PLANT AND INSECT REMAINS FROM THE LATE NEOLITHIC WELL AT KOLHORN

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ABSTRACT: Organic remains in the filling of a Neolithic well were predominantly derived from a reed vegetation. Formation processes of the fill are discussed.

KEYWORDS: Insect remains, plant remains, formation processes, site ecology.

1. INTRODUCTION

The occupation layers of the Neolithic site at Kolhorn are rich in carbonized plant remains; about 50 samples especially from the southwestern part of the site have been analysed. These samples consistently contain charred flax seeds (*Linum usitatissimum*), cereal grains (*Hordeum vulgare* var. *nudum*, *Triticum dicoccum*), chaff remains (*Hordeum* internodes, *Triticum* spikelet forks and glume bases), numerous culm nodes and small seeds of Poaceae (possibly *Phragmites*), occasional remains of gathered wild fruits (*Corylus*, *Malus sylvestris*) and seeds of wild plants, of which *Atriplex* spp. and *Althaea officinalis* are the most common (Pals, 1988; and forthcoming).

It was expected that phyto- and entomo-archaeological analysis of waterlogged organic remains from the well (feature 41) at this site could give additional information about activities in, and the landscape around, the settlement. A sample was taken from a layer that was expected to have been deposited during the period in which the well was in use (cf. van der Waals, 1988).

The lower half of the well is filled with a homogeneous layer of dark material (layer 5, see van der Waals, 1989: fig. 2), presumably put in to prevent the lower part of the well from caving in. The layer on top of this fill is supposed to represent the period of use of the well (van der Waals, 1988; 1989). The sample (c. 500 cc) was taken from the lower part of this layer (no. 4), consisting of waterlogged, coarse organic material, at 2.91 m. below N.A.P.

2. FIELD AND LABORATORY PROCEDURES

Two subsamples were prepared for pollen analysis, following Fægri & Iversen, 1975; the rest was washed over a nest of sieves with meshes of 2, 1, 0.5, 0.25 and 0.16 mm. For archaeobotanical analysis the fractions coarser than 0.25 mm were sorted under a stereo microscope. Charred insect remains were also extracted during this procedure. For entomological analysis all fractions were put together again and subjected to paraffin flotation (Coope, 1986).

3. RESULTS: NOTES ON IDENTIFICATION; RECENT ECOLOGICAL DATA

3.1. Macroscopic plant remains

The results are listed in table 1. The fraction >2mm consisted predominantly of Poaceae stalk fragments, mainly culm nodes. About 80% of this material was carbonized. Considering the size and the presence of auxiliary buds at the nodes, these stalks should belong to *Phragmites*. This identification is corroborated by the presence of many waterlogged and carbonized reed seeds. Another abundant taxon, *Atriplex*, was also represented by both carbonized and waterlogged remains.

The size range of the *Atriplex* seeds includes *A. littoralis*, *A. hastata* and *A. patula*. Identification of the separate species according to the criteria established by Körber-Grohne (1967) was impossible, due to the preservation condition of the seeds. Following Pals (1984), seeds larger than 2.5 mm are classified as *A. littoralis/hastata*, those smaller than 2.5 mm as *A. hastata/patula*.

Atriplex littoralis is a characteristic pioneer on organic debris washed up by the sea. This is also one of the natural habitats of *Atriplex hastata*. The ecological range of the latter species is not restricted to salt marshes and the banks of tidal creeks, but it may also form closed stands of vegetation in the reed-belt along estuaries (Körber-Grohne, 1967). In the coastal lowlands of the Netherlands it is common in nitrophilous vegetations, in combination

Table 1. Seeds and other plant remains.

	Charred	Waterlogged
Atriplex littoralis/hastata	8	53
Atriplex hastata/patula	60	138
Althaea officinalis	1	-
Chenopodium album	-	1
Chenopodium ficifolium	-	9
Chenopodium rubrum/glaucum	-	5
Capsella bursa-pastoris	-	2
Stellaria media	-	2
Phragmites australis seeds	142	24
Phragmites, stem fragments/culm nodes	25	5
Rubus sp. (fragment)	-	1
Carex cf. otrubae (fragment)	-	1
Veronica sp. (recent?)	-	1

with species such as *Althaea officinalis*, *Rumex crispus*, *Scirpus maritimus* and *Phragmites australis* (Westhoff & den Held, 1975).

Some species represented exclusively by waterlogged material (*Chenopodium* spp., *Capsella bursa-pastoris*, *Stellaria media*) are ecologically different: this is a group of annual ruderals, characteristic for strongly disturbed habitats.

An important point of difference between this sample and the samples from the occupation layer is that no macroscopic remains of cereals or other food plants were found.

Table 2. Microfossils (numbers absolute).

	S1	S2
Pinus	6	2
Betula	7	1
Ulmus	1	1
Tilia	1	2
Quercus	3	4
Corylus	5	20
Salix	1	-
Alnus	6	6
Ericaceae	1	-
Artemisia	1	-
Chenopodiaceae	252	44
Gramineae <40μ	114	109
Triticum type	2	30
Cyperaceae	2	5
Typha latifolia	-	1
Compositae tub.	1	10
Compositae lig.	-	1
Malvaceae (cf. Althaea)	-	1
Polypodium	2	-
Sphagnum	2	-
Filicales indiff.	9	8
cf. Mougeotia	-	1
Hystrichosphaeridae	2	-
Type 128	-	1
	418	247

3.2. Pollen

The two subsamples were rich in charcoal particles. The pollen was well-preserved. The results are presented in absolute numbers in table 2.

Both samples are characterized by a low content of arboreal pollen, indicating an open landscape (cf. Pals, 1984). Pollen grains from Chenopodiaceae and Poaceae <40μ are the most numerous. The two samples differ in the number of *Triticum*-type pollen grains (Beug, 1961), indicating an uneven distribution of organic remains in the layer.

3.3. Insect remains

The results of the analysis of insect remains are presented in table 3. Most elements were well-preserved, but highly fragmented, which hampered the identification. Some of the pieces were in a very poor condition.

The interpretation of the insect remains is based primarily on the beetles. The minimum number of beetle individuals is only 33. In general this is not a very solid base for a reconstruction, but in this case it is enough to draw some conclusions.

Recent ecological data were mainly derived from Horion (1941-1974), Lindroth (1985-1986) and *Die Käfer Mitteleuropas* (1965-1983). Information concerning the distribution of the beetles with respect to the environmental factors salinity, moisture and the structure of the vegetation is presented in table 3. For the eurytopic species and higher taxa this information is incomplete and the codes are put in brackets.

A strong point of resemblance between the ecological preferences of the beetles is their relation to the environmental factor moisture. All recovered beetle species can be found at water sides and/or in marshy places.

The next important environmental factor is the presence of other organisms or organic substances for food, shelter etc. Some species live on bare ground, others need some sort of vegetation. *Olibrus aeneus* develops in the northern parts of Europe in *Matricaria* species, but the adults live on all kinds of flowers. The presence of *Phragmites* and other tall waterside plants, such as *Typha*, is indicated by 5 of the more specific beetle species. Most of these do not need the living plant. *Agonum thoreyi*, *Dromius longiceps*, *Stilbus oblongus* and *Anthicus gracilis* are especially common in heaps of dead reed. In fact almost all beetles can be found in litter or washed up organic debris. The description of the habitat of *Bembidion fumigatum* by Burmeister (1939) may be very close to the overall picture: "unter dichter Chenopodiendecke, Tang, Genist, in Rohrstengeln, zwischen angeschwemmten Schilf".

The interpretation is mainly based on the more specific species; the more eurytopic species need only be checked whether they fit in. It must therefore be mentioned that *Carpelimus pusillus*, *C. corticinus* and *Anotylus rugosus* not only occur in natural debris, but also in anthropogenic waste.

Another important ecological factor is salinity. *Bothriophorus atomus* and *Carpelimus schneideri* are confined to a saline environment (halobiontic species). Species with a preference for a saline environment (halophilous species) are *Bembidion fumigatum* and *Carpelimus foveolatus*. Four species are explicitly mentioned as occurring in a saline environment. Whether some of the remaining species are halophobic cannot be concluded on the basis of the consulted literature.

Apocrite Hymenoptera (small wasps) are common on, and especially in, reed, but identification in order to detect specific species would have consumed too much time, even if it is at all possible. In addition to the remains of imagines, larvae of insects of several orders (Coleoptera, Diptera and Lepidoptera) were found. One charred, but unrecognizable larva was found in a fragment of a reed stem. Other reed stems had one or two round or oval openings. These could very well be the entrance and exit holes of caterpillars that lived inside the stems. The single frontoclypeus of a caterpillar could, however, not be attributed to one of the common reed infesting species. Four of the 30 fragments of reed stems (mainly nodes) had clearly been attacked by insects. Since the attack of only one caterpillar is sufficient to retard the growth to a considerable extent (Skuhravý, 1981), and a reed stem normally has about a dozen nodes, this means that the material from this sample was heavily infested.

Apart from remains of insects and other Arthropods one other animal fragment was recovered: a fragment of the chitin-like perisarc of the colony of a Hydrozoan polyp. Although the class Hydrozoa is almost entirely marine, the specimen could well belong to the only colonial species that occurs in brackish to almost fresh waters, *Cordylophora caspia* (Pallas). This species is widespread and common in the lower parts of the Netherlands. It lives on several types of substrate, among which reed stems (Vervoort, 1946).

Two species are of special interest. *Anthicus gracilis* has never been collected in the Netherlands and *Bothriophorus atomus* only once (Brakman, 1966; Huijbregts & Krikken, 1985). It is then all the more striking that both species were also recovered from the Early Iron Age site Q in the Assendelver Polders (Hakbijl, 1989). The biogeographical implications of these finds will be evaluated elsewhere.

3.4. Correspondence between the three categories

On the whole the results of the different groups of material (pollen, seeds, insects) correspond fairly well. The organism represented by the most abundant remains, *Phragmites australis*, was present in the form of waterlogged and carbonized seeds, stem fragments and culm nodes. This is consistent with the large amount of grass pollen, although this pollen can not be identified to the species level. The majority of the insect species could have lived in or below a vegetation dominated by reed.

Chenopodiaceae are represented by both macroremains and pollen. No common specialized beetles of the two large families Chrysomelidae and Curculionidae feeding on Chenopodiaceae (Mohr, 1966; Hoffmann, 1958; Lohse, 1981-1983) are found in the Netherlands, so no remains from this group could be expected.

The most important discrepancy we have is the lack of macroscopic remains of wheat, despite the presence of a considerable amount of *Triticum*-type pollen in one of the samples.

4. TAPHONOMY

Any kind of interpretation is impossible without a discussion of the processes acting upon the formation of the layer in question.

4.1. Preservation

The mere fact that both waterlogged and carbonized material are present in one sample is not unusual. However, there is a group of species that is only present as waterlogged remains. Furthermore the species of this group can be distinguished from those in the other group in terms of ecological preferences. *Capsella bursa-pastoris*, *Stellaria media*, and the *Chenopodium* species could have grown in the direct neighbourhood of the well. The relatively few seeds of these species and a few of the eurytopic insects could have easily ended up in the well to be preserved in a waterlogged state. Other taphonomic processes and a different path must be involved for the group of charred waterside organisms. The charring must of course have taken place before deposition in the well.

4.2. Deposition

It is assumed that layer 5, underneath layer 4 from which the sample was taken, had been deliberately introduced into the well at the time of construction (cf. van der Waals, 1988; 1989). Thus, the contents of layer 4 would have been deposited either during or after the period in which the well was in use.

The following mechanisms may have caused the deposition of the remains of the animal and, to a lesser extent, the plant remains:

Table 3. Insect remains. Numbers represent minimum numbers of individuals, numbers between brackets represent estimated numbers of species. Nomenclature (if possible) and classification follows Kloet & Hincks (1977). S(alinity): H(alobiontic), h(alophilous), + recorded from the seashore, ? heterogeneous group, . no references. M(oisture): + = waterside, marshland, etc. inhabiting species. O(rganic substrate): b(are ground), l(itter and washed up organic debris), v(egetation), r(eed and other tall vegetation).
N.B. taxa marked (+) or (....) etc. have a wider range.

	Waterlogged	Charred	S	M	O
Hemiptera (Homoptera)					
Cicadellidae					
Aphrodes spec.	1	.			
Lepidoptera					
larva indet.	1	.			
Coleoptera					
Carabidae					
Dyschirius globosus (Hbst.)	1	.	+	(+)	(blv.)
Bembidion fumigatum (Duft.)	1	.	h	+	.lv.
Agonum thoreyi Dej.	1	.	+	+	.lvr
Oodes helopioides (F.)	1	.	.	+	...r
Dromius longiceps Dej.	.	1	+	+	.lvr
Hydrophilidae					
Cercyon spec.	1	.	?	(+)	(blv.)
Hydraenidae					
Ochthebius spec.	1	.	?	(+)	bl..
Ptiliidae					
Ptenidium spec. not punctatum (Gyll.)	2	.	.	(+)	.l..
Staphylinidae					
Carpelimus corticinus (Grav.)	2	.	+	+	(bl..)
Carpelimus foveolatus (Sahlb.)	1	.	h	+	blv.
Carpelimus pusillus (Gr.)	1	.	.	(+)	(.l..)
Carpelimus schneideri (Gangl.)	1	.	H	+	b.v.
Anotylus rugosus (F.)	1	.	.	(+)	(.l..)
Euaesthetus bipunctatus (Ljun.)	1	.	.	+	.l..
Aleocharinae gen. indet.	4(4)	.	?	(+)	(.l..)
Pselaphidae					
Brachygluta spec.	1	.	?	+	.l..
Byrrhidae					
Bothriophorus atomus Muls.	1	.	H	+	.l..
Cryptophagidae					
Atomaria spec.	4(2)	.	?	(+)	(.l..)
Phalacridae					
Olibrus aeneus (F.)	1	.	.	(+)	..v.
Stilbus oblongus (Er.)	3	.	.	+	.lvr
Anthicidae					
Anthicus gracilis (Pz.)	2	1	.	+	.lvr
larvae fam. indet.	1	1			
Hymenoptera					
Apocrita fam. indet.	10(6)	1			
Diptera					
Nematocera larvae					
Bibionidae gen. indet.	+	.			
Brachycera					
puparia indet.	1	.			
larvae fam. indet.	1	1			
larvae order indet.	.	2			

a. Organisms may have lived in the well.

b. Especially insects may have got into it on their own, and subsequently drowned.

c. All kinds of objects may have got into it passively, by means of transport by water, wind or man.

These mechanisms will be discussed in detail:

a. The hydropolyp is the only aquatic organism. None of the insects could have lived in the water and it is improbable that any of them could have lived in the well shaft.

b. There is evidence that an important part of well deposits is formed by insects stumbling in by chance. It appears from actuo-ecological research on the distribution of insects that the majority of the insects caught by means of pitfall traps (jars dug into the surface) consists of Carabidae (ground-beetles with a relatively high running-activity). In many wells from archaeological context this family is amply represented, sometimes in combination with a high proportion of dung-beetles, which, in the presence of sufficient amounts of manure, can be found walking around in large numbers. An extreme example, although somewhat biased by the large mesh of the sieve used in the analysis, is well B at Burst (Belgium): Carabidae 114, dung eating Scarabaeids 'frequent', and others only 4 (Ervynck et al., 1987).

Another characteristic of well-fills and pitfall traps is the very high concentration that may occur. For instance, a sample from an abandoned Roman well at Valkenburg contained almost 1000 beetles per litre (Hakbijl, in progress).

As the sample was taken from the deepest part of layer 4 (the presumed bottom of the well when it was in use), this mechanism would have led to a high overall concentration and a high relative abundance of surface dwellers. These phenomena would even have to be detectable if material is dumped on a layer of concentrated insect remains, since "part of the insect remains present in this deposit may be carried into suspension by turbulence generated by dumping, becoming trapped in this layer of dumped material" (Hall et al., 1980). However, the concentration of Coleoptera in the sample is only 66 individuals per litre. Furthermore, the percentage of Carabidae is not particularly high, and dung beetles are, indeed, totally absent, despite the fact that cattle were kept in the settlement. Most of the Carabids included in the sample do not even belong to the active surface dwellers (*Dyschirius* spends much of its time in burrows, *Dromius* in the vegetation and *Oodes* below water).

The conclusion is that this mechanism was not of great importance in the formation of the well deposit.

c. The possibility of material having been washed in can be ruled out: apart from the hydropolyp, remains of aquatic fauna (water beetles, Trichoptera, Foraminifera, Ostracoda) were not found, and water plants are also lacking. Furthermore, no traces of inundation of the settlement were observed.

If wind transport was an important mechanism in the filling of a particular well, an overrepresentation of relatively light objects (Juncaceae, *Typha*, *Aster tripolium*, etc.) derived from a variety of habitats may be expected. However, this was not the case; the only wind-borne seeds are those of *Phragmites*, and most of these seeds were charred, which implies that they did not come directly from the natural vegetation. Besides, heavy objects such as *Atriplex* seeds and Gramineae culm nodes predominate in the sample. These objects must have been transported by means other than the wind.

The only possibility left is transport by man. Questions arising then are: for what purpose and from where? The abundance of charred *Atriplex* seeds might be indicative for gathering of these seeds for food (cf. Helbaek, 1960, van Zeist, 1970). However, the lack of macroscopic remains of food plants and the combination of *Atriplex* and *Phragmites* (charred, as opposed to other plants) in this sample suggest that these plants were gathered together, not for food, but for some other purpose (fuel, building/filling material). It was argued in section 3.1 that both species could have been derived from a natural stand of vegetation. Since the same combination of charred remains seems to be distributed over large parts of the settlement, the exploitation of this particular vegetation type would seem to have been customary. After use and partial charring the remains could have been dumped in the abandoned well.

An aspect of dumping is that it results in a mixture of well preserved and corroded remains, since both living and decaying material are dumped together. In the sample this aspect is represented by the fact that both well preserved and grossly corroded insect remains (*Bothriophorus atomus*, *Anotylus rugosus*) were found.

What remains to be explained is the proportion of 12% *Triticum* pollen. A percentage as high as this can only be obtained by transport through the air during threshing. Even mowing of modern, free threshing cereals leads to amounts of only 1 or 2% in and around the field (Hall, 1988, Meurers-Balke & Lüning, 1990). A possible explanation is that the pollen was transported together with uncarbonized grain or chaff remains, which had decayed, whereas the more resistant pollen was preserved. This would also explain the uneven distribution of the pollen in the well deposit.

All in all it seems plausible that layer 4 was the result of a deliberate backfill for reasons of safety. The uncarbonized seeds of plants that could have grown around the well could have entered the well before it was backfilled, or together with the fill.

The question remains what happened before this. We previously concluded that invertebrates and vertebrates did not stumble in by chance. A very plausible explanation for this is that the opening of the well was fenced off in one way or another. This would not necessarily have to result in visible traces of some sort of structure. More problematic is the absence of wind-born seeds. The cause of this may be: a) the opening of the well could be closed, b) the well was open only for a very short period, or c) the well was not in use after the formation of layer 5. If the last assumption is correct, this could mean that this layer is the result of a previous backfill.

5. ENVIRONMENT

Pollen and plant macrofossils show that the settlement was surrounded by an open landscape covered by a vegetation dominated by *Phragmites* and *Atriplex*.

An important aspect of the environment has not yet been discussed: salinity. As was mentioned in section 3.3, two halophilous and two halobiontic beetle species were found; *Carpelimus schneideri* is known to survive in desalinated marsh (Horion, 1963).

Plants are expected to be more precise salt indicators because they react more directly on the presence of salt than most land animals do. *Atriplex*, *Althaea* and *Phragmites* are salt tolerant, but certainly no specific salt marsh plants. If salt marsh vegetations were present anywhere near the settlement, species such as *Triglochin maritima*, *Aster tripolium*, *Juncus gerardii* and *Spergularia* spp. would be expected. But even the small seeds of proliferous producers such as *Juncus gerardii* and *Spergularia* spp., which are readily transported by wind or water, and are abundantly found in archaeological context in the coastal area (cf. van Zeist, 1974; Pals, 1987) are lacking. The amount of Hystrichosphaeridae (marine Dinoflagellatae forming cysts which are transported by the wind and are common in pollen spectra from the coastal area) is also very low.

The conclusion is that the influence of the sea was remote.

The organic remains do not give any clue as to the reason the well was filled up. At any rate it must have happened while the site was still occupied, for part of the occupation layer is superimposed on the top of the backfill of the well. Possibly the environment was already strongly desalinated at the time the deposit was formed. On the other hand, diminishing rainfall and overexploitation of fresh water could also have attracted brackish ground water, thus making the well unfit for use.

We must regretfully conclude that this sample provides only limited information on site ecology, despite the high initial expectations.

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