The Westfrisian Bronze Age: a view from Enkhuizen-Kadijken

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JALC
JOURNAL OF ARCHAEOLOGY IN THE LOW COUNTRIES

Review data
Submission: 13/2/2012
Revision: 16/2/2013
2nd submission: 23/9/2013

available online at www.jalc.nl and www.jalc.be

Abstract

The eastern part of West Frisia, in the northwest of the Netherlands, was densely inhabited in the Middle and Late Bronze Age (c. 1600-800 BC). Forty years ago large-scale excavations were carried out in the region and extensive settlement areas were investigated. None of these excavations are fully published, but nevertheless a model for Bronze Age habitation of West Frisia was presented in the 1970s. In 2007, 2009 and 2011 a total area of 6 ha to the northwest of the town of Enkhuizen was excavated. The results of these excavations present us with an opportunity to evaluate some current ideas about the wide distribution and development of the settlements, the house building traditions and economic aspects of Bronze Age farmers in West Frisia. At least a few centuries before the estuary at Bergen closed, Bronze Age habitation appeared, both on sanded up creek ridges and on the low lying clay areas adjacent to, and between the creek ridges. The extent of habitation appears to be on a much wider scale than was previously suggested. House plans are remarkably similar, but there is substantially less repairing and rebuilding than previously thought. Also, there are new considerations about the generality of changes in subsistence strategy, the presumed landscape openness and the way the habitation came to an end just before the start of the Iron Age. If it is not a higher groundwater level that caused the inhabitants to build the 'terps' in the second half of the Late Bronze Age, it may well have been inundations, though not necessarily of a marine origin.

Keywords: Bronze Age, the Netherlands, West Frisia, Enkhuizen, settlements

1. Introduction

West Frisia, today part of the province of North Holland, is for the Bronze Age one of the most interesting regions in the Netherlands, due to its extended habitation and the generally excellent preservation of archaeological remains, despite the destruction brought about by modern developments. Since 1996 a new housing estate northwest of the town of Enkhuizen (location 'Kadijken') has been developed (fig. 1). This town development led to excavations in 2007, 2009 and 2011, of what proved to be part of an extended settlement site from the Middle

and Late Bronze Age. It is the intention of this paper to offer a contribution to the discussion about Bronze Age developments in West Frisia.

We will first present a brief overview of the archaeological research in the region and its most important results and subsequently those of the excavation at Enkhuizen. This allows us, together with the results of recent excavations at Hoogwoud, Medemblik and Zwaagdijk, to evaluate some current theories on Bronze Age West Frisia.

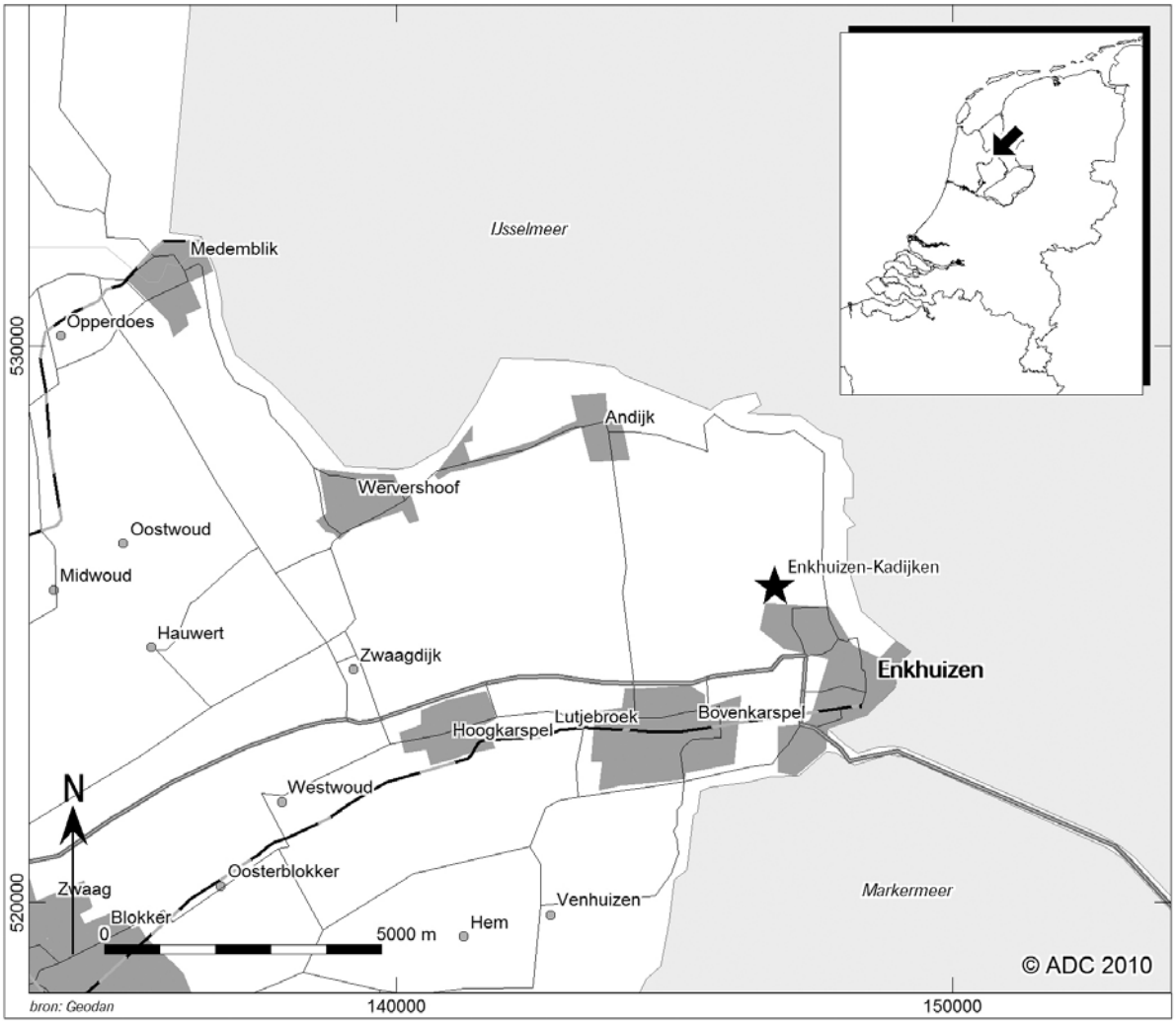

Figure 1. Location of Enkhuizen-Kadijken in the Netherlands.

2. The landscape

The Neolithic landscape of West Frisia can be described as a tidal basin, dominated by long and broad creeks with high levees accompanied with marine crevasses and vast open intertidal sand and mudflats. Seawater could enter the area via an inlet near the modern village of Bergen through two large creeks. Around 2800 BC the northern creek system silted up. Late Neolithic habitation adjusted to a dynamic landscape of changing creek and gully systems that eroded traces of older settlements (Woltering 1985, 217; Louwe Kooijmans 1997, 16). The southern creek system became inactive when, somewhere around 1250 BC, the Bergen-inlet closed. Dates from geological contexts (De Mulder *et al.* 2003, 224; Van Heeringen & Theunissen 2001, 49) and the results from archaeological excavations, such as the occurrence of brackish water

at Hoogkarspel (Bakker *et al.* 1977, 200), the existence of a tidal gully in the vicinity of Hoogwoud (Lohof & Vaars 2005, 58) and possibly near Medemblik (Schurmans 2010, 116) make it more likely that the final closing of the estuary took place at a considerably younger date.

The Bronze Age landscape of West Frisia can therefore be described as a former salt marsh area, which had transformed into a freshwater environment with a patchwork of lakes, marshy areas and arable soils with high natural fertility. The old creeks consisted of sand deposits and their banks formed higher elements in the landscape. In the course of time, the streambed silted up and the ridges became even more prominent in the landscape due to the 'shrinkage' of the surrounding clayish flat planes, consisting of layers of peat and clay. This landscape was supposedly rather treeless, with occasional willow and alder bushes (Buurman 1996, 286).

3. Earlier Bronze Age research in West Frisia

The first recognized features of Bronze Age occupation in West Frisia were the barrows. In 1942 three burial mounds located near the village of Zwaagdijk were excavated, and in the following decennia more barrows and several flat graves were investigated (Van Giffen 1944, 1954, 1962; Modderman 1964, 1974). The location of these barrows seems to follow the sandy or loamy silted up creeks and gullies. As the presently-known distribution is based solely on the visible barrows and their soil marks on aerial photographs, an unknown number of levelled barrows may remain invisible.

The widespread existence of settlements became evident during a soil survey of the region by P.J. Ente in the period 1953-55 (Ente 1963). In the years 1964-75 the University of Amsterdam excavated several locations, in total about 15 ha, of a settlement near the village of Hoogkarspel (the most important being Tolhuis and Watertoren; Bakker *et al.* 1968, 1977; Fokkens 2005b, 418). Barrows, houses, ditches, a large amount of rather small round structures (ring ditches and pit circles) and ard marks were found, dating to the second half of the Middle Bronze Age and the Late Bronze Age (1350-800 BC). The excavators distinguished two phases, mainly on the basis of pottery, of which the first was supposed to be in the Middle Bronze Age until halfway in to the Late Bronze Age (Bakker *et al.* 1977, 196, 208; Butler & Fokkens 2005, 376, fig. 17.7).

In advance of drastic land re-allotment in the eastern part of West Frisia, archaeologists of the State Service undertook an intensive field survey campaign between 1972 and 1979 in the *polder* 'Het Grootslag'. This resulted in the identification of 68 new Bronze Age sites (Metz 1993, 158). Two small excavations were carried out in 1973 near the village of Andijk, where an area of 1 ha was investigated. The excavations yielded settlement features and two barrows, dating to the Middle Bronze Age (IJzereef & Van Regteren Altena 1991, 61-2).[1] In 1974 the excavation of a settlement northwest of the village of Bovenkarspel started. It continued until 1978 and in total 15 ha were investigated of the large settlement that became known as Bovenkarspel-Het Valkje (IJzereef 1981; IJzereef & Van Regteren Altena 1991; Fokkens 2005b, 419). The site was occupied during the Middle and Late Bronze Age, between 1600 and 800 BC. From 1974, and especially in 1979 and 1987, W. Metz discovered more barrows and many Bronze Age settlement features using aerial photography (Metz 1993). In the present century, excavations were conducted near the village of Hoogwoud (0.62 ha, Lohof & Vaars 2005), near the village of Zwaagdijk (2.3 ha, Ufkes & Veldhuis 2003; De Wit & Stokkel 2011), southwest of the town of Medemblik (1.5 ha, Schurmans 2010) and northwest of the town of Enkhuizen (6 ha, Roessingh & Lohof 2011; Roessingh & Vermue 2011). In 2012 another 3 ha was excavated on an adjacent parcel west of Enkhuizen-Kadijken (Van der Linden & Hamburg in print). When we also take some smaller (published and unpublished) excavations into account, at least 50 ha of Westfrisian settlement sites have been excavated. The location of the Bronze Age settlements sites mentioned in the text can be found on figure 2.

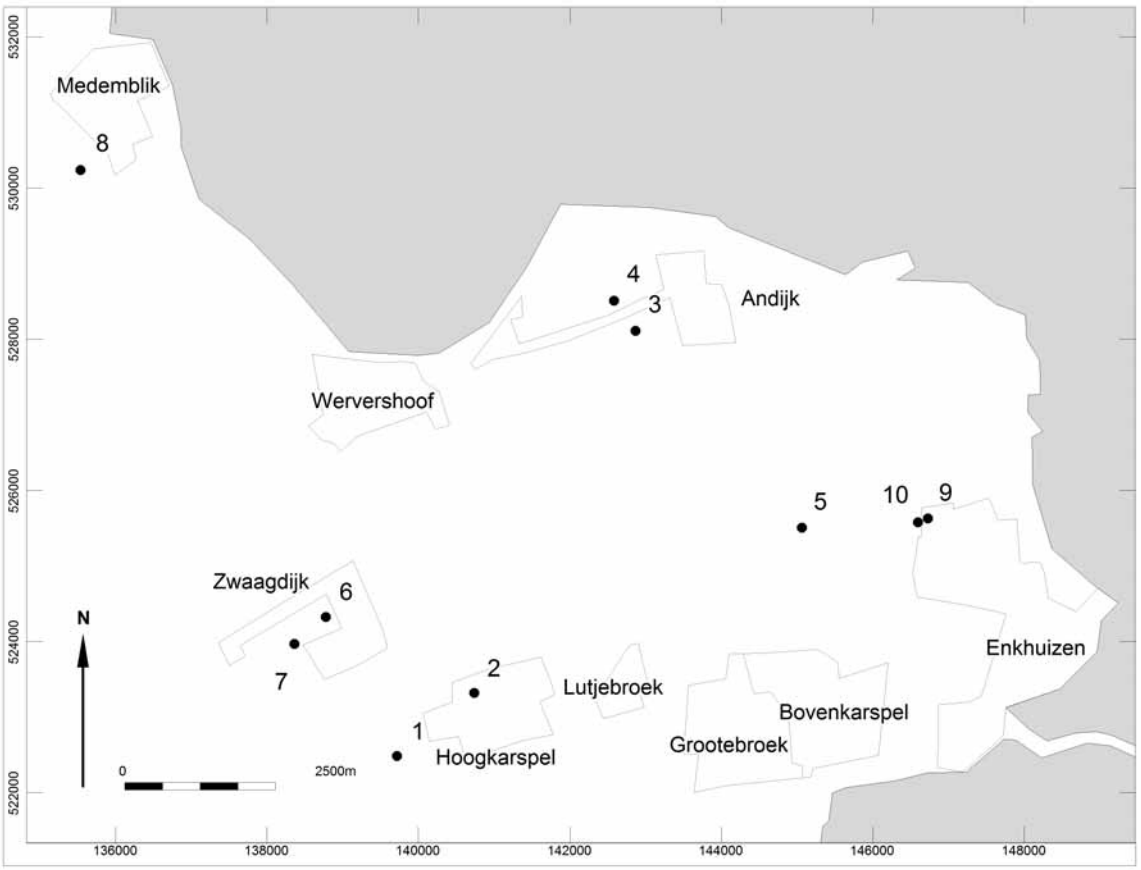

Figure 2. Location of Bronze Age settlement sites in West Frisia, mentioned in the text. 1: Hoogkarspel-Tolhuis, 2: Hoogkarspel-Watertoren, 3: Andijk-Zuid, 4: Andijk-Noord, 5: Bovenkarspel-Het Valkje, 6: Zwaagdijk-Oost I, 7: Zwaagdijk-Oost II, 8: Medemblik-Schepenwijk II, 9: Enkhuizen-Kadijken, 10: Enkhuizen-Haling.

4. Some excavation results of the last century

Evidence for human activities in West Frisia prior to the Bronze Age habitation, although scarce, does exist. Traces of Neolithic habitation, barrows and settlements, are predominantly found in the western part of the region (Van Heeringen & Theunissen 2001, 21-23). It is difficult to determine whether small finds like pottery sherds from the Early and the first part of the Middle Bronze Age are *in situ* (site-related) or washed up, but they are known from a dozen sites (Roessingh & Lohof 2011, 299). The site of Twisk is a settlement site that can be placed in the Early and first part of the Middle Bronze Age (Buurman 1987, 7). The two barrows from Oostwoud dating between 1950-1660 BC (Van Giffen 1962; Lanting & Van der Plicht 2001/2002, 181) also indicate habitation predating the 16th century BC. There are some indications that the area was at least partly flooded in the Early Bronze Age (IJzereef & Van Regteren Altena 1991, 64; Roessingh & Lohof 2011, 299). Traces of habitation of this and earlier periods may still be present underneath these inundation layers.

In the 70s of the last century a coherent 'model' was drawn up for the colonization and subsequent habitation of Bronze Age West Frisia, under the influence of the so-called New Archaeology, based on the results of the excavations at Hoogkarspel, Andijk and Bovenkarspel (Brandt 1976; 1980; 1988b; Brandt & IJzereef 1980). The model, formulated mainly by R. Brandt and G. IJzereef, focused on the adaptation of the colonists to their new environment. Their concept of 'colonization' was closely linked to the transformation of the salt marsh area into inhabitable land, for which the closing of the inlet at Bergen was considered a prerequisite (Brandt 1980, 142; IJzereef & Van Regteren Altena 1991, 64). Brandt originally thought that

the colonists occupied the new land in a wave like motion, but this idea was soon abandoned as aerial photographs showed the extent of the habitation. The colonists were supposed to have arrived from the coastal dunes or 'Het Gooi', a relatively small Pleistocene outcrop southeast of Amsterdam (Brandt & IJzereef 1980, 53). The beginning of habitation was dated to the 16th century BC (IJzereef 1981, 142; IJzereef & Van Regteren Altena 1991, 64). The radiocarbon dates of at least some barrows, one of the flat graves and a ditch from Zwaagdijk, date from 1600 BC onwards. Settlement features predating the barrows are scarce but present. Ard marks, ditches and round structures were found in a 'grey layer' underneath some of the excavated barrows (Bakker *et al.* 1977, 192). According to Brandt these were constructed within a century after the arrival of the first settlers (1980, 147). Not a single house plan can be associated with this occupation layer. This might be just a case of bad luck, but it is worth considering that in the Netherlands as a whole, house plans from the Early and first part of the Middle Bronze Age are scarce (Harsema 1993; Fokkens 2005a, 76-77; Arnoldussen 2008, 174-185). The situation in West Frisia may not be different in this respect.

The first settlement-nuclei (fig. 3) were thought to concentrate on the (flanks) of the ridges, about 3 or 4 km from each other, around an inland lake, surrounded by marshy, low-lying areas (Brandt 1976, 12; IJzereef & Van Regteren Altena 1991, 65, fig. 2; Fokkens 2005b, 417, fig. 18.7).

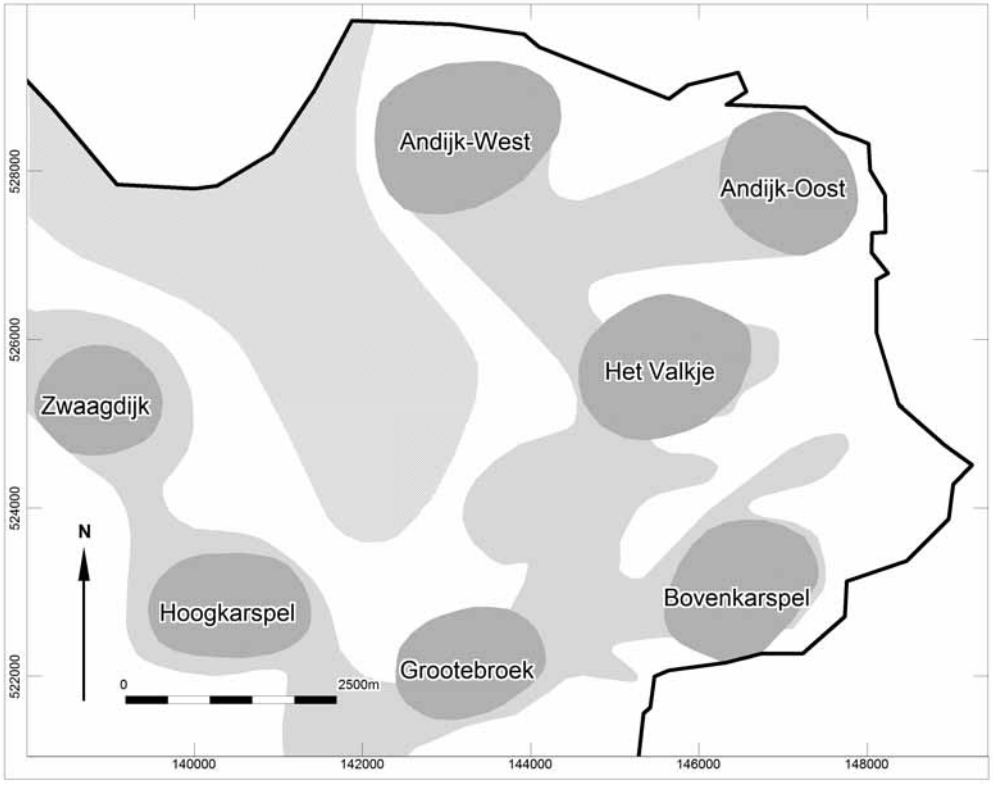

Figure 3. Distribution of Bronze Age settlement sites in the eastern part of West Frisia within the 'Westfriese Omringdijk', according to IJzereef & Van Regteren-Altena. The first 'colonists' were clustered in seven nuclei. In a later stage the occupation spread out over a larger area (light grey). In white the lower-lying area, sometimes open water. The hatched area is open water (after IJzereef & Van Regteren Altena 1991, 65, fig. 2).

The arable areas were assumed to have been on the top of the ridges (Brandt 1980, 148; Brandt & IJzereef 1980, 54). Only in a later phase the houses moved to the top of the ridges (Brandt 1980, 148). According to IJzereef & Van Regteren Altena however, the first houses from Bovenkarspel and Andijk were built on the very top of the silted up creek ridges and were only

later moved down to the flanks of ridges and the flat lands further from (and between) the creek ridges (1991, 67).

The successful adaptation of the colonists to their new environment was represented in the numerous ditches around their houses, yards and fields. The flat, lower-lying areas were used as pasture and commons, where the animals grazed all year (sheep and goat) or in de summer months (cattle). For some sites, more complex settlement dynamics were reconstructed such as for Hoogkarspel-Tolhuis, where in a few centuries, houses and fields were thought to have switched locations on two nearby, parallel creek ridges (Brandt 1988b, 74).

IJzereef identified two occupation phases at Bovenkarspel (1981, 17). The early phase started with the 'colonization' in the 16th century and lasted until the 10th century BC. All of the houses and most of the other features could be dated within this period. The late phase lasted from the 10th century BC until c. 800 BC. Originally, an interruption in habitation was assumed between 1100 and 900 BC (IJzereef 1981, 17; Woltering 1977, 191; Schurmans 2010, 28, 145), that is between the first serious consequences of an increasing wetness of the area and the building of raised mounds or *terps*, but this was later called into question (Woltering 1977, 191; IJzereef & Van Regteren Altena 1991, 64).

The shape of the house ditches was assumed to have a chronological meaning (Brandt 1976, 58; IJzereef 1981, 142; IJzereef & Van Regteren-Altena 1991, 68). The 'oldest' house plans have a rather narrow, bracket-shaped ditch, whereas 'later' house plans have straight, rectangular ditches and the 'youngest' houses have wide and straight ditches, very often situated a little farther from and only along the long sides of the house. It was assumed that houses were repeatedly rebuilt and repaired at rather short intervals (IJzereef & Van Regteren Altena 1991, 74). The economy consisted of a mixed farming system of animal husbandry (in which cattle dominated) and arable farming with emmer and barley as the main crops.

IJzereef also suggested that over time the house plans at Bovenkarspel became shorter (IJzereef 1981, 177). Since this was attended with a slight increase in the number of slaughtered young cattle in the Late Bronze Age, he assumed this was due to a change from an emphasis on meat production in the early period to one on dairy production in the late phase (IJzereef 1981, 42, 53, 195, 203-204; Louwe Kooijmans 1993, 87; Buurman 1996, 290). Also, in the last phase, increasing humidity and flooding forced the inhabitants to focus on hulled (instead of naked) barley and to give up on wheat (Buurman 1996, 277).

Houses were presumably divided into a living quarter and a byre for up to 30 cattle (Brandt 1976; 1980; Brandt & IJzereef 1980; IJzereef 1981, 177) or even forty (Louwe Kooijmans 1993, 87). Manure from the byre was used to fertilize the arable land (IJzereef & Van Regteren Altena 1991, 77; Buurman 1996, 283). It is also remarkable that four- or six-post granaries (Dutch *spiekers*), that elsewhere appear after 1400 BC (Arnoldussen 2008, 241) are completely absent in West Frisia.

The Westfrisian Bronze Age pottery was subdivided into Hoogkarspel-old and Hoogkarspel-young pottery (Brandt 1988a; Butler & Fokkens 2005, 376, fig. 17.7). The Hoogkarspel-old group consists mainly of thick-walled barrel and bucket shapes with coarse tempering and dates to the Middle and early stage of the Late Bronze Age (1600-1100 BC; Brandt 1988a). The Hoogkarspel-young pottery includes thin-walled bucket and biconical shapes, dishes, bowls, miniature pots, spoons, discs and conical artefacts. It is divided into two phases: one from 1100-950 BC and the second from the actual 'terp-period', 950-750 BC (Brandt 1988a).

According to the traditional view the end of the Bronze Age habitation in West Frisia was caused by a combined rising of seawater and groundwater levels and insufficient drainage of the area. The inhabitants reacted by moving their houses to the top of the creek ridges and eventually by raising terps on which they built their houses. The terps were assumed to be a couple of decimetres to one meter high (IJzereef & Van Regteren Altena 1991, 65). These have all been levelled since medieval times and are now only recognizable by the broad and deep parallel ditches that originally surrounded them. In a few cases turf sods, supposedly from

the mound, were found in these ditches (Brandt 1980, afb. 7; IJzereef & Van Regteren Altena 1991, 65, fig. 3b; Woltering 1985, 218). Not a single convincing house plan is known from the terps. On the Pleistocene outcrop on the island of Texel, houses became shorter around 800 BC (Woltering 2000/2001, 268, 272, table 2). Though this transition is recognized around the same time in the whole country (Roymans & Fokkens 1991, 9; Arnoldussen 2008, 466), it is not known whether it also took place in West Frisia.

Radiocarbon dates from the terp ditches range from 950–780 BC (Lanting & Van der Plicht 2001/2002, 205). This is consistent with the exclusive presence of Hoogkarspel-young pottery in these ditches. When the environmental situation deteriorated further and started to affect crops and the health of animals, the inhabitants left the area altogether, shortly after 800 BC (IJzereef 1981, 17; IJzereef & Van Regteren Altena 1991, 64, 67). Only in a few elevated parts of the landscape (near Medemblik and Opperdoes) habitation continued at least into the Early Iron Age (Woltering 1981, 210-2).

5. Excavations at Enkhuizen-Kadijken

5.1 The landscape

The Bronze Age settlement site at Enkhuizen is situated in a former salt marsh on either side of a narrow sandy, former gully that runs in east-west direction, as visible on Ente's soil-map (fig. 4) and is located 1 km to the east of the broad sandy, former creek-ridge on which Bovenkarspel-Het Valkje is located. During the excavation a number of these narrow and shallow former gullies were identified. Broad sandy creek ridges appear both to the north and the southwest, outside the excavated area of the Enkhuizen settlement.

Figure 4. The location of Enkhuizen-Kadijken (in red) on the Ente soil map (after Ente 1963).

5.2 Dating of the main settlement phases

A total of 6 ha was excavated in 2007, 2009 and 2011 (Roessingh & Lohof 2011; Roessingh & Vermue 2011; fig. 5). The excavations yielded house plans, circular structures, pits, wells and ditches, similar to those known from other settlement sites. Using stratigraphy, the distribution of pottery and 25 radiocarbon dates, four main settlement phases were established (Roessingh & Lohof 2011, 279-284, fig. 6).[2] The oldest phase consists of a barrow with a ring ditch that must have been constructed between 1600 and 1400 BC. Whether the barrow was constructed on older arable land is unclear. It was built on the narrow sandy remains of a gully that was already silted up. There are no house plans directly associated with this phase. Some small and irregular ditches - spread out over the excavated area - probably belong to this first phase. Only one radiocarbon date, on a sample from one of the features of house 2, comes in the range of the (*terminus ante quem*) date of the barrow (appendix 1). In theory the inhabitants of this house could have built the barrow.

Figure 5. The main features of the Enkhuizen-Kadijken excavations.

Figure 6. Suggested habitation phases of the Enkhuizen-Kadijken settlement.

On the basis of radiocarbon dates and pottery (table 1), nearly all the other house plans can be dated to the second phase (1400-1200 BC). Two house plans can be dated in phase 3 (1200-1000 BC): house 5 in the north and house 14 in the west. Hoogkarspel-young pottery was found in a house ditch of house 14 that dates to phase 3 (Roessingh & Vermue 2011, 20). This is one of the very few occasions that Hoogkarspel-young sherds have been associated with a house.[3] The barrow must still have been an important feature in this phase, since an inhumation was placed in a burial pit in its northwest flank. The skeletal remains belonged to a man of 20-25 years, whose femur was dated between 1220-1000 BC (Boston 2011, 393).

There are no house plans associated with the last phase (1000-800 BC). The vast majority of Hoogkarspel-young pottery (c. 90%) came from a supposed 'terp ditch' in the upper northeast part of the excavation plan. A possible terp ditch in the lower southeast part yielded the remaining Hoogkarspel-young pottery.

5.3 House plans and house sites

It is useful to distinguish between a house plan and a house site. A house plan can be defined as the remains of a single house (i.e. post holes, surrounded by a house ditch). The house site

or yard is a limited area around the house plan. House sites may contain multiple successive individual houses. In Enkhuizen on two house sites at least three subsequent houses were built. In all, fifteen house sites and at least nineteen individual houses were found. The house sites in the central and southern parts of the excavation plan all show a clearly recognizable yard boundary with modest dimensions (c. 50 x 50 m). In the north such boundaries are less clearly identifiable.

House	*Radiocarbon date (2 σ range)*	*Hoogkarspel-old pottery (gram)*	*Hoogkarspel-young pottery (gram)*	*Hoogkarspel-unknown (gram)*
HS01	1410-1190 BC	77	-	-
HS02	1500-1360 BC	56	-	-
HS03	1430-1260 BC	-	-	3
HS04	1410-1190 BC	228	-	-
HS05	1220-970 BC	3086	-	-
HS06	1410-1210 BC	91	-	-
HS07	1410-1190 BC	404	-	-
HS08	1420-1250 BC	481	-	-
HS09	1410-1200 BC	-	-	21
HS10	1410-1190 BC	727	-	-
HS11a	1420-1250 BC	-	-	-
HS11b	1410-1200 BC	623	-	-
HS11c	-	28	-	-
HS12	-	31	-	-
HS13	-	-	-	-
HS14	1211-994 BC	-	370	-
HS15a	1412-1264 BC	-	-	-
HS15b	-	-	-	-
HS15c	1450-1309 BC	-	-	10

Table 1. Hoogkarspel-old and -young pottery recovered from house features at Enkhuizen-Kadijken. For the location of the houses see appendix 2.

The house plans show remarkable similarities in construction but differ in length and type of house ditch. All the houses have a three-aisled structure (fig. 7). There are no central or ridge-bearing posts. The posts appear as two rows of roof-bearing posts, which probably represent trusses. The distance between the posts (the span) of a pair varies from 2.6 to 3.4 m with an average distance of 2.9 m. The distance between the pairs (the spacing) is with 2.1 m very regular. In the absence of wall posts, we suggest that the walls were made of sods (Roessingh & Lohof 2011, 286-8; Lohof in print). The entrances are situated in the short sides of the house plans. In most houses the last posts of a pair are placed closer to each other, (1.1-1.8 m) and probably formed an entrance portal. In some cases the short side of the house consist of two or even three of those pairs (elaborate entrance portals). More or less complete entrances were only identified in three house plans. The eastern entrance posts are placed further apart compared to the entrance posts in the west.

The exact width of the houses can only be estimated due to the absence of recognizable walls. When we take the outer aisles to be 1,2 – 1,5 m wide and the distance between the house ditches into consideration, the average width of the house may have been 5.3 m. The length of the houses varies from 14 to 23 m. In Enkhuizen house 2 (with the oldest radiocarbon date) is the shortest and house 5 (with the youngest radiocarbon date) is the longest (appendix 1). The probably contemporary houses 6 and 10 differ about 5 m in length, and so do the contemporary houses 1 and 7. This suggests the simultaneous existence of houses of different length.

The house plans of Enkhuizen do not show the renovations or extensions such as those suggested for Andijk and Bovenkarspel (IJzereef & Van Regteren Altena 1991, 69)

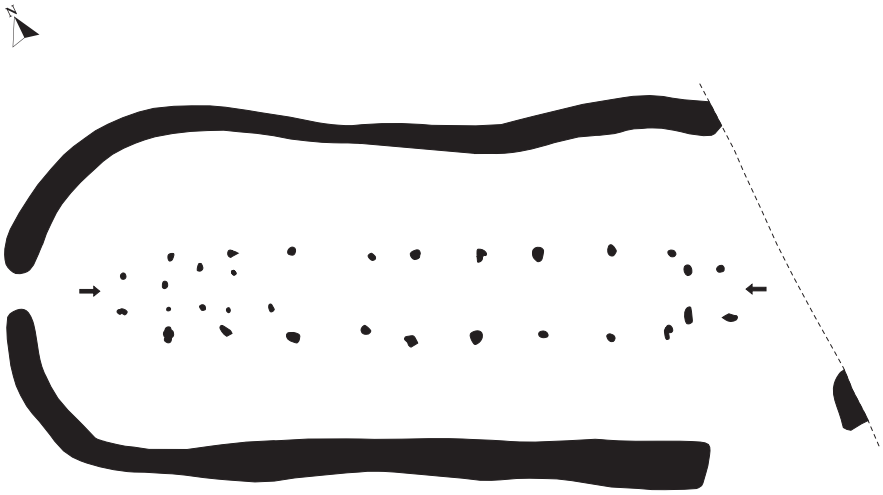

Figure 7. House plan 10 at Enkhuizen-Kadijken (1:200).

A house was completely rebuilt three to four times at the same spot at two locations: house 15a-c in the cluster of houses along the northern border of the excavated area; and house 11a-d in the southeast, probably also within a cluster of houses in the southern part that extended in the unexcavated area.

Around every house plan there was a ditch (fig. 8), supposedly under or close to the eaves of the roof. The soil from the ditch could have been used to raise the floor inside the house. Different types of house ditches occur, but the 'bracket-shape' type is most common. At the two locations where a new house was built at the same spot the old ditches were first filled up with settlement refuse from around the house or from neighbour houses. This may explain why most of the find material from the house ditches was found in the upper fillings (Roessingh & Lohof 2011, 97).

Figure 8. House ditches are a structural and clearly recognizable element of house sites. This is house 2, seen from the west.

In six house plans at Enkhuizen, four to six smaller posts were placed between the trusses in the western part of the construction (fig. 7). This was also observed in some house plans from Bovenkarspel (IJzereef & Van Regteren Altena 1991, 72). Since among house plans the number of these posts varies they are not all contemporary. They seem to belong to a construction with two or four posts at a minimum. These constructions are too irregularly placed to be a part of the house structure and therefore they must have had another function, for example a loom or a construction around a fireplace (Roessingh & Lohof 2011, 294-6; Lohof in print). For Enkhuizen, house plans with these constructions do not seem to be restricted to a certain period, as has been suggested for the house plans at Bovenkarspel (IJzereef & Van Regteren Altena 1991, 72).

5.4 Pit circles and ring ditches

One of the most striking features of the Westfrisian Bronze Age settlements are the pit circles and ring ditches (Bakker & Metz 1967). At Enkhuizen, over 270 of these structures, with an average diameter of 4,2 m, were found dispersed over the excavated area. Some predate houses, others were built on top of abandoned house sites. The pit circles consist of small pits that are dug at a regular interval to form a circle (fig. 9).

The function of these pit circles and ring ditches has been debated for a long time (e.g. Buurman 1979; 1996). The absence of recognizable granaries on Westfrisian Bronze Age sites does suggest an interpretation as storage facility. Pit circles and small ring ditches however are a much earlier phenomenon than *spiekers*, since they have been found underneath houses and barrows that are much older than the appearance of *spiekers* elsewhere. Since there are indications that grain was reaped by pulling it out with stalks and roots from the clayey soil, it is assumed the pit circles and small ring ditches can be interpreted as stooks to let the grain sheaves dry. This would happen after or even before the first thresh in the field, but certainly before the second thresh in or near the house and the processing of the amount needed for the day (Bakker & Metz 1967; Buurman 1979; Buurman 1988, 277; Buurman 1996, 140, 282).

Figure 9. Pit circles in Enkhuizen-Kadijken.

5.5 Long ditches and land partitioning

As in all other Westfrisian Middle and Late Bronze age settlements the most conspicuous features are the numerous ditches in the form of (multiple) yard boundaries, ditches surrounding parcels and longer ditches bordering settlement areas or house clusters. They must have had an important drainage function. Reaching an average depth of 50 cm below the excavated level (suggesting an original depth of 80 to 100 cm), it must have been a substantial task to dig these ditches in the clayey soil. It is unknown what happened to the excavated soil.

Possibly a small bank was constructed alongside the ditches, but this could not be established in the field. Many ditches were repeatedly dug out, probably for maintenance or cleaning. The mud and refuse of these periodically cleaned ditches could have been used to raise a bank. The humid and fertile soil in the ditches was easily accessible and could therefore also have been used to fertilize the arable fields, as has been suggested by Kooistra (2010, 141). Neither the ditch nor the bank would have kept animals out. If ever intended to do so, there must have been a fence on top of the bank since no fence-lines along the ditches were found.

Some small and irregular ditches, both in the north and in the south of the excavated area probably belong to the first phase. In the second phase (1400-1200 BC) a number of long, wide and deep ditches were dug. One runs northeast-southwest through the north part of the excavation plan. This ditch was dug out more than once, in places six times, and must have been in use over a long period of time.

In the absence of ard marks, it is not immediately clear where arable fields can be located. On the excavation plan, possible arable parcels surrounded by ditches can be seen west of (and in line with) some yards. Other plots can be found in the central part of the excavation plan where houses are absent. Although the complete layout of the settlement site is unknown, it looks like the inhabitants structured their landscape from different nuclei around the barrow towards all four main quarters.

Only a few ditches can be associated with phase 3 (1200-1000 BC). It is possible that in this phase most of the excavated area consisted of arable fields and pasture. In phase 4, the final phase of occupation (1000-800 BC), two ditch systems can be identified in the northeast and southwest of the excavation. The ditch in the northeast is most likely a so-called terp ditch.

5.6 Subsistence

A total of 15.000 finds was recovered from Enkhuizen-Kadijken, consisting of fragments of bone, stone, flint and pottery. Some 3.000 of these are pottery sherds, but the vast majority (over 12.500 fragments) are animal bones, primarily of cattle, both in number and in weight.

Species	*MBA (% number)*	*LBA (% number)*	*MBA (% weight)*	*LBA (% weight)*
Cattle	80.9	58.5	96.7	91.5
Sheep/goat	9.9	35	1.6	4.7
Pig	9	6.5	1.7	2.3

Table 2. Bones of cattle, sheep/goat, pigs from Enkhuizen-Kadijken. MBA: Middle Bronze Age, LBA: Late Bronze Age.

In addition, remains of sheep, goats, pigs, dogs and horses are present. A few bones of non-domesticated animals such as wild boar, deer, beaver, elk and a brown bear have also been identified. It is clear however that hunting hardly played any role.

In Enkhuizen we see a small increase in sheep/goat from the Middle to the Late Bronze Age (table 2).

Small animal bones, discovered mostly by wet sieving ditch fills, comprise remains of various birds like duck and goose, hawk, woodcock, ruff and a thrush. The more than 3.000 fish bones are from fresh water species like bream, roach, carp, catfish, pike and perch. Bones of eel (a catadromous species) are also well represented. The find of an almost complete fish trap to catch eel demonstrates the importance of this species for the menu (fig. 10). Only one fish bone could be identified as a true salt-water species: the grey gurnard.

Figure 10. A fish trap for catching eel, found on the bottom of a deep pit.

That emmer wheat and hulled barley were the main crops in the Middle and (probably hulled) barley in the Late Bronze Age bears no surprise. It is remarkable to discover seven species of wood among 38 determinable fragments, recovered from a small number of wells (table 3). Among the wood fragments were several wooden artefacts, of which four wooden planks are worth mentioning, all dating to the Middle Bronze Age. One of the planks was pointed and found on the bottom of a well. All of the planks had a row of rectangular holes in the middle and they could have been used as a ladder to dig out the steep wells, but this was not their primary constructional function. They may have been part of a dry-rack for grass or reed (fig. 11). The origin of the wood fragments could be driftwood, imported or local. If local, this would have implications for our image of the landscape around the settlements.

In connection with the use of wood on the site, more than 500 stake holes (i.e. fences) should be mentioned. Some rows of stakes could be followed over more than 40 m. It is possible that stake fences were also set on the banks, which would have left no traces at the excavated level.

Cow dung was probably used as fuel for the hearth (Buurman 1996, 144). Small fragments of fossilized cow dung from Enkhuizen, however, turned out to have burned at the remarkable high temperature of c. 1420 ºC. Since this is above the melting point of bronze, it is possible that these fragments result from dung used as fuel in the context of metallurgical activities.[4]

Species	*Alder*	*Willow*	*Oak*	*Birch*	*Ash*	*Pine*	*Poplar*
Number	18	10	6	1	1	1	1

Table 3. Species of wood from Enkhuizen-Kadijken

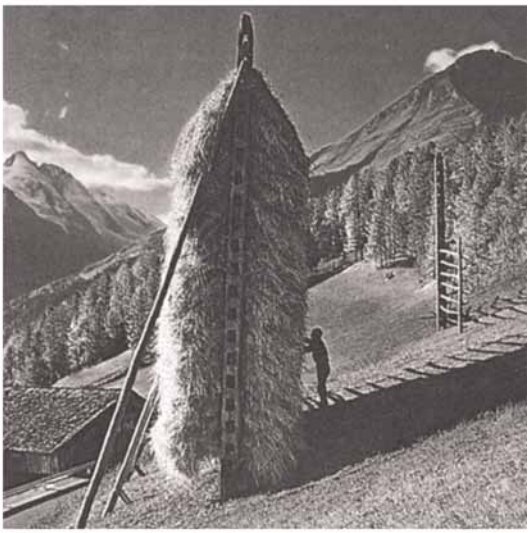

Figure 11. Wooden object, possibly from a dry-rack for grass or reed.

6. Evaluation of some aspects of the old model in relation to the Enkhuizen results

In many respects the results of Enkhuizen have confirmed our image of the developments in West Frisia during the Bronze Age. In other ways they throw doubts on apparently all too accepted ideas and notions. We focus our considerations on those aspects that seem to deviate from the current 'model' or give us reason to elaborate on it.

6.1 Environment and landscape

It is now generally acknowledged that the closing of the estuary near Bergen was not a pre-requisite for the start of the Bronze Age habitation of West Frisia (De Mulder *et al.* 2003, 224; Van Heeringen & Theunissen 2001, 49), as this started centuries earlier. Traditionally, Bronze Age landscapes in West Frisia are envisioned as open landscapes, devoid of closed woodland areas, with at most a few trees (e.g. Buurman 1996, 188; Kooistra 2010, 140; Moolhuizen & Bos 2011, 268) or low bushes and alder-brakes (Bakels 1974, 260). This scarcity of trees was held responsible for the absence of wooden outbuildings and post circles around the Westfrisian barrows (Brandt 1980, 148). The abundance of wood found at recent excavations makes it very unlikely that wood was scarce. The absence of post circles around barrows may very well

have a cultural background. Substantial numbers of stake rows possibly representing fences have not only been found in Enkhuizen (Roessingh & Lohof 2011, 139-144), they are also present in Medemblik-Schepenwijk II (Schurmans 2010, 198-200) and at Andijk and Bovenkarspel (Roessingh in prep.). Furthermore, the various finds of wood fragments at Enkhuizen and Medemblik-Schepenwijk II (Schurmans 2010, 143) and animal remains of red deer, goshawk and beaver do not tally with a completely treeless landscape (Roessingh & Lohof 2011, 300). Of course, none of this is conclusive evidence for the local presence of trees on any scale. The use of driftwood may well be the explanation for the appearance of large pieces of oak such as at Enkhuizen.

More important however, is that we still have a rather limited amount of information about the environment at this time. It is apparent that West Frisia was densely inhabited in the Middle and Late Bronze Age with hundreds of houses being built in the region. Botanical and pollen samples originated mainly from within the settlement area (with two exceptions from the Klokkeweel Bog (Pals *et al.* 1980) and the Westfriese Zeedijk (Van Geel *et al.* 1983). Botanical and palynological studies on the environment outside the settlements remain vital to our understanding of what the landscape of West Frisia looked like beyond the as yet unknown boundaries of the settlements. Present results feed reservations about a rather uniform, treeless landscape and its changes during the period concerned. Centuries of habitation may have had a strong (possibly devastating) effect on the vegetation in West Frisia. So far, we know very little about the changes in the landscape that took place during the Bronze Age.

6.2 First settlements

In both Bovenkarspel and Enkhuizen, Middle Bronze Age habitation started on the low-lying clayey basins of the salt marshes, somewhere between 1600 and 1500 BC, as soon as sedimentation had ceased. The barrow at Enkhuizen with *a terminus ante quem* of 1610-1420 BC, is one of the oldest barrows in West Frisia.[5] If barrows were raised within a century after the arrival of the first settlers, they may well be the graves of the 'founding fathers' of the habitation nuclei. No contemporary house plans are yet known. Post depositional processes or a different way of building houses (irregular construction or the use of sill-beams) could be put forward for the present lack of those house plans (Arnoldussen 2008, 185).

According to IJzereef, habitation started from residential nuclei around a shallow lake (IJzereef & Van Regteren Altena 1991, 65, fig. 2). With the extensive and contemporaneous settlement traces at Enkhuizen it is now clear that more nuclei must have existed (Roessingh & Van Zijverden 2012, 124). Also, in addition to habitation on the silted up creek ridges, habitation had started already at an early age on the clayish lower-lying areas between the ridges.

The oldest radiocarbon dates for house plans date around 1450 BC. At that time houses were built both on the creek ridges as in Bovenkarspel and on the clayish flats in between the ridges as in Enkhuizen (house 2) and Zwaagdijk-Oost (Ufkes & Veldhuis 2003, 17, 43, 210). Since we do not know the boundaries of the Enkhuizen settlement and those of Bovenkarspel, both settlements, now a little more than one kilometre apart, could very well be linked through continuous habitation. The impression this leaves is less of nucleated villages than of an extended field of small groups of houses surrounded by arable fields, which filled the spaces in between, though they roughly remained at the same location. In some of the clusters a house was rebuilt three to four times on the same spot (as was the case for two house sites in Enkhuizen). Similar examples can be found in Andijk and Bovenkarspel. This suggests that around such houses with indications for a prolonged longevity (as evidenced by rebuilding), clusters of additional, younger, houses developed. These clusters around a multi-phased house site suggest an on-going branching-off of households around a nucleus that remains in existence for a long period of time. The actual lifespan of Westfrisian Bronze Age houses is

unknown. If we assume that houses stood for 30 to 50 years, this would imply that some house sites were in use for about 150 years. The multi-phased house, as appeared to form 10-15% of houses, may represent the core lineage residence. There is a formal resemblance to barrows with multiple additions or 'periods' on them. Most later periods from barrows elsewhere in the country appear to be contemporary with Middle Bronze Age houses (Arnoldussen & Scheele 2012, 167). Whether there is an actual relationship must await further research of the settlement dynamics.

In Enkhuizen, as elsewhere, features like postholes are extremely well visible because of a very dark, almost black filling, that is typical of the Middle Bronze Age layers postdating the barrows and is markedly different from the light grey layer underneath the barrows (Bakker 2004). The dark colour appeared to emanate from fragments of charcoal, supposedly originating with large-scale burning of vegetation (Van Geel *et al.* 1983, 272, 298) *during* the Bronze Age habitation. Since there are indications that grain were reaped by pulling it out (stalks, roots and all: Buurman 1987, 28; Buurman 1996, 140), there were no stubble fields. It is more likely that the charcoal originated from burned weeds or grass. This may have been done to improve the quality of the pastures, or as preparation before ploughing in a three-course rotation system (Bakker *et al.* 1977, 222). In this last case however, it must be noted that features like ard-marks within this layer are absent. It is obvious that this black layer can not be a chronological marker; as an irregular practice it may have quite different dates at different locations (Van Geel *et al.* 1983, 273, 298). At Enkhuizen this incorporation of charcoal is also found in deposits that sealed the Late Bronze Age surface. For this, the intentional burning of grassland *after* the Bronze Age is the most likely explanation (Exaltus & Kortekaas 2009).

6.3 Houses and house ditches

All the houses in West Frisia are remarkable similar in construction, and are therefore thought to form a specific Westfrisian type (Arnoldussen 2008, 195, fig. 5.14; Lohof in print). The houses from Enkhuizen are no exception and the study of the house plans led us to the following four observations.

First, as far as the house plans are concerned, we accept (with reservations) the current idea of the existence of an internal bipartitioning, but we also emphasize that there is no indication at all for the existence of a byre or cattle boxes. The assumption that the living quarters are in the western or northern (depending of the orientation of the house) part of the house is based on a single hearth in house plan 45 from Bovenkarspel (IJzereef & Van Regteren Altena 1991, 69). Fireplaces have not been identified in the Enkhuizen houses. There is little to add to that, except that entrances in the western short sides of the houses at Enkhuizen are narrower than the entrances in the opposite sides, suggesting a difference in function.

Second, in relation to the construction of houses, the absence of any wall indication in the Enkhuizen houses lead us believe that the walls were completely made of sods (Roessingh & Lohof 2011, 286-8; Lohof in print). The wooden stakes, as found within the house plans 2 and 5 in Enkhuizen, do not contribute to the wall construction proper. They were sometimes placed on the inside against the wall of sods as a kind of panelling or wainscoting, as can be seen in the reconstruction of IJzereef & Van Regteren Altena (1991, 76, fig. 10). The use of these stakes should not be seen as a regular phenomenon, but can more likely be seen as a regional tradition or a matter of individual taste. Examination of all the house plans from the sites Andijk-North (n = 10), Andijk-South (n = 12) and Bovenkarspel-Het Valkje (n = c. 90) has revealed that only three house-plans at Andijk-North and two plans at Bovenkarspel-Het Valkje yielded stakes at the inner location of the wall. These are the house plans that were repeatedly published. The general absence of stakes in other houses cannot be related to bad preservation conditions (see for example IJzereef & Van Regteren Altena 1991, 69) because the

stake holes have a considerable depth (sometimes up to 20 cm) and other 'fragile feature' categories like rows of stakes or plough marks are present at the afore mentioned sites.

Though trusses can bear the weight of the roof, a wall of stakes and wattle is not strong enough to stabilize and to withstand any pressure lengthways from the trusses (Huijts 1992, 33). A wall of sods on which the roof's eaves rest would certainly have stabilized the structure.

A third consideration is about an assumed constant repairing and extending or shortening of a house in Bovenkarspel and Andijk. In Enkhuizen there is an almost complete absence of repairs and no indication of extending or shortening of any house, though the time range of habitation is nearly the same as that of Bovenkarspel-Het Valkje. A survey of the (unpublished) house plans from Bovenkarspel-Het Valkje and Andijk, resulted in 'only' about 90 convincing house plans in Bovenkarspel (instead of nearly double that amount), and also in the observation that the amount of repairs is not exceptional as compared to contemporary house plans from the Pleistocene part of the country or the central river area.[6] The amount of repairs, extensions and multi-phased houses, as mentioned for West Frisia by Arnoldussen (2008, 213, 405-6) certainly will have to be adjusted. This has of course implications for the way we look at settlement dynamics. Instead of repairing the house, people may have preferred building a complete new house.

The fourth observation concerns the assumption that houses became shorter in the beginning of the Late Bronze Age compared to the Middle Bronze age (IJzereef 1981, 177; IJzereef & Van Regteren Altena 1991, 78; summary in Louwe Kooijmans 1993, 87). In Enkhuizen however, at least three of the early house plans are two meters shorter than three younger ones. This number of well-established lengths of houses from Enkhuizen may be too small to draw any general conclusions. It appeared, however, that the existence of extremely long houses at Bovenkarspel and Andijk (up to 30 m) is due to a disputable interpretation of two or more houses build on the same spot. Another example is found at Hoogkarspel, where house plan 2 is assumed to be the youngest at the site, but is also the longest house (Bakker *et al.* 1968, afb. 4). We see therefore no clear proof of the assumption that houses became shorter in the beginning of the Late Bronze Age. On the contrary, we must not exclude the possibility of the simultaneous existence of houses of different length, as is known from settlements on the Pleistocene soils (Elp, Waterbolk 1987; Hattemerbroek, Hamburg *et al.* 2011) and in the central river area (Zijderveld: Knippenberg 2008; Arnoldussen 2008, 435).

A closer look at the shape of the house ditches, in short hand 'bracket or rectangular', upholds a chronological meaning only in a very general way. According to stratigraphy and radiocarbon dates their occurrence seems to overlap in time to a great extent.

6.4 Subsistence

The slaughtering practices at Enkhuizen show that more cattle were killed at an older age than in Bovenkarspel. In numbers of bones 81% of butchered cattle were older than 3,5-4 years. This is 16% more than in Bovenkarspel (Zeiler & Brinkhuizen 2011, 217). In Bovenkarspel nearly a quarter of cattle bones were from animals younger than 2–2,5 years. In Enkhuizen this was less than 9%. The numbers for Bovenkarspel led to assume a (slight) change from meat production towards dairy production in the Late Bronze Age (IJzereef 1981, 53, 195, 203-204). Lipid analysis on residues on the surface of pottery fragments from Enkhuizen attested the presence of milk products on a Hoogkarspel-young sherd. Analysis of residues on other fragments from both Hoogkarspel-old and young pottery were not conclusive (Roessingh & Bloo 2011, 184; Heron & Hancox 2011, 408). Nevertheless, even though dairy production was not absent in Enkhuizen, it did not play any major role in cattle management (Zeiler & Brinkhuizen 2011, 218). Also in Medemblik (Groot 2010, 101) and Zwaagdijk-Oost (Halıcı & Buitenhuis 2003, 183) there seems to be no indication for a shift towards dairy production. Of course,

economic developments do not have to occur in a similar way everywhere, but here it is remarkable because the settlements of Enkhuizen and Bovenkarspel are so close to each other. If these developments did occur, they must have been a very local phenomenon.

The sizes of the Bronze Age herds are unknown. Neither is known whether all cattle were kept indoors all year through or only in wintertime. The appearance of hoof prints as in Enkhuizen and in several other settlements, suggests a seasonal stabling, likely to collect manure and to take care of cows in calf. In fact, with rather mild winters, there is no compelling reason to keep all cattle indoors at any time a year. It is, apart from the size of the herd, unlikely that one half of the floorspace of every house at any time was filled with cattle. On the Pleistocene soils only a third of the floor space in contemporary Emmerhout type houses is regarded as byre (Huijts 1992, 36, 38; Kooi 2007/2008, 357). In Elp type houses of the Late Bronze Age this amount of byre space had in fact increased, but is not yet half the floor space (Huijts 1992, 36, 54; Arnoldussen 2008, 436). Not necessarily every house contained a byre for cattle, or a byre at all. From the inner constructions found in some houses at Enkhuizen and Bovenkarspel, that are not part of the house structure, it can be concluded that different activities in different houses were carried out. For example, weaving may be restricted to some houses. It is unlikely that these settlements were made up of unrelated competing households. They were communities (German *Gemeinschaften*) of closely related people, with very little or no indications for internal social differentiation beyond those of age, gender and kinship. Their household activities may partly have been complementary. They had different subsistence strategies, as for example some fished in a semi-marine (Hoogwoud, Medemblik) and other in a fresh water environment (Enkhuizen, Bovenkarspel). Hamlets vary in their use of domestic animals, in that for example, people close to the tidal inlet of Bergen (like Hoogwoud and Schagen) depended more on sheep/goat while people living farther inland depended more on cattle (Zeiler & Brinkhuizen 2011, 217, afb. 7.7). In Hoogkarspel there is a remarkable high percentage of pig bones as compared to other sites (Bakker et al 1977, 208).

6.5 Pottery

The pottery from Enkhuizen has little to add to what is already known about the West Frisian Bronze Age pottery. Nonetheless, a few remarks can be made. It is still too early to determine whether the Hoogkarspel-old pottery has closer affinities with that of the so-called Elp-pottery from the Pleistocene landscape of the northeast or with the Laren or Drakenstein variety of the so-called Hilversum-pottery from the south (for a discussion of this pottery see Arnoldussen 2008, 177-178). It is even questionable whether such affinities exist at all beyond the similar thick wall, coarse tempering and poor quality. Neither Elp- nor the later Hilversum pottery has been published in substantial detail. The Hoogkarspel-young pottery is predominantly found in terp ditches and rarely associated with known houses. This pottery shows a new variety in form and manufacture, starting around 1100 BC (Brandt 1988a). The renewal in style and manufacture is not local, but has occurred under a strong influence from outside the region, probably from the east and northeast (Van Heeringen 1992, 217; Roessingh & Bloo 2011, 190). It is a development in accordance with changes in pottery in the rest of the country (Van den Broeke 1991) and, for that matter, in all of Central Europe (Lanting & Van der Plicht 2001/2002, 164; Van den Broeke 2005a, 479; 2005b, 607). By c. 950 BC some of the forms are specific to West Frisia (Roessingh & Bloo 2011, 190). The differences with pottery from surrounding coastal areas, in particular the Heemskerk pottery group to the south, however, may not be as significant as was originally assumed (Van Heeringen 1992, 193).

Within the Hoogkarspel-young group, Brandt made a distinction in two phases based on two contexts at Hoogkarspel-Tolhuis; a terp ditch at Hoogkarspel-site D (first phase) and a terp ditch at Hoogkarspel-site F (second phase). According to Brandt, sherds of the first phase

are more frequently decorated in comparison to the sherds of the second phase. Biconical shapes are dominant in the second phase (1988a, 215, 218). The exact dating of these contexts is problematic because only a few radiocarbon dates are available. Further research and more radiocarbon dates will shed more light on developments within the Hoogkarspel-young pottery. The contexts with Hoogkarspel-young sherds at Enkhuizen, for example, could be dated from 1000-800 BC. A sub- phase (or first phase) within this pottery could not be identified.

Nearly all terp ditches produce an abundant amount of pottery, bones and various other finds. It is certainly not only the better quality of the pottery that is responsible for this increase in finds compared to what we find in ditches from the Middle Bronze Age. Different excavation methods, like sieving, add to the discrepancy. It is conceivable that a regular cleaning of ditches is responsible for the scarcity of finds in those from the Middle Bronze Age. The abandonment of terp ditches where cleaning is neglected in the last stage of habitation may at least be partly responsible for the abundance of finds.

6.6 A decline in habitation of the 11th – 10th century BC?

For a few settlements in West Frisia a decline of habitation between 1100 and 950 BC was assumed and sometimes the word hiatus was used (IJzereef 1981, 17). At the settlement site of Medemblik an interruption of habitation between 1150 and 950 BC is assumed (Schurmans 2010, 28). The features at Hoogkarspel-Watertoren are divided into two phases; an older phase in the late Middle and early Late Bronze Age and a younger phase, represented by the presence of Hoogkarspel-young pottery from the 'terp phase' (Bakker *et al.* 1977, 192; 208). Between these phases the excavators assumed the existence of a hiatus. Also for Bovenkarspel an interruption was assumed, but later called in question (IJzereef & Van Regteren Altena 1991, 64; Woltering 1977, 191). The possible hiatus seems to coincide with the appearance of the Hoogkarspel-young pottery assemblage.

The results of Enkhuizen show a decline in habitation for this period but this may be deceptive. Most of the houses at Enkhuizen are dated between 1400-1200 BC. For the period 1200-1000 BC, there are only two houses (table 1). This means, roughly 13 or 14 houses in a period of three centuries compared to two houses for the subsequent two centuries. The assumption that habitation moved to the slightly higher creek ridges because of a rise in groundwater table, is not supported by the existence of the two house plans in the clayish flatland. That houses from this period are scarce, yet not completely absent, is also illustrated at Zwaagdijk and Medemblik (appendix 1).

The cause or causes of this assumed population decline remain unclear, but environmental factors may have affected individual locations differently. It may be of importance that one of the sections at the excavation of Enkhuizen show indications for an inundation during habitation, but it is not yet known whether we can date this layer to c. 1000 BC (Van Zijverden 2011, 48-49). This could have been a one-time event, that drove no inhabitants away, but if it indicates a more general deterioration of the environmental situation, parts of the population may have been encouraged to relocate to higher ground or leave the region entirely. An inundation layer in Hoogkarspel (Bakker *et al.* 1977, 195) is not dated either. Far from being catastrophic, these developments gave parts of the population sufficient time to leave the area (Van Heeringen 1992, 241-2). We suspect that at Enkhuizen (as elsewhere) at least part of the community stayed, both on the higher ground of the ridges, and in the lower clayey parts.

6.7 The last phase and end of habitation

Terps or raised dwellings were mainly erected near or on the slightly higher silted up creek ridges from shortly after 950 BC until 780 BC (Lanting & Van der Plicht, 2001/2002, 202; Roessingh & Lohof 2011, 305). These are the oldest known raised house sites in the country, possibly along the whole North Sea coast line. There are indications for the existence of terps on most of the sites where there is also an earlier habitation. Only in Andijk-North & South and Zwaagdijk-Zuid there seems to be no habitation prior to the terp phase, though there are indications of older activities in the vicinity (Ufkes & Veldhuis 2003, 208). During the final stage of the Late Bronze Age the terps were extended and probably heightened again (Van Geel *et al.* 1997, 154; Schurmans 2010, 145-6).

The causes of the end of the habitation are still heavily debated. In general, wetter conditions and a rise in groundwater level are held responsible (Pals *et al.* 1980; Roep & Van Regteren Altena 1988, 228). It is assumed that this caused the growth of peat all over West Frisia from c. 900 BC (Van Geel *et al.* 1983, 305), about the time the terps were raised. However, at Enkhuizen there is no indication for peat formation before or after the region was deserted. The formation of peat seems to have been in great extend the result of local conditions (Van Zijverden 2011, 49). Apart from raising terps there are few clues to how the inhabitants adjusted their subsistence strategy. The slight increase in the number of sheep/goat towards the end of the Late Bronze Age in both Enkhuizen (table 2; Zeiler & Brinkhuizen 2011, 214), Medemblik (Groot 2010, 89, 94, 99-101) and Bovenkarspel (IJzereef 1981, 26) at the cost of cattle, does not seem appropriate for a wetter environment, since sheep/goat do not cope well with these conditions (with the chance of catching liver fluke being considerably enlarged in these kinds of environments; Zeiler & Brinkhuizen 2011, 216). Only in Zwaagdijk-Oost II a slight decrease in sheep/goat in the last phase can be shown (Buitenhuis 2011, 57). A rise in ground water level is difficult to prove, because the occurrence of stagnant water or water-plants in ditches and wells is not necessarily an indication for such a phenomenon (Moolhuizen & Bos 2011, 267). Assessment of the ground water table depends on an adequate dating of wells (Van Geel *et al.* 1997, 154). Results so far do not fit the situation at Enkhuizen (Roessingh & Lohof 2011, 127), which would have been under water by current estimates.

It is obvious that the inhabitants, while living on terps, had no problem growing their cereals in the vicinity and tending their sheep. The presence of some Late Bronze Age pottery fragments in ring ditches, presumably used for storing cereals, is an indication for agricultural activities near the terps. This in turn leads to the question why the inhabitants needed terps in the first place when the ground water level was apparently low enough to grow their crops? The building of terps and the continuing use of agricultural fields points rather at seasonal or irregular flooding, which improved soil fertility and brought higher yields, in turn making it worthwhile building the terp in the first place. This could be a marine inundation through the former Bergen estuary or a fresh water inundation from the (later) 'Zuiderzee area' to the east (Van Zijverden 2011, 49). The fish bones from Bovenkarspel and Enkhuizen, all from terp ditches, are almost exclusively from fresh water fish (Zeiler & Brinkhuizen 2011, 207-8). This does not point at marine influence in the immediate surroundings, but does not exclude it either. Finally, a permanent raise in groundwater level must have affected their crops and the health of their animals in such a way that the inhabitants left altogether.

7. Conclusion

The Bronze Age habitation in West Frisia appears to have been prosperous, given its dense population and long history of six or seven centuries. Settlements were permanent, but show variation in subsistence patterns. The inhabitants were connected to supra-regional networks

as is shown by the imports of flint sickles (apparently for cutting the sods for the terps; Roessingh & Lohof 2011, 315) and bronzes (socketed axes and spearheads are only known as stray finds, but there is a sword from a grave; Modderman 1964). While we have considerable information on the nature and clustering of house sites for the Middle Bronze Age in West Frisia and the general subsistence activities, our information on house site usage as well as the interrelations of fields and house site and older funerary sites is still limited. Secondly, the dating, chronology and internal dynamics of Bronze Age settlement sites is still an open question as long as we do not know the extent of a single settlement. We know little about the character of the cultural landscape between the settlements, where we may expect ritual, depositional and funerary features. There are new results to be expected from the research project 'Farmers of the coast' at Leiden University that involves a critical re-evaluation of geophysical and environmental data and an analysis of several older excavations. This can only be an encouragement for purposive excavation in the future to tackle these problems.

Acknowledgements

Without the contributions of the persons involved in the fieldwork and analyses, this article could not have been written. We are very grateful for the efforts they have made. Furthermore we like to thank Gavin Williams for editing our English text.

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Notes

1. The radiocarbon samples from Andijk, and some from Bovenkarspel, are considered unreliable, because they have been treated with a preservative (Lanting & Van der Plicht 2003, 185-6). We have ignored them in this paper.
2. See appendix 2 for the location of the houses with house number.
3. Only a few Hoogkarspel-young sherds from Bovenkarspel could be associated with a house site.
4. In Medemblik-Schepenwijk II five fragments of what was supposed to be 'metal slag' were found in Bronze Age context (Boreel 2010). After publication, some samples from Medemblik were analysed by F. Braadbaart (Utrecht University). The chemical composition of the fragments appeared to be the same as the Enkhuizen samples.
5. Together with the sample of charcoal from a ring ditch at Bovenkarspel-Het Valkje (tumulus I); GrN-7472, 3275 ±35 (Van Regteren Altena *et al.* 1977, 250-1, table 1).
6. The second author is studying the original field drawings from Bovenkarspel and Andijk for his PhD research in the research project 'Farmers of the coast' at Leiden University.

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Appendix 1. Radiocarbon dates (2 sigma) of Bronze Age houses from recent excavations at Medemblik-Schepenwijk II (Schurmans 2010), Enkhuizen-Kadijken (Roessingh & Lohof 2011; Roessingh & Vermue 2011) and Zwaagdijk-Oost I & II (Ufkes & Veldhuis 2003; De Wit & Stokkel 2011).

Site	*Excavated*	*House*	*Radiocarbon code*	*14C-date (BP)*	*2 σ range (cal BC)*	*14C-Context*	*C14-Findnr and featurenr*	*C14-Material*	*HK-old pottery*	*HK-young pottery*
Zwaagdijk-Oost I	2003	Huis-I	GrN-28826	3130±50	1520-1260 BC	House ditch	1213, 113-13	Bone	X	-
Zwaagdijk-Oost I	2003	Huis-II	GrN-28823	3120±50	1497-1269 BC	House ditch	1071, 109-13	Bone	-	-
Zwaagdijk-Oost I	2003	Huis-III	GrN-28824	2960±50	1371-1019 BC	House ditch	1101, 110-2	Bone	?	?
Zwaagdijk-Oost I	2003	Huis-III	GrN-28825	3130±50	1520-1260 BC	House ditch	1154, 112-6	Bone	X	-
Medemblik-Schepenwijk II	2007	Huis 1	KIA-37075	3140±30	1466-1376 BC	House ditch	61, 24-26	Bone	?	?
Medemblik-Schepenwijk II	2007	Huis 2	KIA-37076	3115±30	1445-1313 BC	House ditch	54, 9-79	Bone	?	?
Medemblik-Schepenwijk II	2007	Huis 3	KIA-37077	3050±25	1406-1261 BC	Posthole	5, 30-156	Wood	?	?
Medemblik-Schepenwijk II	2007	Huis 3	KIA-36979	3045±25	1398-1259 BC	Posthole	6, 30-165	Wood	?	?
Medemblik-Schepenwijk II	2007	Huis 5	KIA-36981	2960±25	1262-1109 BC	House ditch	25, 10-2	Carbonized seed	?	?
Medemblik-Schepenwijk II	2007	Huis 7	KIA-37073	3055±30	1410-1260 BC	House ditch	37, 23-90	Bone	?	?
Medemblik-Schepenwijk II	2007	Huis 12	KIA-37074	3015±25	1386-1193 BC	House ditch	54, 6-250	Bone	?	?
Enkhuizen-Kadijken	2009	HS01	SUERC-28667	3035±35	1410-1190 BC	Posthole	109, 3-52	Charcoal	X	-
Enkhuizen-Kadijken	2009	HS02	SUERC-28668	3140±35	1500-1360 BC	Posthole	736, 59-271	Charcoal	X	-
Enkhuizen-Kadijken	2009	HS03	SUERC-28669	3085±35	1430-1260 BC	House ditch	967, 68-61	Charcoal	-	-
Enkhuizen-Kadijken	2009	HS04	SUERC-28670	3030±35	1410-1190 BC	Posthole	965, 68-6	Carbonized seed	X	-
Enkhuizen-Kadijken	2009	HS05	SUERC-28661	2895±35	1220-0970 BC	Posthole	1270, 81-38	Carbonized seed	X	-
Enkhuizen-Kadijken	2009	HS06	SUERC-28660	3045±35	1410-1210 BC	Posthole	1242, 73-26	Charcoal	X	-
Enkhuizen-Kadijken	2009	HS07	SUERC-28662	3030±35	1410-1190 BC	Posthole	1227, 78-106	Carbonized seed	X	-
Enkhuizen-Kadijken	2009	HS08	SUERC-28671	3065±35	1420-1250 BC	House ditch	346, 21-35	Carbonized seed	X	-
Enkhuizen-Kadijken	2009	HS09	SUERC-28681	3040±35	1410-1200 BC	House ditch	484, 40-8	Carbonized seed	-	X
Enkhuizen-Kadijken	2009	HS10	SUERC-28672	3030±35	1410-1190 BC	Posthole	198, 12-33	Carbonized seed	X	-
Enkhuizen-Kadijken	2009	HS11a	SUERC-28673	3055±35	1420-1250 BC	Posthole	354, 1-351	Charcoal	-	-
Enkhuizen-Kadijken	2009	HS11b	SUERC-28663	3040±35	1410-1200 BC	Posthole	355-1-302	Carbonized seed	X	-
Zwaagdijk-Oost II	2009	Huis 2	Beta-294647	3020±30	1380-1200 BC	House ditch	57, 2-30	Charcoal	X	-
Zwaagdijk-Oost II	2009	Huis 3	Beta-294648	2790±40	1020-0840 BC	House ditch	97, 5-22	Charcoal	-	-
Enkhuizen-Kadijken	2011	HS14	SUERC-37152	2895±30	1211-0994 BC	House ditch	13, 2-19	Carbonized seed	-	X
Enkhuizen-Kadijken	2011	HS15a	SUERC-37157	3065±30	1412-1264 BC	Posthole	35, 4-68	Carbonized seed	-	-
Enkhuizen-Kadijken	2011	HS15c	SUERC-37158	3115±30	1450-1309 BC	Posthole	36, 4-49	Carbonized seed	-	-

Appendix 2. Location of the houses with number at Enkhuizen-Kadijken.