to beams or the outer wall of the house with the aid of rope (headgear). Since these different methods of keeping animals will not be visible as postholes during excavation, they may easily be missed as an option for how a prehistoric barn may have functioned. These Danish examples are therefore very valuable, providing evidence for alternative possibilities for keeping animals, which may also have been performed similarly in West Frisia, especially considering the fact that West Frisian houses also showed no signs of wooden stall separations in the house lay-out.

In Denmark, outside structures which may be related to animal husbandry were also observed, and consist of circular posthole configurations, which may have functioned as animal pens (Nyegaard 1996,

13). Comparable structures were observed in great numbers in West Frisia. Therefore, these structures may perhaps also be related to animal husbandry. However, due to a scarceness of finds from the circular structures in West Frisia, this could not be confirmed and other possible functions are by no means excluded.

Switzerland

No clear examples of designated animal locations in Bronze Age Switzerland were observed. Neolithic examples do exist however, with animals possibly being kept inside pile-dwellings over a lake (Akeret *et al.* 1999).

Slaughter practices

The programme Faustitas (Appendix A1.7) was used to re-interpret slaughter ages data, including considering the effects of taphonomy as much as possible. Unfortunately, only one (Danish) NLBA site, Kirkebjerg, provided the raw data required for the analysis with Faustitas, and only for cattle remains. The other sites and regions could therefore not be

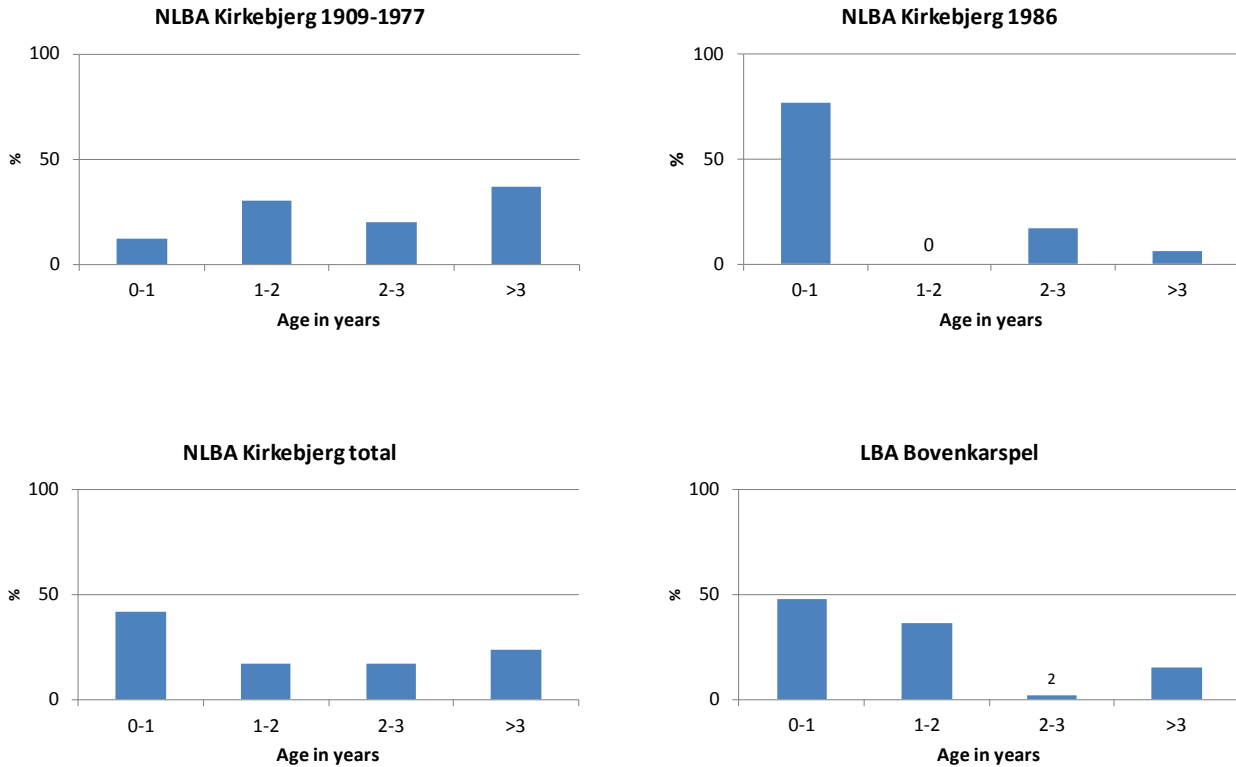


Figure 9.35. Mortality profiles of the sites from (Nordic) Late Bronze Age Denmark (i.e. Kirkebjerg) in comparison with Late Bronze Age West Frisia (i.e. Bovenkarspel). All sites have been corrected using the ravaging correction suggested by Munson (cf. Chapter 5, section 5.4.2). Original data from Kirkebjerg 1909-1977: n=646; Kirkebjerg 1986: n=157; Kirkebjerg total: n=803; Bovenkarspel: n=288.

included here. When and if the raw data becomes available in the future, this analysis could be completed. The results of the analysis on the data of all excavations from Kirkebjerg (1909-1986), as well as average values of Kirkebjerg and Bovenkarspel are summarized in Figure 9.35.

As can be seen, the general trends of slaughter ages between the different sites of NLBA Kirkebjerg and LBA Bovenkarspel are not very comparable. In period V of Kirkebjerg's NLBA (excavations from 1909-1977), most animals are slaughtered around 1-2 years of age, as well as around 3-4 years, whereas LBA Bovenkarspel is characterized by slaughter mainly at a young age (0-2 years old). In period VI of Kirkebjerg (1986), the mortality profile is more comparable to that of Bovenkarspel. However, this Danish site only comprises of one context, and the results obtained should therefore be interpreted with caution.

When the average Danish and West Frisian data are compared, the overall high peak in 0-1 year old animals is similar, but the ratios of the other ages of culled animals are different: in West Frisia, 1-2 year old individuals are the second highest group of cattle slaughtered, whereas in Kirkebjerg, this is the 3-4 year old age group.

Use of animals

Cattle

Faustitas was also used on the data from Kirkebjerg to analyse the use and long-term viability of the herds. The results of the analysis are shown in Figure 9.36. In Denmark, no clear signs of specialization are visible in the data from 1909-1977 or the combined data for Kirkebjerg. This image is comparable to the Middle Bronze Age in West Frisia (Figure 9.37), which also showed no clear specialization, and similar values for growth and birth rates.

In the data from the excavation of 1986 however, it appears as if production has increased in general, and milk production seems to have become more important. However, since this data derives from only one context, caution is advised.

Using this caution, it remains interesting to note that the 1986 NLBA Kirkebjerg data and LBA Bovenkarspel data both show an increased production potential of the herd, combined with an increased birth rate, and a decreased growth rate. In combination with the slaughter ages observed in the previous paragraph, a possible interpretation could be postulated. For some reason, LBA West Frisian and perhaps NLBA period VI Danish farmers suddenly needed to produce more animals (hence the higher birth rate and production potential) in comparison to the previous period. However, concurrently, a higher number of young individuals was slaughtered (see Figure 9.35, lower half), which resulted in the growth rate and long-term viability of the herd being negatively affected (Figure 9.37). In Denmark, the herd seems to mainly have potential for milk during this time, whereas the West Frisian herd has a higher potential for meat. The growth rate of herds at both sites was equal or even less than one, meaning that these herds would eventually not be able to sustain themselves if no changes were made to the animal husbandry practices.

The use of cattle for milk is also emphasized by the presence of ceramic sieves in Denmark which are often related to cheese making (Nyegaard 1996, 158), similar to the ones found in West Frisia (Chapter 5, Figure 5.28), the analysis on Bronze Age human dental calculus which has revealed mostly bovine milk consumption in northern European areas (Chapter 8; Warinner et al. 2014, Suppl. Table 1 and 2) also emphasizes this use. Another use of cattle in Denmark evidenced by the bone material is traction. Many bones from Kirkebjerg portray pathologies on the metapodia which are commonly related to intense labour in the form of traction (*e.g.* ploughing and pulling of carts) (Nyegaard 1996: 33, 159).

Swiss cattle also show possible signs of labour, shown by the fact that horns show pathologies potentially caused by pulling a yoke (Borrello *et al.* 1986, 54).

Use potential and general herd characteristics of cattle from Denmark

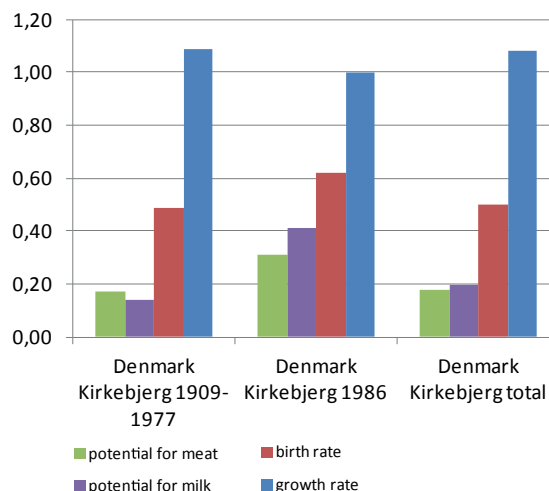


Figure 9.36. Use potential of herds and general herd characteristics of the Late Bronze Age site Kirkebjerg. Use potential is a relative value to evaluate the production potential of a herd for different uses (*cf.* Cribb 1985). The higher the value, the higher the potential.

Birth rate indicates the number of young born per female per year and growth rate indicates the annual growth of the herd. Growth rate values higher than one indicate an increase of the herd, whereas a value lower than one indicates a decrease.

Sheep/goat

Although no analysis on the use potential of sheep/goat was possible with the aid of Faustitas, both the Nordic and Swiss regions possess indications for sheep/goat use based on the presence of slaughter marks (*i.e.* meat), and tools created from horn and bone (*i.e.* raw material) (Nyegaard 1996, 44-5; Borrello *et al.* 1986, 66). In addition, milk and wool are not suggested to be the main reasons for keeping sheep or goats, although of course both could very well have been exploited before being slaughtered for meat (Nyegaard 1996: 44, 160-1). Use of milk is further made plausible by the presence of ceramic sieves in Denmark (Nyegaard 1996, 158). The idea of multiple uses of sheep/goat fit very well with the image for West Frisia.

Pig

Pigs are presumably only kept for their meat and fat, evidenced by the slaughter at relatively low age in both Denmark and Switzerland (Nyegaard 1996,

Use potential and general herd characteristics of cattle from different sites

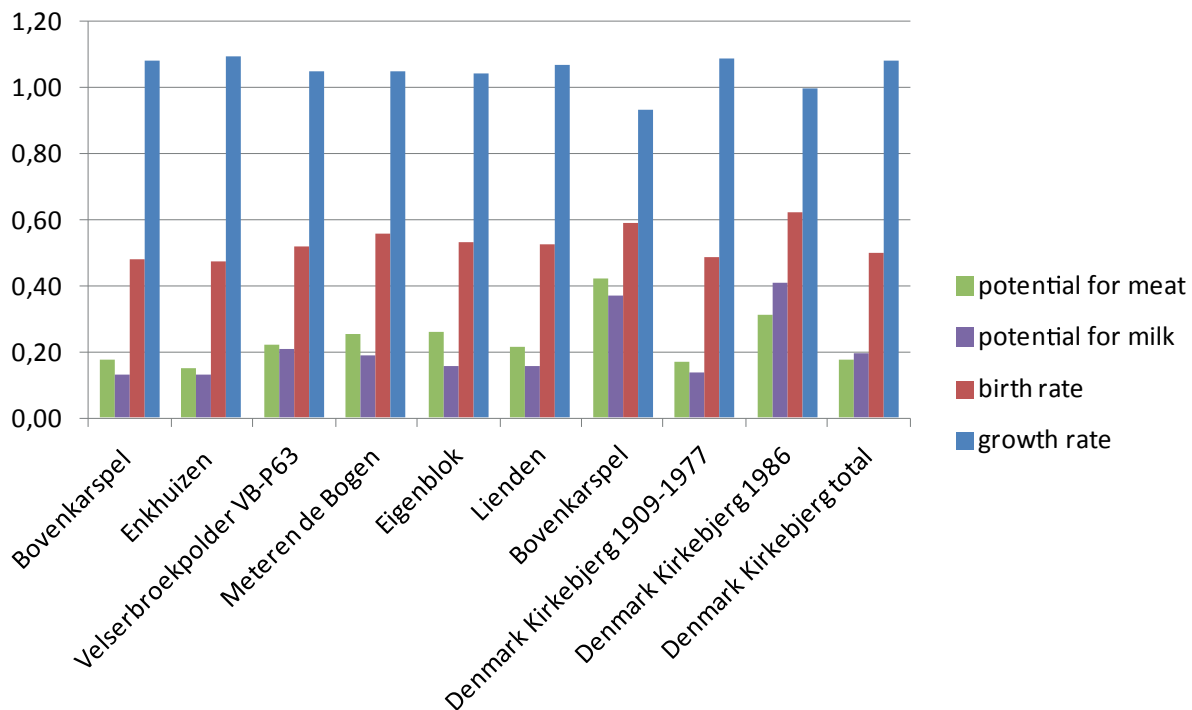


Figure 9.37. Use potential of herds and general herd characteristics of West Frisian, Dutch and Danish sites from the Middle and Late Bronze Age. Use potential is a relative value to evaluate the production potential of a herd for different uses (cf. Cribb 1985). The higher the value, the higher the potential. Birth rate indicates the number of young born per female per year and growth rate indicates the annual growth of the herd. Growth rate values higher than one indicate an increase of the herd, whereas a value lower than one indicates a decrease.

40; Borrello *et al.* 1986, 56). The prolific pig makes an excellent variable addition to subsistence. When fodder is sufficiently available, pigs can provide abundant meat at a high rate and within a short time. During less favourable years, fewer pigs can be kept until more bountiful times.

Dog

As mentioned above in the paragraph on breeds, dogs appear at varying sizes in all regions, possibly indicating specialized functions. They may have been used as a shepherd dog, hunting dog, or guard dog.

Horse

In Denmark, several indications for the use of Bronze Age horses exist, both direct and indirect. Besides pictorial evidence of horses pulling carts/

wagons (e.g. the Sun Chariot, found in a bog near Trundholm in north-west Sealand), the presence of several Bronze Age red deer antler bridles indicates that the horse was used as a riding and/or traction animal (Nyegaard 1983, 33-5). In addition, harness equipment and wagon parts have been uncovered at several locations (Nyegaard 1996, 160 and references therein). However, many horses were slaughtered in the prime of their lives, indicating that their use as riding or traction animals will not have been very intense (Nyegaard 1996, 153). Moreover, slaughter at this prime age indicates that the ultimate use of the horse was for meat. Horse hair, finally, has also been used, for example to create objects such as a hairnet, which was found in a Danish grave at Skrydstrup (Broholm 1949, 210).

9.5.3 Crop husbandry

Crop composition

Not all site publications yielded raw data on the frequency of the remains of the different cultivated crops. For this reason, a more general discussion is held here, based on presence/absence and postulated dominance of the crops in the various regions by the respective authors. Data from overview articles is also used. This means that in this section, additional sites are included to those of Figures 9.26-9.27 and Table 9.4, the references of which can be found in the sections below.

Major crops

Denmark and Sweden

Denmark and Sweden have very similar cereal assemblages. Both show a presence of naked barley, hulled barley, and emmer wheat. Other cereals include einkorn for the Nordic Early Bronze Age, and bread/club wheat and spelt for the Nordic Late Bronze Age (Figures 9.38-9.39).

In Denmark, wheat is the more dominant crop in the NEBA, followed by naked barley, and then hulled barley (Robinson 2003, 148: f2; Andreasen 2009, 54). The type of wheat cultivated differs per site and includes mostly emmer, but also spelt and bread wheat. The Danish NLBA is still characterized by a shared dominance of emmer wheat and naked barley, but both spelt and hulled barley are becoming increasingly prevalent (Robinson 2003, 148: f2).

Naked barley is the dominant crop in the NEBA in Sweden, followed by wheat (emmer and einkorn), and hulled barley. The NLBA in Sweden is still characterized by a dominance of barley, but hulled barley now becomes equally dominant to naked barley, at the expense of wheat (Berglund 1991; Gustafsson 1998).

Switzerland

In Switzerland, an equally elaborate range of cereals as in the Nordic countries was present (Figure 9.39). Cereals include hulled barley, emmer, einkorn, spelt, and bread wheat. Based on frequency, spelt is the most dominant crop, followed by emmer wheat, einkorn,

and finally hulled barley (Jacquat 1989, Plate 3).

The summary figures 9.38 and 9.39 were made based on relative dominance. When regions are compared, it is clear that in the northern countries, a wide variety of crops was cultivated, with a more or less equal distribution between wheat and barley species. In Switzerland, mostly wheat species were cultivated.

The most dominantly occurring cultivated species in Denmark are emmer wheat and naked barley, which both appear to be the dominant crops throughout the NEBA and NLBA. In Sweden, a relatively higher dominance of barley is observed, mostly naked barley in the NEBA, changing to a dominance of the hulled variety in the NLBA. In LBA Switzerland, wheat species are in overwhelming majority, with spelt forming the dominant species.

The almost equal ratio observed between wheat and barley species in West Frisia seems most comparable to the Nordic countries throughout the Bronze Age. However, even though the overall ratios of wheat and barley are comparable between the Nordic countries and West Frisia, the variety of crops in Denmark and Sweden is different and much wider during this period as well as the later Bronze Age. In the LBA, the dominance of emmer seems to increase in West Frisia, whereas both Denmark and Sweden show no such trend. Conversely, in both Nordic regions the hulled variety of barley does seem to experience a relative increase in frequency during the (N)LBA, and this is not observed in West Frisia.

Switzerland, of which only LBA data is available, shows different ratios between wheat and barley species from all the other regions and time periods, with wheat species being very dominant. This situation is only comparable to the Netherlands when the separate Dutch areas are considered: a comparable high dominance of wheat species was observed in the LBA Dutch river area also (Figure 9.18, previous section 9.3).

Minor crops

Denmark and Sweden

Danish NEBA sites only yielded linseed/flax (Robinson 2003, 148: f2). In the Danish NLBA, minor crops again include linseed, but also broomcorn millet, rye, and gold-of-pleasure (Robinson 2003,

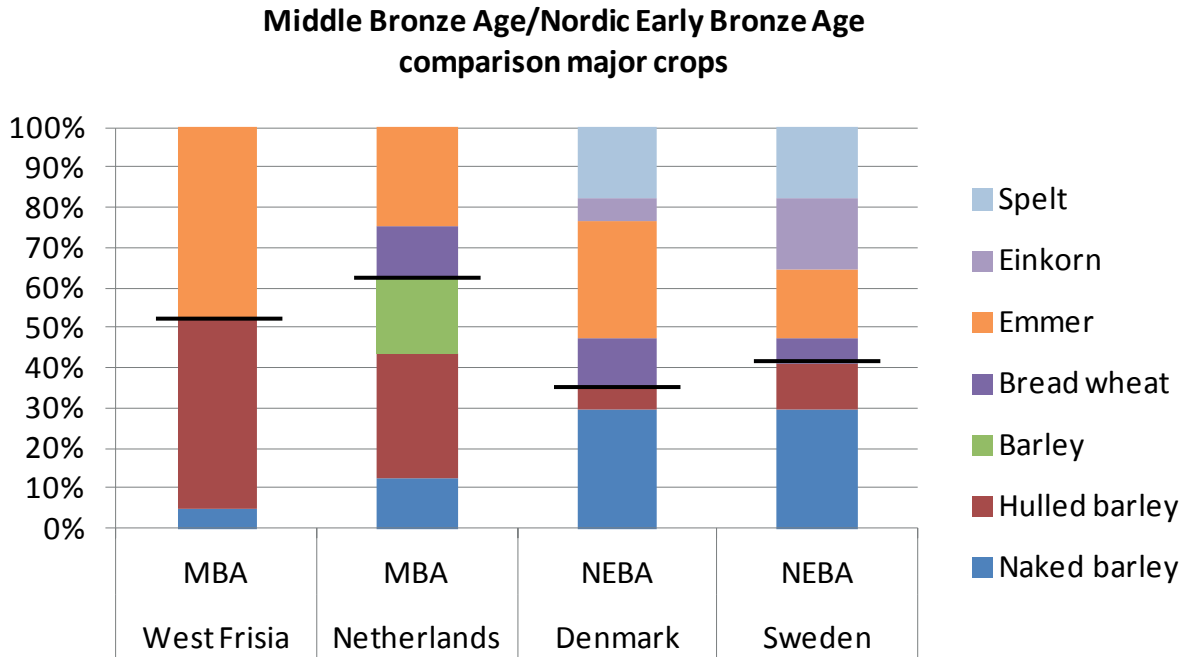


Figure 9.38. Ratios of major crop species in the Middle Bronze Age/Nordic Early Bronze Age in the different regions of the Europe in comparison with the Netherlands and West Frisia.

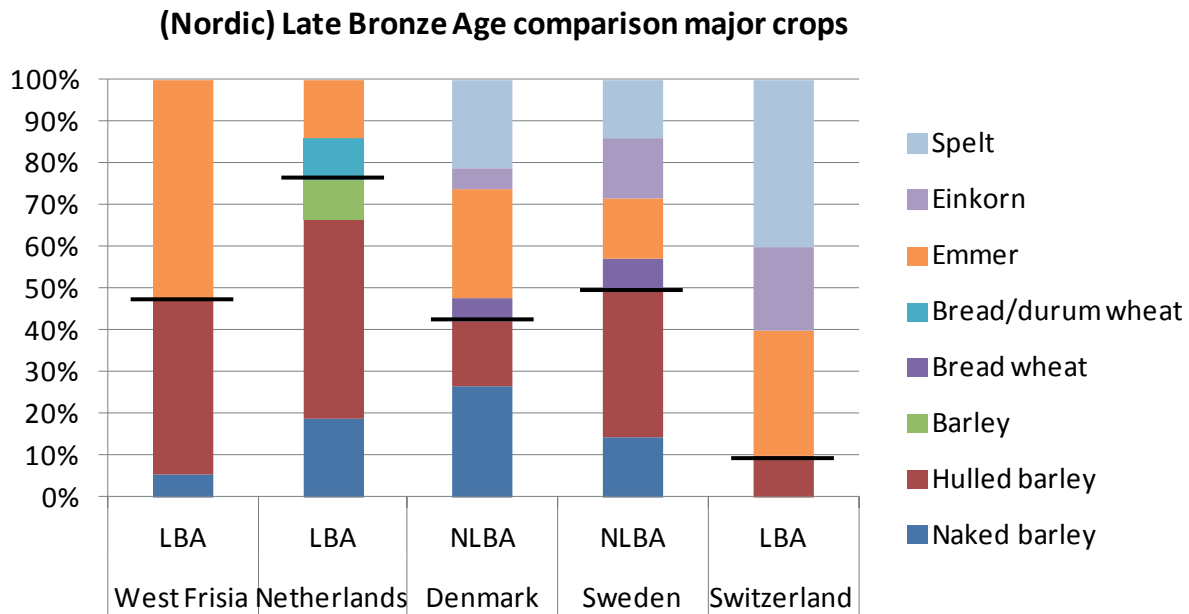


Figure 9.39. Ratios of major crop species in the (Nordic) Late Bronze Age in the different regions of the Europe in comparison with the Netherlands and West Frisia.

Middle Bronze Age/Nordic Early Bronze Age comparison minor crops

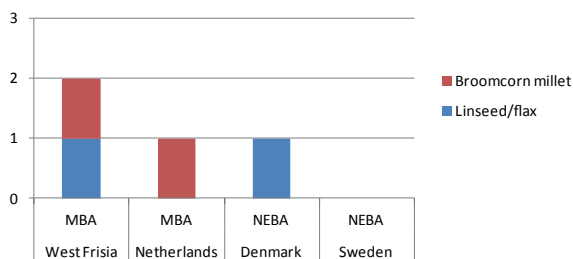


Figure 9.40. Presence/absence of minor crop species in the Middle Bronze Age/Nordic Early Bronze Age in Denmark, the Netherlands, and West Frisia.

148: f2). In Sweden, both linseed (Gustafsson 1998) and broomcorn millet are found in the NLBA.

No cultivated pulses or legumes were found in the Nordic countries, which is in concurrence with the outcome of the overview used in Chapter 6, section 6.3.1 in which Bronze Age crop assemblages of the areas of Western Central Europe (WCE), Southern Scandinavia (SSc), and the North Sea Coast (NSC) were summarized.

Switzerland

The Swiss sites yielded remains of linseed/flax, broomcorn millet, foxtail millet, gold-of-pleasure, and opium poppy. In this area, pulses and legumes were also uncovered, including lentil, pea, and broad bean. Summarizing graphs were made of all the regions, but since frequencies of remains were unknown, only presence and absence of minor crops was plotted (Figure 9.40 and 9.41). It is clear from these graphs that a varying range of minor crops existed in Bronze Age Europe. In the NEBA/MBA, only very few minor crops are present in the different regions, and are completely absent in Sweden. Denmark resembles West Frisia with regard to the presence of linseed/flax, but broomcorn millet is absent from the Danish assemblage.

In the NLBA, sites in all regions show a wider range of minor crops, with broomcorn millet, and gold-of-pleasure, but also often linseed/flax becoming a definite part of the Bronze Age farmer's crop spectrum. Switzerland stands out with its very broad

array of minor crops, since pulses and legumes, and opium poppy are available here as well.

In LBA West Frisia, gold-of-pleasure is noticeably absent. An explanation for this absence can be found in the somewhat skewed time periodization between the areas, as mentioned in section 9.4, as well as geographical location. Gold-of-pleasure occurs earlier in Central Europe than it does in its northern parts (Zohary & Hopf 1988, 125), so its availability in Switzerland during the Late Bronze Age comes as no surprise. However, the latest period of the NLBA in the Nordic countries also shows the presence of this crop, even though they are located further north than West Frisia. At first sight, this seems surprising, but the NLBA spans roughly the Dutch Late Bronze Age and the Early Iron Age (Table 9.3). Since gold-of-pleasure is commonly found in the Netherlands during the Iron Age, it makes sense that it is not yet present in West Frisia during the Dutch Late Bronze Age, but will have already reached Nordic countries during the Nordic Late Bronze Age. Sure enough, gold-of-pleasure is present on the West Frisian Iron Age site of Opperdoes, which confirms that skewed time scales are the cause of these observed differences (Buurman 1993, 72-3).

The variety of minor crops available in West Frisia during the NEBA/MBA period is relatively wide in comparison to other regions, with both linseed and millet being cultivated. Possibly, these minor crops formed a buffer for West Frisian farmers because their range of available major crops was limited in comparison.

For the LBA, it is hard to compare West Frisia with the Nordic countries, due to the fact that the NLBA also encompasses part of the Dutch Iron Age. Overall, West Frisia maintains its two minor crops in the LBA, which are comparable to those in the NLBA Nordic countries, although gold-of-pleasure was not (yet) a part of the West Frisian crop range during this time. It is much more difficult to reason the other way around however, since it is hard to assess whether the minor crop spectrum present at the NLBA Danish and Swedish sites was already available during the first half of the NLBA (*i.e.* the Dutch LBA), or whether the availability of (parts of) their minor crops assemblage

(Nordic) Late Bronze Age comparison minor crops

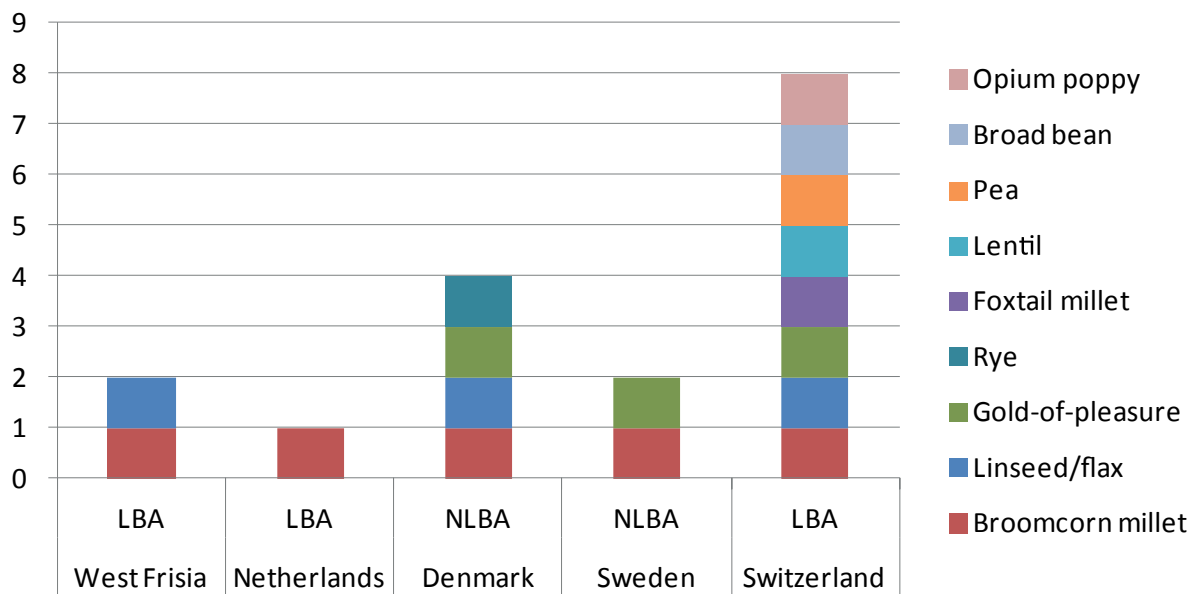


Figure 9.41. Presence/absence of minor crop species in the (Nordic) Late Bronze Age in Switzerland, Sweden, Denmark, the Netherlands, and West Frisia.

is more comparable to the Dutch (Early) Iron Age situation.

Arable fields

Denmark and Sweden

In Denmark, details from several regions are available to investigate the arable field conditions, both from the Nordic Early and Late Bronze Age (Robinson 2003). In the NEBA in Denmark, manuring of arable fields is not observed everywhere. Several NEBA sites on Jutland show no indications that manuring was being practiced during this period (Andreasen 2009, 25), but in the same article, it is mentioned that the bad preservation conditions in this area may be the cause of this. Conversely, in another area of Denmark, Djursland, indications do exist for improving the soil during this time period. Throughout the Nordic Bronze Age, including the NEBA, fertilizing the soil with household refuse was practiced. In the NLBA, the Danish sites show a larger variety of fertilizers being used, which include household waste, fen peat,

manure, and stubble burning (Robinson 2003, 163). It appears that the Nordic Bronze Age farmers applied a range of fertilizers to improve their arable field conditions, which diversified even more in the NLBA.

In Sweden, archaeological and organic remains dating to the NEBA were not sufficient to evaluate the use of manure, but the NLBA finds seem to (indirectly) indicate that manuring might have occurred (Berglund 1991, 76). This indication derives from a combination of observations including changing internal structures of houses which may indicate that a barn was used for keeping animals inside for the collection of manure (although no stable partitions have been detected). Another observation is the increasing dominance of barley in this time period in comparison with the NEBA (also see Figures 9.38-9.39).

Overall, it seems that in NLBA Denmark and Sweden, manuring was occurring on a regular basis, consisting of several types of fertilizer, of both vegetative and animal origin.

Switzerland

In Hauterive-Champréveyres, no indications for the use of fertilizer have been found in the crop weed assemblage (Jacquat 1989, 55). In addition, manuring was not deemed necessary for this particular area at this time, due to very rich local soil conditions (Jacquat 1989, 68).

The few indications for manuring in West Frisia also confirm that a wide spectrum of fertilizers will have been necessary to manure the arable fields (Chapter 6, section 6.4.5; Appendix A1.11): the use of a combination of household waste, manure, and stubble burning will have been available to Bronze Age farmers to improve the quality of their fields.

Crop husbandry practices

Denmark and Sweden

For Denmark, it is assumed that crops were spring-sown (Andreasen 2009, 24-5). Moreover, based on the ratios of crop weed seeds found, no weeding is expected to have occurred in the NEBA in for example Jutland, Denmark (Andreasen 2009, 26). Sowing probably occurred on separate fields for different crops, indicated by the fact that crop remains of different species were found in separate containers at two Danish sites. This also means that families might have possessed more than one arable field (Andreasen 2009, 23-4).

The presence of crop weeds with low maximum growing heights, such as chickweed (*Stellaria media*), common field pansy/heartsease (*Viola arvensis/tricolor*), and corn spurrey (*Spergula arvensis*), at almost all Danish Bronze Age sites indicates that reaping occurred at the base of the stem or via uprooting, signifying the potential importance of straw throughout the NLBA.

Swedish sites did not yield enough information to investigate crop husbandry practices.

Switzerland

In Switzerland, most crops will have been spring-sown, especially the pulses, legumes, and oil seed plants. Alternatively, gold-of-pleasure may also have been sown in autumn, and spelt wheat will definitely

have been a winter crop (Jacquat 1989, 67). Crops were most likely sown as monocultures, evidenced by the presence of charred lumps consisting of cereal grains from only one species at a time, which is unlikely to be the result of tedious sorting of two species after harvest (Jacquat 1989, 68). This means that families required multiple arable fields to grow all their crops.

Reaping occurred low on the stem, shown by the fact that many low growing crop weeds were uncovered, such as scarlet pimpernel (*Anagallis arvensis*), ground pine (*Ajuga chamaepitys*), and small bur-parsley (*Caucalis platycarpus*). Again, straw seems to have been important, either as fodder, insulation and/or thatching material (Jacquat 1989, 68).

Both regions researched seem to have several similar crop husbandry practices to West Frisia (cf. Chapter 6). Spring sowing was practiced everywhere (although also autumn sowing occurred in Switzerland), as was reaping low on the stem or uprooting. The possession of multiple arable fields may also have been a consistent practice during this time, to accommodate the cultivation of multiple crop species.

Harvest processing

Due to the abundance of the Swiss data and the limited scope of this chapter, this data was not analysed in terms of household size based on harvesting practices (cf. Chapter 6, section 6.4.4). A few sites from three regions in Denmark however, with data of a more manageable size, were analysed, including sites in Jutland, Northern Schleswig, and Djursland (Robinson 2003, Table 3-8). Sites from both the NEBA and NLBA were employed, and only contexts from houses, including hearths, postholes, and cultural layers from settlements.

The results of the analysis are shown in Figure 9.42. Since only summarizing information was used for this analysis (Robinson 2003), sites are represented by only one data point.

Interestingly, the sites from Denmark dating to the NEBA all fall in the category “large households”. The only site from West Frisia which portrays similar characteristics during this time period is Middle Bronze Age Bovenkarspel (Chapter 6, Figure 6.20).

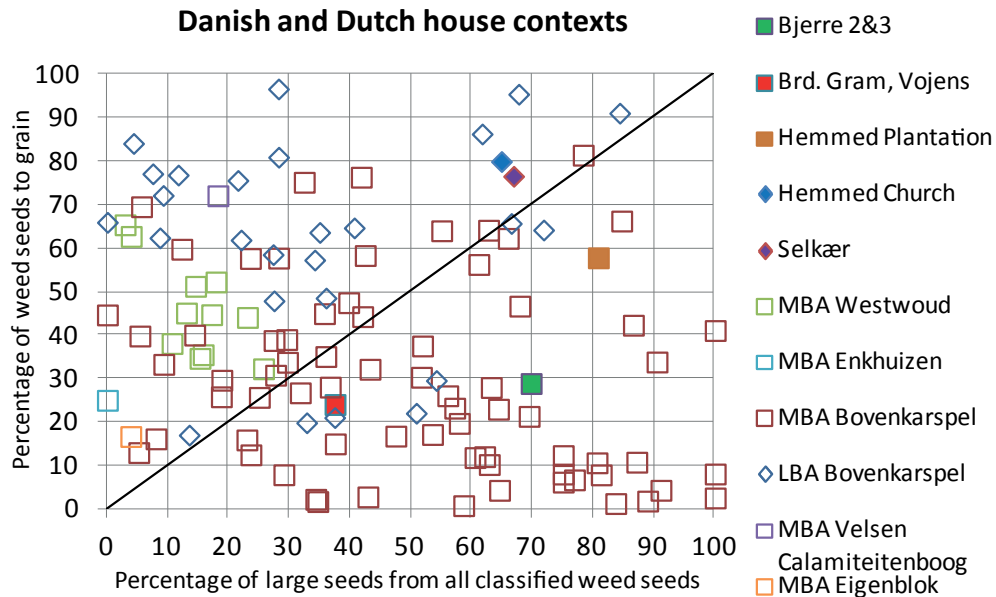


Figure 9.42. Harvest processing practices of the Dutch (empty symbols) and Danish sites (filled symbols). Squares denote MBA/NEBA sites; diamonds represent LBA/NLBA sites. x-axis represents the percentage of large weeds in a sample, y-axis represents percentage of small weeds in a sample. Many small weeds are related to unclean storage of harvest and small households, whereas few large weeds in a sample are related to clean storage of harvest and large households (cf. Chapter 6, section 6.4.4).

Based on the data presented, Danish NEBA sites from all areas mostly possessed larger households than sites in West Frisia (except Bovenkarspel) and the Netherlands at large. However, due to the proximity of one sample to the 45° line (*i.e.* Brødrene Gram, Vojens, Northern Schleswig), it is possible that this sample in fact reflects a mixed situation. More samples are necessary to draw stronger conclusions about the harvesting practices from this particular area and time period.

The two examples of NLBA sites fall just left of the 45° line, and seem to have shifted slightly towards smaller households, similar to the LBA Bovenkarspel situation. Again, samples are few and close to the line, so conclusions must be interpreted with caution until more data is available.

It seems that the sites in Denmark are generally comparable to the West Frisian situation, but only regarding Bovenkarspel. In the NEBA/MBA, Danish sites fall within the category “large households”, whereas most West Frisian households are still

“small” during that time. In the NLBA/LBA, both Bovenkarspel and Denmark seem to experience a shift in size towards smaller households which are related to the more unclean storage of crops.

Storage

Several examples of grain storage in Denmark are summarized by Andreasen (2009). She lists finds of wooden containers, leather sacks hung from the ceiling, and ceramics in which the grain was stored (Andreasen 2009, 55 and references therein). Presumably, grain was stored in the eastern part of the house, either on an attic or below the ground, provided that there was no barn in this part (Andreasen 2009, 55). Bronze Age examples of storage in Switzerland are unknown to the author.

9.5.4 Wild plant gathering

Wild plant composition

Wild fruits and nuts

Wild fruits and nuts from Danish and Swiss sites

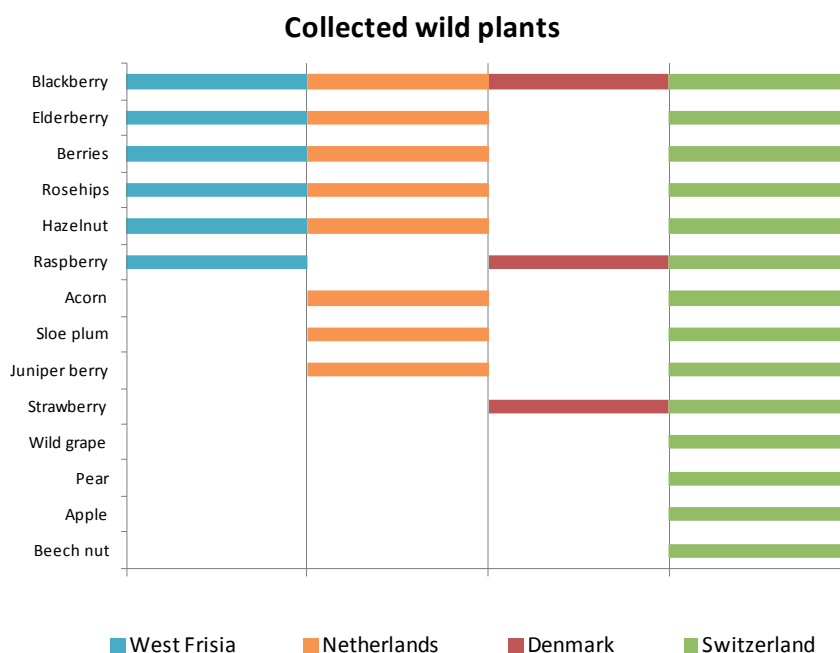


Figure 9.43. Presence/absence of collected wild plant species in the Bronze Age in Denmark and Switzerland compared with the Netherlands and West Frisia.

were summarized from all contexts and states of preservation (Figure 9.43); other wild plants were only included here when obtained from house contexts. Swedish data was insufficient. The total list of wild plants from Switzerland was too elaborate to be included here, but it is discussed in summary, where appropriate, in each of the following paragraphs. Several fruits and nuts were found in both regions, including wild strawberry, raspberry, and blackberry. Switzerland furthermore yielded apple, pear, sloe plum, wild grape, numerous other berries, hazelnut, acorns, and beech nuts (Jacquat 1989, 77-8). Other wild plant species are only included in following discussions on wild plant use when obtained from house contexts.

Other wild plants

The wild plant species from both regions are represented by mostly charred seeds or fruits, or remains of unknown preservation condition. This means that an analysis similar to that performed for West Frisia and the Netherlands could not be attempted for the European regions. However, it can be assumed that the collecting practices in these areas will have resembled the Dutch trends, also

considering the fact that many of the plant species possess other consumption possibilities besides seed (including consumption of roots, leaves, stems, and flowers). Still, in order to test this assumption, more data will need to be analysed in the future.

Gathering locations

Both the Nordic and Swiss regions possess a range of wild plant species that derive from many different habitats. They include, amongst others, heather, forest, open grassland, arable fields, wetland areas, and mountains. Similar to the Dutch situation, people exploited a wide variety of landscape types present in the (presumably) near surroundings of the settlement to aid their subsistence.

Gathering practices

Considering the essential nature of wild plants in Bronze Age subsistence based on the results of Chapter 8, it is assumed that wild plant gathering will also have occurred year-round in the other European regions in order to meet raw material and dietary requirements.

Use of plants

Direct indications for wild plant use in the Nordic countries are restricted here to what is mentioned in the site references of Table 9.4, and some further stray examples. The overall extent of wild plant use in the Nordic countries cannot be entirely covered by this small selection, but it will be able to provide an impression of the variety of possibilities during this time period. Indirect indications for plant use in Denmark were investigated using the PFAF ethnobotanical online database (PFAF 2016).

In the Swiss lakeside settlements, the preservation conditions were so excellent, that a large variety of wild plant species was uncovered. Due to this abundance, only some examples of wild plant use are highlighted here. For more elaborate reading, see Pillonel (2007) and Jacquat (1989).

Raw material

Denmark and Sweden

At several sites, wooden objects were uncovered – excluding the building material here – which include ards, wooden (grain storage) containers, oak coffins, and even a folding chair (Andreasen 2009: 24-6, 32-2 and references therein; National Museum of Denmark 2016a; 2016b). Furthermore, the famous cloth made from nettle fibres is a Danish find, as are numerous other textiles made from various plant fibres (Bergfjord *et al.* 2012; Scandinavian prehistoric costume 2016). Clearly, wild plants played a very important role in all aspects of Danish Bronze Age life.

Indirect indications for wild plant use in Denmark include uses such as insecticides and repellents, thatch, basketry, dye, tannin, fuel, bedding, soap, rope, fibre, and of course wood as building material. Unfortunately, the Swedish data was again insufficient for a similar study of wild plant use.

Switzerland

The Swiss lake-side settlements have yielded many examples of the use of wild plants. Direct indications include numerous types of wooden objects, which range from various types of building material, to everyday objects including: wood working tools, such as handles of axes, adzes and chisels, hammers, and wedges;

agricultural equipment, such as hoe, rake, digging stick, and sickle handles; food processing tools, such as a whisk, various containers, dishes, ladles, and a bucket. Other wild plant uses include examples of various crafts such as creating wickerwork, basketry, and making pottery. Evidence for the construction of textiles and clothing was also present in the form of spindle whorls and related equipment, as well as buttons. Finally, boat fragments were uncovered, as were floats, which are both related to the practice of fishing (Pillonel 2007). Indirect indications mentioned by Jacquat (1989, 89-91) for plant used as raw material include use as fodder, bedding, dye, and fibre. Most likely, a more in-depth analysis of the plant remains from Hauterive-Champréveyres with the use of the PFAF ethnobotanical online database (PFAF 2016) would reveal even more potential applications. However, due to the large amount of data and the limited scope of this chapter, a complete analysis of the Swiss botanical data is not attempted here. Overall, however, the assemblage of wild plants uncovered in Switzerland does provide a more detailed view into the elaborate skill and knowledge present amongst Bronze Age farmers. It also underlines the effect that less favourable preservation conditions can have on the range of possibilities postulated for a society. Surely, a comparable spectrum of tools and equipment such as found in Switzerland must have existed in the other regions as well.

Diet

Denmark and Sweden

Clear indications for wild plant collection for the diet in Denmark are obtained from the presence of berries, fruits, and nuts, such as acorns, hazelnuts, dried apples, wild strawberries, raspberries, and blackberries (Andreasen 2009, 33-4). There are also several indications that other wild plants, not so often considered as an addition to the diet, were purposefully collected. They include finds of clean concentrations of wild plant seeds such as soft brome, black bindweed, and corn spurrey (Behre 2008; Andreasen 2009, 34). Corn spurrey was also indicated as being collected for its seed based on the data from Hattemberbroek (Table 9.2), which now seems confirmed as a practice. Black bindweed, however, was not included in the analysis of section 9.3.4 as it was classified as being unsuitable for consumption based on ethnobotanical references

(cf Chapter 7, section 7.4.2). The finds from Denmark signify that the edibility of a plant is very subjective: the range of edible plants in both West Frisia and the Netherlands can now be viewed as a further underestimation of reality.

Although an in-depth analysis was not possible based on the available Danish data, it should be mentioned that of the 34 edible species uncovered in Denmark, more than a quarter of the species (*i.e.* nine) are only collected for the consumption of vegetative parts. Since plants collected for this purpose are always underrepresented in comparison with plants collected for their seed, it can be imagined that the original range of collected plants for vegetative parts will have been extensive.

Switzerland

The potential to investigate dietary uses of wild plants was very high in Switzerland. Apart from the cereals mentioned in the previous section 9.5.3, several wild plant species were collected for their various parts. These include plants of which the roots, tubers, leaves, flower heads, and stems are consumed (Jacquat 1989, 76-7). Furthermore, several fruits and nuts were found, including apple, pear, sloe plum, wild grape, and numerous berries, hazelnut, acorns, and beech nuts (Jacquat 1989, 77-8). Other culinary uses of wild plants are represented by several plants used as potherbs and oil plants. Clearly, wild plants still formed an integral part of the subsistence economy in LBA Switzerland.

Preservation conditions will have been a major limiting factor when interpreting wild plant use on many Bronze Age sites, which has resulted in a greatly impoverished image of a farmer's life. Rare finds with good preservation conditions, such as in Switzerland but also West Frisia, can provide valuable insights into the daily life of Bronze Age people which would otherwise remain invisible.

9.5.5 Summary and discussion

West Frisia was originally considered as a case study for communities along the North Sea coast. Due to the fact that research on coastal communities in eastern Great Britain and northern Germany is

done in different research projects (see note 1), the comparison of West Frisia with other regions has been extended to include other coastal sites. These include the Nordic sites in Denmark and southern Sweden (also on the eastern coast), as comparative regions, whereas the lakeside villages in western Switzerland were chosen as a contrasting example of Bronze Age subsistence near a lakeshore in central Europe. What has become clear from both comparisons is that the Bronze Age was a period in which each area possessed its own unique set of crops. At first glance, the same set of domestic animals was kept everywhere, but there are indications that different breeds were kept in each region. However, not only the domestic plant and animal species differed; also varying ratios of the available crops and livestock species were observed. The set of domestic resources clearly differed between regions, which was possibly a result of a combination of local environmental, subsistence economical, temporal, and/or social conditions.

What has furthermore become clear from the comparison of West Frisia with the different regions is that basic crop and animal husbandry practices are largely comparable. The purpose of keeping livestock may, however, have differed from region to region.

In contrast to domestic resources, which appear to have been diverse in both composition and relative frequency, wild resource exploitation was comparable between regions and a constant factor. Overall, both the hunting of large mammals and the collection of wild plants seemed to have targeted similar species regardless of region, and was probably performed with a similar purpose: indications for hunting large mammals for raw material in the form of antlers or hides/pelts exist in both Denmark, Sweden, and Switzerland; wild plant use included many examples of raw material, as well as additions to the diet, with many different (vegetative) wild plant parts being consumed. Both wild plant and animal exploitation will have occurred throughout the year, to form a constant addition to subsistence. These resources will have been exploited in the immediate surroundings of the settlements, since none of the species show clear indications for non-local habitats.

The rich dataset from West Frisia has provided a good basis for comparison with the Nordic coastal communities, where the available botanical and especially zoological data was less well preserved. Switzerland, where more pronounced differences occurred in both crop and animal husbandry practices, provided a good contrasting example to compare with West Frisia. Furthermore, the excellent preservation of remains at the Swiss lake-side sites has enabled a more detailed insight into Bronze Age subsistence, and provided more concrete evidence for the elaborate role of wild plants in it.