

BURNT ANIMAL REMAINS FROM *FEDERMESSER* SITES IN THE NETHERLANDS

Information about the fauna at sites of the Late Palaeolithic *Federmesser* tradition in the Netherlands is scarce (Lauwerier / van Kolfshoten / van Wijngaarden-Bakker 2005; Deeben / Arts 2005) (fig. 1). Antler, bone and artefacts such as antler axes, harpoons and awls have been found in rivers and other wet environments, though their primary context and exact dates generally remain unknown (see, *inter alia*, Arts 1988; de Jong 1998; Prummel 2001). Faunal material from this period is very rare throughout the North European Plain. Exceptions include the *Federmesser* findspots in the Neuwieder Basin, such as Niederbieber (Bulus 1992), Andernach-Martinsberg (Street 1995; 1997), Urbar (Baales et al. 1998; Eiden / Löhr 1973) and Kettig (Baales 1994; 1996; 2002), and the palaeontological complexes dating from the Allerød Interstadial of Miesenheim (Street 1986) and Mertloch (Baales / von Berg 1997). Faunal material has been found in Northern Germany, such as at Klein Nordende (Bokelmann et al. 1983). For a more complete summary of Allerød fauna from France, Northern Germany and Great Britain, see Baales (2002) and Street / Baales (1999). Remains have also been found in Tongeren, Belgium (Dijkstra et al. 2006; Bink 2007).

In the western part of the Netherlands Late Palaeolithic sites lie almost inaccessibly beneath thick layers of Holocene sediments. The top of the Pleistocene sediments in the coastal area is located approx. 20 m below the present surface. All known *Federmesser* sites are therefore located in the Pleistocene part of the country. However, the probability of finding archaeozoological remains in this part of the Netherlands is low, as bone decays rapidly in the dry, acidic, mostly sandy soils. This means that a find of even one or just a few pieces of bone, as in Milheeze and Westelbeers (both province of Noord-Brabant), is very informative (Rensink / Deeben / Stapert 1996). This is especially the case if, as at Doetinchem-Dichteren (province of Gelderland), thousands of fragments of bone are found, several dozens of which could be identified (Johansen et al. 2000). The same applies to the Wierden-Enterse Akkers HS site (province of Overijssel), where several hundred pieces of faunal material were found, some of which could be identified (Deeben / Lauwerier 2004; Deeben et al. 2006). One of the peculiarities of the sites mentioned is that burnt



Fig. 1 Location of the sites: **1** Wierden, province of Overijssel. – **2** Doetinchem, province of Gelderland. – **3** Milheeze, province of Noord-Brabant. – **4** Bakel, province of Noord-Brabant. – **5** Westelbeers, province of Noord-Brabant. – (Map M. Haars).

bone has been recovered, which is by far more resistant than unburnt material. For example, in Doetinchem the thousands of small, entirely burnt fragments were found in a hearth and a spot that can possibly be interpreted as a dump from a hearth. Due to the fact that reports on the sites were only available in Dutch and incompletely published, the archaeozoological information was largely inaccessible to our international colleagues. This paper is intended to complete the situation of information.

One of the reasons for studying the bone assemblages from these sites was to select bone material for radiocarbon research. Until then, it had been difficult to obtain reliable dates for the *Federmesser* occupation in the Netherlands because the association between the charcoal used for dating and the artefacts was not evident (Lanting / Mook 1977). For example, charcoal at *Federmesser* sites may originate from the top (A horizon) of the »Usselo soil« that formed during the Allerød Interstadial; but could equally be the result of bioturbation, charcoal from younger or older sediments or more recent occupations; or it could originate from forest fires. One decade ago, developments in dating techniques made radiocarbon dating of calcined bone possible (Aerts-Bijma et al. 1999; Lanting / Brindley 2000; Lanting / Niekus / Stapert 2002; Naysmith et al. 2007; Olsen et al. 2008). The archaeologically well-dated bones from Doetinchem provided an opportunity to test this technique. More generally, the heavily fragmented burnt bone material from sites that were studied in the past was examined again considering the new dating possibilities (e.g. Deeben / Dijkstra / van Gisbergen 2000).

The archaeozoological aim of the bone research was to obtain knowledge about activities of the people who lived at these sites in the past, as well as the environment they exploited. The following questions were to be addressed in connection with the latter aspect:

- Which animals were hunted and consumed as food?
- What were the environmental conditions? Alongside studies of the geological situation and analyses of the small amount of charcoal that has been found at some sites, research on the bones could contribute to a reconstruction of the landscape of the area occupied and exploited by the users of the sites.
- Does the distribution and nature of the bone fragments at Doetinchem and Wierden give information about the use of the settlement area? For example, are there any differences between the supposed fireplace, the dumping zone and the rest of the area at Doetinchem, and if so, what do they signify?
- Are there indications for butchering and the use of hides, tendons or other animal products, or does the material rather indicate the use of bone or antler tools?

We were also keen to discover which formation processes – specific to this type of context – are of importance for the interpretation of faunal material. For example, what is the impact of burning on the determination of bone material?

Although calcined bone from the Ahrensburg culture has been dated and determined at species level (Deeben / Dijkstra / van Gisbergen 2000), this paper only studies calcined bone material from *Federmesser* sites. All the burnt bone has been found at sites with backed blades and backed points and dated to a period (ca. 11,800-10,800 BP or ca. 13,800-12,700 cal BP, calibration with CalPal according to Danzeglocke et al. 2010) in which evidence of the *Federmesser* tradition can be expected in the Netherlands. As already mentioned, the beginning and end of the *Federmesser* occupation remain unclear, due to the lack of an unambiguous chronological framework (Deeben / Arts 2005, 142).

In the following section the archaeological context and dating of the analysed sites will be presented. The section on »material and method« lists the type of material analysed from each findspot and the method both of collection and of examination in the lab. The results from each site are then presented, and the above questions addressed.

site and sample	lab. no.	date BP	cal BP 68% range	dated material	reference
Doetichem-Dichteren 8	GrA-13387	10,880 ± 50	12,760 – 12,924	calcined mammal bone	Aerts-Bijma et al. 1999
Doetichem-Dichteren	GrA-13388	10,930 ± 50	12,782 – 12,958	calcined mammal bone	Johansen et al. 2000
Doetichem-Dichteren	GrA-13868	10,870 ± 50	12,755 – 12,920	charcoal	Johansen et al. 2000
Wierden/Enterse Akkers HS-1	GrA-23973	10,720 ± 60	12,651 – 12,749	calcined mammal bone	Deeben et al. 2006
Wierden/Enterse Akkers HS-1	GrA-24847	10,690 ± 50	12,631 – 12,737	calcined mammal bone	Deeben et al. 2006
Wierden/Enterse Akkers HS-2	GrA-23987	10,020 ± 70	11,370 – 11,727	calcined fish bone	Deeben et al. 2006
Wierden/Enterse Akkers HS-3	GrA-23937	10,350 ± 60	12,076 – 12,466	charcoal <i>Pinus</i>	Deeben et al. 2006
Wierden/Enterse Akkers HS-3	GrA-24580	10,610 ± 60	12,448 – 12,693	charcoal <i>Pinus</i>	Deeben et al. 2006
Wierden/Enterse Akkers HS-3	GrA-25906	11,070 ± 60	12,854 – 13,067	charcoal <i>Pinus</i>	Deeben et al. 2006
Milheeze/HP/1988(-1)	GrN-16508	10,810 ± 60	12,715 – 12,861	charcoal	Lanting / v. d. Plicht 1995/1996
Milheeze/HP/1988(-2)	GrN-16509	11,445 ± 35	13,243 – 13,481	gyttja	Lanting / v. d. Plicht 1995/1996
Milheeze II	GrN-2318	8,500 ± 160	9,307 – 9,697	charcoal	Lanting / Mook 1977
Milheeze/Hutseberg	GrN-2314	10,880 ± 125	12,740 – 12,977	charcoal	Lanting / v. d. Plicht 1995/1996
Milheeze I-1960	GrA-23908	11,150 ± 60	12,929 – 13,183	calcined mammal bone	unpublished
Westelbeers-ZW B	GrA-20207	11,510 ± 60	13,291 – 13,530	calcined mammal bone	Deeben / Rensink 2005
Westelbeers-NO 226-115	GrA-32787	11,030 ± 45	12,828 – 13,033	calcined mammal bone	unpublished

Table 1 Available ¹⁴C-dates from the Doetinchem, Wierden, Milheeze and Westelbeers sites. Calibrated using the CalPal-2007 online program (Danzeglocke / Jöris / Weninger 2010).

SITES, CONTEXTS AND DATING

Doetinchem-Dichteren

In 1994, during road-construction in the new Dichteren housing development in the town of Doetinchem (province of Gelderland), amateur archaeologists discovered features from prehistoric times. The subsequent field research first revealed features from the Iron Age, but at a lower level a Late Palaeolithic camp came to light. The latter was recognised as belonging to the *Federmesser* tradition. The site is indicated as Doetinchem-Dichteren; its coordinates are 215.900/440.855 (*Rijksdriehoeksmeting* coordinates, national triangulation system) (Hulst / Krauwer 1995, 79; van de Graaf / van Tuijl 1994; Niekus / Stapert / Johansen 1998).

The identification of the site as belonging to the *Federmesser* tradition was based on the typology of the lithic artefacts. Additional radiocarbon results with a mean value of 10,893 BP and those of archaeobotanical research date the site to the last part of the Allerød Interstadial (Johansen et al. 2000), around 12,850 cal BP (table 1). In this period the more moderate climate had changed the former tundra to a landscape dominated by birch and pine. The site is situated in the stream valley of the Oude IJssel river and is located on a low, somewhat loamy sandy ridge west of one of the channels of the river system (Scholte Lubberink 1997). Roughly half the settlement has been excavated; the other half had already been removed

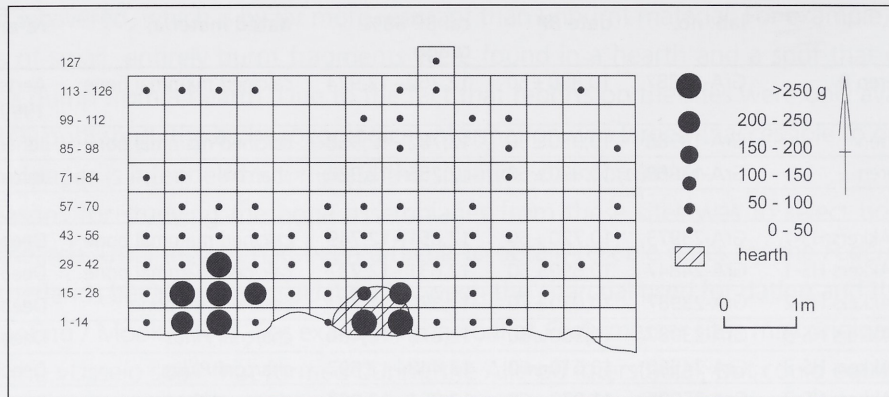


Fig. 2 Doetinchem-Dichteren. Spatial distribution of the faunal material expressed in weight (g). The excavation squares and feature 58, the hearth, are indicated. The numbers of the squares are given on the left axis, and read from left to right. – (Map M. Haars; after Johansen et al. 2000).

with a dragline, resulting in the discovery of the site. On the edge of the excavation area, which measured four by 7 m, half a hearth was present, as is evident from a semicircular patch of red-coloured soil (Niekus / Stapert / Johansen 1998). Within this red zone, approximately 1 m in diameter, thousands of entirely burnt bone fragments were found (fig. 2). A further concentration of burnt bone was present about 2 m west of the hearth. This spot, where there was no red discoloration of the soil, can be interpreted as a dump.

Wierden-Enterse Akkers HS

During the excavation of a Roman settlement in the municipality of Wierden (province of Overijssel) in 2002 the research agency and consultancy BAAC found a *Federmesser* site. The Late Palaeolithic site is indicated as Wierden-Enterse Akkers HS; its coordinates are 236.050/479.720 (Hulst 2004; Deeben / Lauwerier 2004; Deeben et al. 2006).

The excavated area is located on the north-eastern edge of one of a series of north-south oriented ice-pushed ridges that formed during the Saalian. Later, parts of the ice-pushed ridges were covered by coversand. The *Federmesser* site is located on a coversand ridge that is bordered to the west by an ice-pushed ridge and to the east, at a distance of 50 to 100 m, by a low-lying plain that was part of the river valley of the Regge (de Bakker 1979).

The *Federmesser* site was found in the coversand beneath a plaggensoil. During the Holocene a xeropodzol soil developed in the coversand; the podzol was partly disturbed by man during reclamation of the landscape and the laying of the thick plaggensoil (de Bakker / Schelling 1966, 199). Due to these activities, some 30 cm of the original xeropodzol has disappeared. The *Federmesser* finds were found in the lower part of the B horizon and in the C horizon.

The *Federmesser* site has been only partially excavated. The finds were recovered by shovelling, excavating the Roman soil features and by sieving the sediment in squares of 50 by 50 cm. Most of the finds were located in the 10 cm directly beneath the plaggensoil, indicating that part (probably some 20 cm) of the site was lost due to land reclamation. As well as 44.2 g of cremated bone, 1002 pieces of worked flint, 100 fragments of other material, mostly quartzite and sandstone, and 7.5 g of charcoal were also found. The several hundred fragments of bone were found in one cluster (fig. 3).

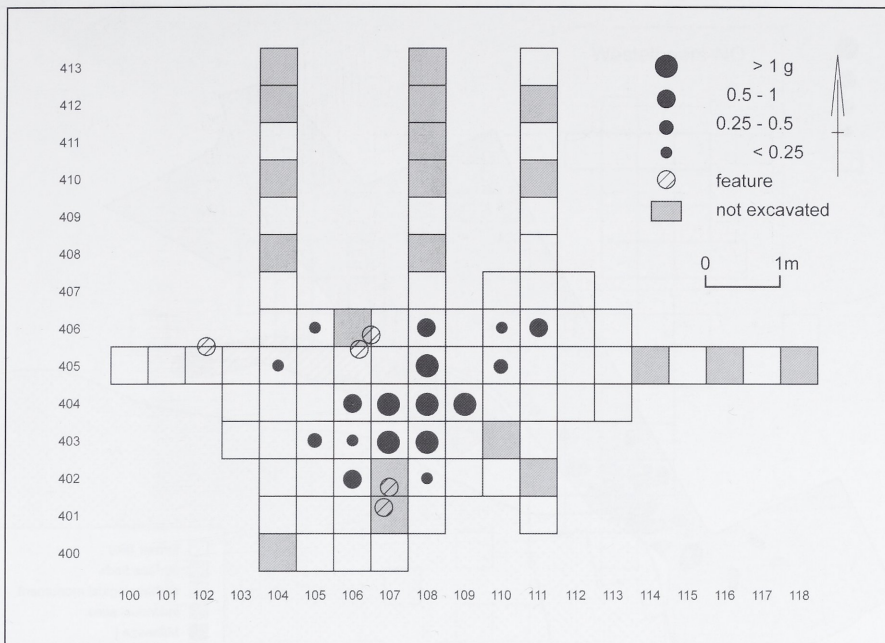


Fig. 3 Wierden-Enterse Akkers. Spatial distribution of the faunal material expressed in weight (g). Square numbers are indicated on the x- and y-axes. – (Map M. Haars; after Deeben / Lauwerier 2003).

The site was dated by cremated mammal bone, fishbone and charcoal of *Pinus* (table 1). The samples used for dating were all found close together in squares 107-405, 108-403, 108-404, and 108-405. The ^{14}C dates cover a remarkably long timespan of approx. 1412 calendar or 1050 ^{14}C -years (10,020 \pm 70 BP or 11,549 \pm 178 cal BP and 11,070 \pm 60 BP or ca. 12,961 + 106 calBP) covering the transition from the Allerød Interstadial (ca. 11,800-10,800 BP or ca. 13,800-12,700 calBP) to the Late Dryas stadial (ca. 10,800-10,150 BP or ca. 12,700-11,820 cal BP), and the first part of the Preboreal (ca. 10,150-9,500/9,400 BP or ca. 11,820-10,740/10,630 calBP). The ages for the ecological periods are derived from Lanting and van der Plicht (1995/1996, 84) and the calibration from CalPal (Danzeglocke / Jöriss / Weninger 2010).

Milheeze I and Bakel-De Rips

Prehistoric sites on a coversand ridge eroded by cart tracks in the municipality of Gemert-Bakel (province of Noord-Brabant) were already known to 19th-century farmers looking for flint artefacts for their tinderboxes. As yet some 35 sites have been identified by excavation, fieldwalking and coring over an area of approx. 1,500 by 100 m. This zone is located west and north of a depression that formed a lake measuring about 1.7 km (east-west) by 1 km (north-south) in the Late Glacial and Early Holocene (fig. 4). The stratigraphical information associated with the archaeological remains, palaeobotanical analysis and ^{14}C dates suggest that the *Federmesser* hunter-fisher-gatherers returned frequently to this coversand ridge along the lake (Bos / Janssen 1996).

The first archaeological excavations of the Milheeze sites were carried out in the period 1958-1960 by what is now the Groningen Institute of Archaeology (GIA) (Bohmers 1960a; 1960b). The findspot covers an area of several thousand square metres and consists of various incompletely demarcated sites that were partially excavated. The excavations were carried out on the coversand ridge and an adjacent depression filled with



Fig. 4 Location of the Milheeze I and Bakel-De Rips sites along a former Late-Glacial lake. – (Map M. Haars).

gyttja and peat. On the coversand ridge at least two find layers could be dated to the Mesolithic (Milheeze II) and to the *Federmesser* tradition (Milheeze I). On the top of the ridge the find layers were separated vertically by an empty zone of approx. 45 cm, whereas downslope in the direction of the depression the layers were intermingled. The *Federmesser* finds were discovered in the yellow coversand, and were present just under, in and above a bleached horizon, known as the Usselo soil, typically containing a high amount of charcoal. The Mesolithic artefacts were recovered from the higher-lying Holocene xeropodzol (Arts 1988, 342). Towards the low-lying depression the Usselo soil transforms into a layer of gyttja, in which pieces of burnt bone, about 10,000 stone artefacts and several pieces of worked wood were found (Bohmers 1960a; 1960b; Arts 1988). Although Rozoy (1978) and Arts (1988) made an initial attempt, the finds and their spatial distribution have never been studied in depth. In this study the site is indicated as Milheeze I; its coordinates are 185.300/391.930.

In 1988 parts of the 1958/1960 excavations at Milheeze I were reassumed by the second author and samples were taken for palaeobotanical research. The samples were taken from several spots in the depression now filled with organic sediments, and also near the shore where the *Federmesser* site was found. The palynological analysis showed that over a period of approx. 500 ^{14}C -years the vegetation alternated four times between open vegetation and an open *Pinus* wood (Bos / Janssen 1996). The *Federmesser* hunter-fisher-gatherers probably reoccupied/returned to the place several times, and would remove the *Pinus* trees during every stay in order to make space for a settlement and produce firewood. Every time the place was abandoned the *Pinus* woodland was able to recover.

The Mesolithic occupation has been dated by just one sample of charcoal to $8,500 \pm 160$ BP or $9,502 \pm 195$ calBP (table 1). The ^{14}C -dating of the *Federmesser* occupation is based on cremated bone: $11,150 \pm 60$ BP or $13,056 \pm 127$ calBP. Two charcoal dates, $10,810 \pm 60$ or $12,788 \pm 73$ calBP and $10,880 \pm 125$ BP or

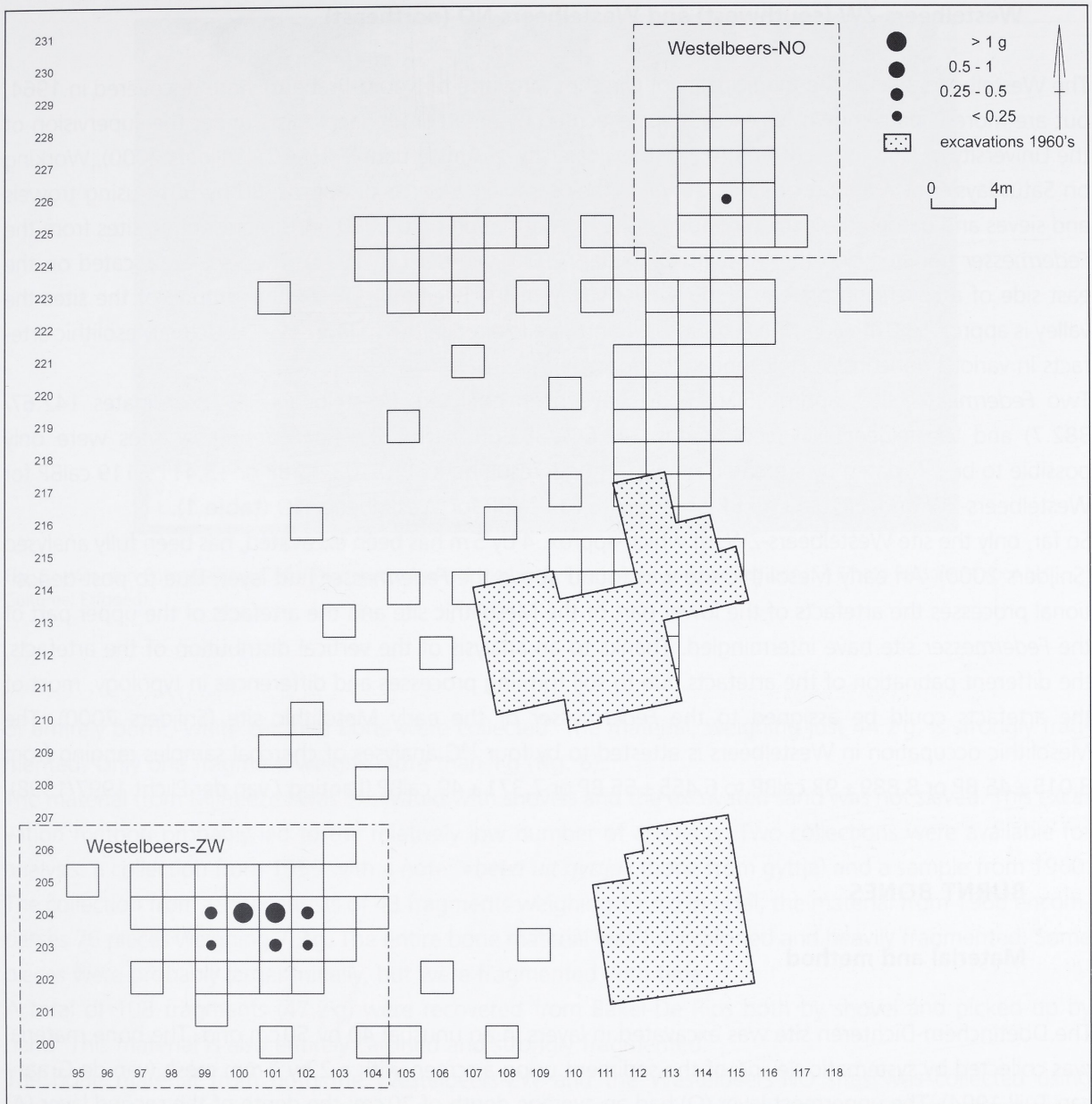


Fig. 5 Westelbeers. Spatial distribution of the faunal material at the Westelbeers-NO and Westelbeers-ZW sites expressed in weight (g). Square numbers are indicated on the x- and y-axes. – (Map M. Haars).

12,859 ± 118 calBP, are problematic because the artefacts were found in an Usselo soil, so that it is not clear whether the dates refer to the Usselo soil, the *Federmesser* occupation or both. Artefacts were also found beneath a layer of gyttja that has been dated to 11,455 ± 35 BP or 13,372 ± 120 calBP. This date is a *terminus ante quem*.

In 1968 a site located 100m southeast of Milheeze I was excavated (Heesters / Wouters 1970). This site, called Bakel-De Rips, covers an area of approx. 12 × 16 m; the coordinates are 185.190/391.845. The *Federmesser* artefacts were found in Usselo soil and up to 20 cm below this soil. Apart from stone artefacts the site also contained fragments of burnt bone. On typological and stratigraphical grounds the findspot has been dated as a site in the *Federmesser* tradition occupied during the Allerød Interstadial.

Westelbeers-ZW (southwest) and Westelbeers-NO (northeast)

The Westelbeers sites in the municipality of Oirschot (province of Noord-Brabant) were discovered in 1964, but are more widely known for excavations executed by amateur archaeologists under the supervision of the University of Groningen (BAI/GIA) and the University of Amsterdam (IPP/AAC) (Snijders 2000). Working on Saturdays over a period of some 25 years they sampled an area of approx. 60 by 50 m using trowels and sieves and gathered mostly three-dimensional information on 60,000 finds representing sites from the *Federmesser* tradition and the Mesolithic (Snijders 2000; van der Lee 1998). The sites are located on the east side of a coversand plateau along a river valley of the Beerze brook. At the latitude of the sites the valley is approx. 750 m wide. The *Federmesser* finds are located in the yellow coversand, the Mesolithic artefacts in various horizons of Holocene xeropodzol.

Two *Federmesser* sites approx. 50 m apart have been analysed: Westelbeers-ZW (coordinates 142.67/382.7) and Westelbeers-NO (coordinates 142.640/382.650) (fig. 5). The *Federmesser* sites were only possible to be ^{14}C -dated by cremated mammal bone, resulting in $11,510 \pm 60$ BP or $13,411 \pm 119$ calBP for Westelbeers-ZW and $11,030 \pm 45$ BP or $12,931 \pm 102$ calBP for Westelbeers-NO (table 1).

So far, only the site Westelbeers-ZW, of which approx. 4 by 5 m has been excavated, has been fully analysed (Snijders 2000). An early Mesolithic site was found above the *Federmesser* find layer. Due to post-depositional processes the artefacts of the lower part of the Mesolithic site and the artefacts of the upper part of the *Federmesser* site have intermingled. Thanks to an analysis of the vertical distribution of the artefacts, the different patination of the artefacts due to soil forming processes and differences in typology, most of the artefacts could be assigned to the *Federmesser* or the early Mesolithic site (Snijders 2000). The Mesolithic occupation in Westelbeers is attested to by four ^{14}C analyses of charcoal samples ranging from $8,015 \pm 45$ BP or $8,889 \pm 93$ calBP to $6,455 \pm 55$ BP or $7,371 \pm 49$ calBP (Lanting / van der Plicht 1997/1998).

BURNT BONES

Material and method

The Doetinchem-Dichteren site was excavated in layers in an unusual 40 by 50 cm grid. The bone material was collected by systematic sieving of the sediment using a screen with a 2 by 2 mm mesh (van de Graaf / van Tuijl 1994). The uppermost layer (O) had an average depth of 20 cm; the depth of the second layer (A) varied between 5 and 25 cm. The thickness of the third layer (B) was not determined during this excavation. As a result of this vagueness, the data from the different layers were combined during the processing of results. Where the *Federmesser* hearth was part of a square, the finds were collected separately inside and outside of this feature. This concerns only the squares 6, 8, 21 and 22. Square 7 is situated completely inside the hearth. Apart from the finds from the squares, which are indicated by their square number, some bones are indicated otherwise, for example as »stray finds«.

Many thousands of fragments were retrieved from the Doetinchem site, all of them entirely calcined and white in colour. The bones were categorised into two fractions for each collecting unit: bone measuring between 2 and 10 mm, and those larger than 10 mm. This was accomplished by sieving the material again at the laboratory using a screen with a mesh size of 10 mm. The material from each entity was weighed and the fragments from the »>10mm« fraction were also counted. Weights were rounded off to 0.2 g.

The Wierden-Enterse Akkers HS site was investigated using a 50 by 50 cm grid. The squares were excavated in layers of 5 cm, and the sediment sieved using a screen with a 2 by 2 mm mesh. A total of 270 fragments

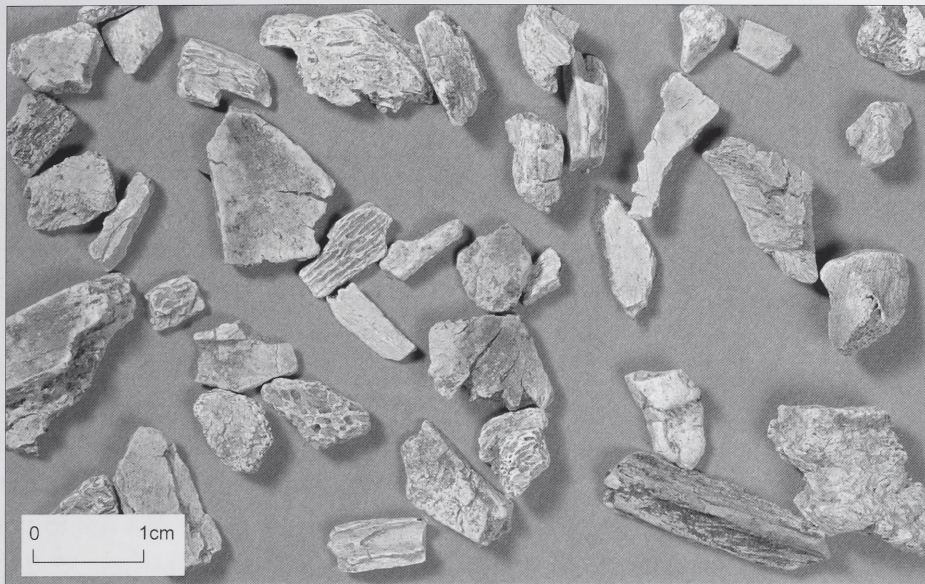


Fig. 6 Wierden-Enterse Akkers. Representative picture of the highly fragmented and calcined bone. – (Photo Rijksdienst voor het Cultureel Erfgoed).

of entirely burnt, white calcined bone were collected. The material, weighing just 44.2 g, is strongly fragmented. Only one fragment weighs more than 1 g (fig. 6).

The material from Milheeze I was excavated with shovels and the excavated sand was not sieved. This excavation method probably led to the relatively low number of artefacts. Two collections were available for analysis: a collection from 1959 with a note: »been uit gyttja« (bone from gyttja) and a sample from 1960. The collection from 1959 consists of 43 fragments weighing 11.4 g in total; the material from 1960 encompasses 76 pieces weighing 7.3 g. The entire bone material was fully calcined and heavily fragmented. Some pieces were probably larger initially, but were fragmented with time.

A total of 108 fragments (47.2 g) were recovered from Bakel-De Rips both by shovel and picked up by hand. This material is also entirely calcined and strongly fragmented.

The bone material from both the Westelbeers-ZW and the Westelbeers-NO sites was collected using trowels, and the finds were plotted three-dimensionally on a 2 by 2 m grid. The excavated sediment was sieved through a 2 mm mesh. 75 fragments were found at the ZW site. One possibly mammal fragment (4.5 g) was separated for radiocarbon dating. The other 74 fragments in total weigh 5.3 g. From the NO site one fragment (1.0 g) was subject of radiocarbon dating.

Several pieces of burnt bone were also found at two spots in the area between the two sites, squares 214/107 and 217/113: Five fragments with a total weight of less than 0.1 g. Given the insufficient investigation on the lithic material, the context of this material is unclear, and it will not be given any further consideration in this presentation.

The material from the sites was tested for identifiable fragments and then identified using the reference collection of the Cultural Heritage Agency (Rijksdienst voor het Cultureel Erfgoed [RCE]). Our colleague Frits Laarman was a great help during this analysis. Particularly fish-remains were analysed under the binocular microscope. The analysis of the highly fragmented and calcined bones focused not only on identifiable material but also on traces of gnawing, butchering or other processing. Considering possible future research elsewhere, the maximum measurement was taken from the identifiable bones to obtain an insight

	Doetinchem	Wierden	Milheeze I	Bakel	Westelbeers ZW	Westelbeers NO
recovering method						
	sieve 2 mm	sieve 2 mm	shovel	shovel	sieve 2 mm	sieve 2 mm
Mammals						
– Perissodactyla horse (<i>Equus</i> sp.)	4	–	–	–	–	–
– Artiodactyla elk (<i>Alces alces</i>)	2	–	–	–	–	–
cervids (Cervidae)	7	–	1?	–	–	–
wild boar (<i>Sus scrofa</i>)	2?	1?	–	–	–	–
– Lagomorpha hare (<i>Lepus</i> sp.)	2	–	–	–	–	–
– Rodentia beaver (<i>Castor fiber</i>)	–	–	–	–	–	1
– mammal indet.						
large	X	–	X	X	X	–
medium	X	–	X	X	X	–
indet.	X	X	X	X	X	–
Fish						
– Osteichthyes						
– pike (<i>Esox lucius</i>)	5	8	1	–	–	–
– salmonids – Salmonidae, cf. <i>Salmo</i>	1	–	–	–	–	–
– cyprinids (Cyprinidae)	4	–	–	–	–	–
indet.	10	–	–	–	–	–
Total	thousands	270	43	108	75	1

Table 2 *Federmesser* bone material identified at species or larger taxonomic group level (number of specimens). – ? probably, X present.

into the dimensions of this material. Bones that would later be destroyed for ^{14}C analysis were photographed first.

RESULTS

Doetinchem-Dichteren

In total many thousands of bone fragments, weighing all together 3 to 4 kg, were recovered and analysed. Most of them originate from two clusters. An overview of the bone-distribution is given in Fig. 2.

The material is highly fragmented. Counts were performed on the finds from square 7, in the middle of the hearth. At a rough estimate, this square contained more than 4500 fragments of burnt bone. Of these, only 54 pieces are larger than 10 mm. A very small proportion of the bones could be identified. Table 2, which presents an overview of the material, shows that a mere 37 fragments from the whole site could be identified at either species or group level. Even the fraction of bones measuring more than 10 mm consists of small fragments. Almost all of them weigh between 0.5 and 2 g. None of the identifiable fragments was bigger than 3 cm; most of them measure less than 1 cm.

Of the identified material, three fragments of horse bone – a piece of a metatarsus (level-square 0-2) and two fitting pieces of a peripheral metapodium (0-17) – could be identified immediately. The possible deter-

mination of a humerus (IA-7) as being from a horse (*Equus* sp.) is based on the fine structure of the interior of the bone. The identifications of two complete or almost complete bones from elk (*Alces alces*), an os malleolare (B-31) and a phalanx II (O-2), are certain. The antler fragments originate from a cervid the size of an elk or red deer but the pieces could not be determined at species level. Three of these (O-3) are fitting fragments, the others originate from level-square O-3. A piece of the corpus of a rib (O-7) and a fragment of skull (O-31), from the occipitale, could be almost certainly be identified as wild boar (*Sus scrofa*). The fragments of hare, a proximal part of a metatarsus (O-17) and an almost complete astragalus (find number »midden«), caused fewer problems. These were clearly recognisable as *Lepus*. Given the dating of the finds, this must be brown hare (*Lepus europaeus*). The elements identified as large mammal are a fragment of a mandibula (O-7), a complete caudal vertebra (O-8), a piece of a metatarsus (O-22) and three fragments of unknown elements (O-3).

Five pieces of fish remains could be identified at species level as pike (*Esox lucius*). An os dentale, a vertebra and two teeth originate from one same spot: level-square O-17; a third tooth was found in B-92. From the other fragments of fish – all vertebrae – one (O-3) could be allocated to the larger group of salmonids and four (O-3 [2x]; B-92; »schaafvondst«) to cyprinids. The other – indeterminable – fish vertebrae originate from level-squares O-3, O-6, O-16, O-17 (4x), O-18, O-22 and B-92.

The pike whose caudal vertebra was found must have had more or less the same dimensions as one of the specimens from the reference collection of the Rijksdienst voor het Cultureel Erfgoed – almost 60 cm long and weighting 1400 g.

Neither cut marks nor traces of gnawing were recognised. The shape of five pieces of bone possibly indicates that they were worked on.

Wierden-Enterse Akkers HS

In total 270 fragments have been subject to archaeozoological analysis. The spatial distribution of these remains is represented in **figure 3**. The identification of nine fragments (3%) was possible. Eight are from pike (*Esox lucius*). A dental was found in each of the layers 0-5 cm and 15-20 cm of square 108-405. Square 108-404 contained two dentals in layer 10-15 cm, one in layer 15-20 cm, and a quadratum in layer 5-10 cm. Square 107-404, layer 20-25 cm contained two dentals. The only identified mammal bone (square 107-403, layer 0-5 cm) is possibly a fragment of a canine of a wild boar (cf. *Sus scrofa*). Apart from the complete calcination of these identified bones, neither cut marks nor other contemporaneous modifications of the bone were found.

Milheeze I

The collection of burnt bone from 1959 consisted of 43 fragments with a total weight of 11.4 g. Six (7.6 g) of these were larger than 10 mm (max. 27.1 mm). The other 37 fragments weighed only 3.8 g. Some of the bone is encrusted with sediment, though this is less firmly adhered to the surface than in the 1960 sample. The bone does not appear to be white calcined, the surface having taken on the yellow-brown colour of the sediment. One single fragment could be identified at species level, as a fragment of a left dental from a pike (*Esox lucius*) which has been described previously (Rensink / Deeben / Stapert 1996, 189). The five other fragments from the fraction larger than 10 mm are all from long bones of mammals: one from a large mammal, the others from medium-sized mammals. One of the latter may be a fragment of the metapode of a cervid. The 2-10 mm fragments are all from mammals, seventeen of them medium-sized. The other fragments are from so far not further specifiable mammals.

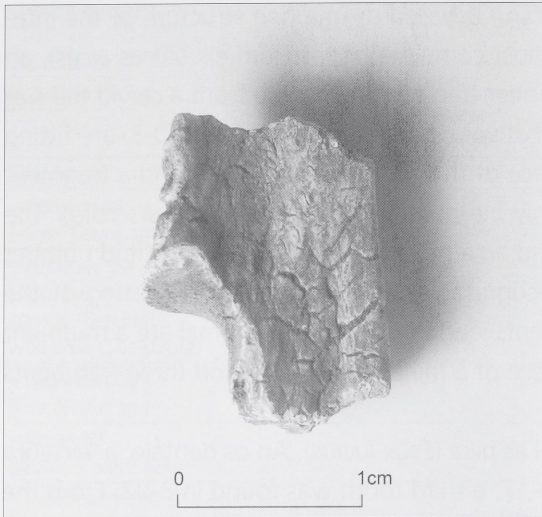


Fig. 7 Westelbeers-NO. Fragment of a beaver (*Castor fiber*) ulna. – (Photo Rijksdienst voor het Cultureel Erfgoed).

maximum length of 31.5 mm, eight were between 20 and 30 mm, and nine between 10 and 20 mm. The remaining 90 fragments (18.6 g) belong to the 2-10 mm fraction. Some of the fragments may even have been larger at the excavation date, but can have disintegrated over the past half century. All remains are from mammals, but none could be identified at species level. Both large and medium-sized mammals are represented.

Westelbeers-ZW

All the bone from Westelbeers-ZW is white and calcined (fig. 5). A small amount of sand is encrusted on most of the fragments. However, there is no sand adhering to the material from squares 203/099, 203/102, 204/100 and some of the bone from square 203/101. All the bone belongs to the 2-10 mm fraction, apart from two fragments: One of them is 20.8 mm long. The other, a piece of mammal bone weighing 4.5 g, had been retrieved for radiocarbon dating. The other 74 fragments all together weigh a mere 5.3 g.

All these remains originate from mammals, which can be shown to include both large and medium-sized animals. Only one fragment – a piece of long bone with a craquelured surface – gave an indication of species, as it bears a strong resemblance to human bone. Our colleague F. J. Laarman came to the same conclusion. It should be noted here that a bone that could clearly be identified as a beaver's had a similar appearance (see below, Westelbeers-NO). The unidentified bone was therefore sent to the Institute for Geo- and Bioarchaeology at Vrije Universiteit Amsterdam for histological species determination (Cuijpers 2009). It was determined that the structure is laminar fibro-lamellar bone. A radial pattern of canals was also observed (more or less radial fibro-lamellar). These two types of bone do not occur in human diaphyses (Cuijpers 2009). In conclusion the bone was therefore identified as a fragment from an animal (Cuijpers 2010).

Westelbeers-NO

Only one fragment is known from this context: a proximal epiphyses fragment of beaver (*Castor fiber*) ulna weighing 0.1 g, retrieved from square 226-115 and subject of radiocarbon dating (fig. 7).

A total of 7.3 g of calcined bone fragments (n = 76) has been analysed from the other collection, Milheeze 1960. Four were larger than 10 mm (max. 22.9 mm), the others (3.8 g) ranged between 2 and 10 mm. A significant part of the weight is not due to the bone but to a layer of ferriferous soil that adheres to it. All remains are from mammals, including two large mammals, none of which could be identified at species level.

Bakel-De Rips

As noted by Heesters and Wouters (1970, 18), the calcined bones from Bakel-De Rips were partly or almost completely encapsulated in ferriferous soil. As a consequence, most of the weight of these fragments (47.2 g) is due to the adhering soil. Of 108 fragments in total, 18 (28.6 g) were larger than 10 mm. The largest had a

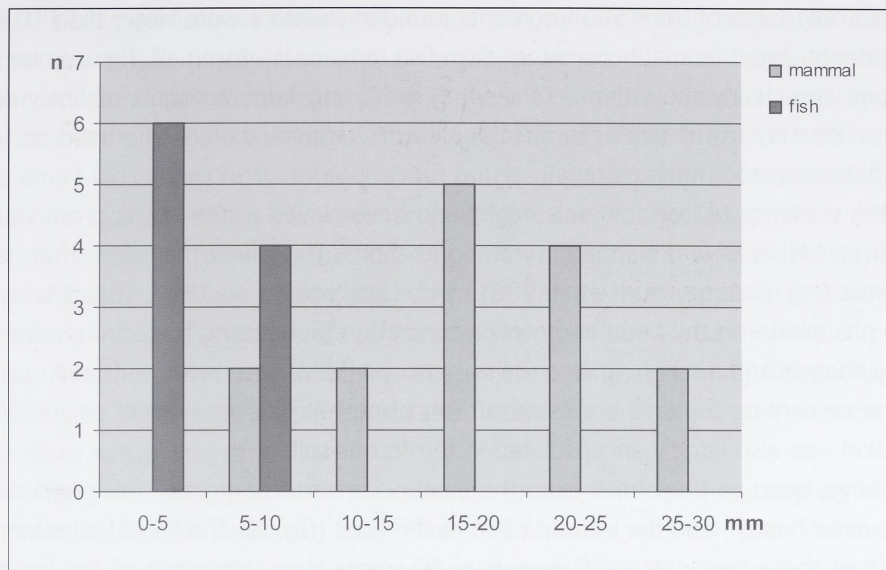


Fig. 8 Size of the fragments of mammals and fish that could be identified at species or wider taxonomic group level.

DISCUSSION

Fragmentation and distribution

In contrast to the conditions in the Tjonger valley in the northern Netherlands (Prummel 2001), the coversand in which the finds from the sites discussed here were situated provides a poor environment for the preservation of bone, being slightly loamy or loam-poor in character. If there was any unburnt bone present in the past, it will have deteriorated completely by now. Bone could only survive at these spots because it was entirely calcined (cremated). Although the bone was affected by fire, causing fragmentation, cracking and flaking, the heat also made it more resistant to deterioration. One reason for this is that the organic part (mostly collagen) has been burnt away, leaving only the calcic skeleton (bone mineral), which is not an attractive food source for micro-organisms (Huisman et al. 2009). Furthermore, the mineral part of the bone changes due to rechrystallisation, adding to its resistance. Only the bone that was thrown either deliberately or accidentally into the fire of the past had a chance of surviving. Due to this selection in prehistoric times and the small proportion of the highly fragmented material that was identifiable at element or species level, we have only a very limited and unrepresentative picture of the fauna exploited, used and consumed in the settlements.

The material from Wierden is an illuminating illustration for the selective effect that fragmentation has on the identifiability of the bone fragments. Although by far the majority of the fragments are from mammals, mainly fish remains could be recognised and identified at species level. The details of the bones of larger animal species, like horses or cervids, are generally too coarse to be recognisable. The fragments only show a fraction of the detail needed to determine the species. When it comes to smaller species, like fish, small mammals and birds, there is a greater chance that the remaining fragments still have the detail necessary for identification. The data from Doetinchem are also illustrative. **Figure 8** gives an overview of the size of the fragments from Doetinchem that could be identified at species or larger taxonomic group level. Only two of the identifiable mammal bones are smaller than 10 mm, whereas all the fish bones fall in this range.

If we consider that only 1.2% of the 4500 fragments found in square 7 were larger than 10 mm, the likelihood of finding identifiable mammal bone rather than fish remains is very small. The numbers and sizes of the identified bone also clearly show that, in the sandy area, only large amounts of finely-sieved material can provide information about the fauna. Sampling only with a trowel, the actual practice at Milheeze I and Bakel, probably disregards too much material.

In some cases, the presence of iron minerals might also have played a role in the preservation of animal bone. The find from Milheeze was trapped in iron concretions. This phenomenon is often seen on material from sandy soils (e.g. Groenewoudt et al. 2001, 343; Lauwerier et al. 1999, 161). Metals such as iron and manganese precipitate on the bone and form a concretion. Submitting bone from a Mesolithic site at Zutphen to X-ray analysis and a scanning electron microscope (SEM) gave proof to that it was impregnated with iron and the cementing material consisted of iron phosphate (Groenewoudt et al. 2001, 343). The material from Bakel was also largely encapsulated in ferriferous soil.

As mentioned above, most of the bones from the Doetinchem site originated from two concentrations, the partially recovered hearth, and the »dump« 2 m to the west (fig. 2). The identified material originated almost entirely from these two clusters. Only square 92, more than 2 m north of the hearth, contained identifiable fragments. Bearing in mind that the »dump« contained more material than the hearth, the data do not indicate differences in composition between the two concentrations. Nor do the two fractions – the light fragments (<10 mm) and the heavier fragments (>10 mm) – differ. This observation reinforces the idea proposed by Niekus / Stapert / Johansen (1998) that material from the hearth was dumped several metres to the west. From ethnoarchaeological research it is known that it is usual to clean up parts of a settlement (Murray 1980; Stevenson 1991). Examples include fireplaces within the living space and reused fireplaces, e.g. upon reoccupation. In the case of Doetinchem this could mean that material was dumped just outside a tent. If so, the similarity in composition of hearth and dump would be expected.

Immediately outside the clusters bone was found in very small amounts in each square. There was no decrease in the quantity of burnt bone relatable to the distance to the concentrations. A scattering of small amounts of animal remains was present up to 1-1.5 m from the hearth and the dump, followed by an area without bones, and finally another scattering of small quantities of material located to the north. The distribution map suggests that on the empty strip the surface was covered at the time the material was disposed of, or that it was cleaned up afterwards. The occurrence of burnt bone north of the empty strip might also indicate the presence of a second hearth further to the north, outside the excavated area. In this northern part only square 92 yielded identifiable material. It is striking that all three fragments from that spot originate from fish: pike and cyprinid. This could represent one occasion or activity in the past when fish was prepared and eaten.

The bones from Wierden were almost exclusively found in the central part of the site (fig. 3). Most of the burnt bone (15.3 g) was found in square 108-404, this being the square where four pike fragments were found, while the other identified elements of the same species were in two adjacent squares (107-404 and 108-405). If the data from burnt finds (burnt bone, burnt stones and charcoal) are combined, the picture of a fireplace located in and around square 108-404 emerges. This might have been a surface hearth with a diameter of 1 to 1.5 m (Deeben et al. 2006).

Hunting, fishing and consumption

Assuming that the animals found were eaten at the spot, the diet of the people who used the camp at Doetinchem consisted at least of the meat and fat of elk, horse, probably wild boar, and hare, supplemented with pike and other freshwater fish. The large number of small fragments delivering such a small

quantity of identifiable material gave the impression that the material mostly originated from bones of large or medium-sized mammals. Small fragments of small mammals such as hares, martens and beavers normally have more identification characteristics than those of larger mammals. If larger quantities of these small animals had been present in the material, one would expect more of them to be recognised.

There were no direct indications of slaughtering and butchering in the form of traces of chopping, cutting and scraping on the bones, as seen on an elk scapula from the Tjonger valley which has been dated as *Federmesser* (Prummel 2001). However, the finds of primary slaughtering refuse – bones not bearing meat – suggest that the Doetinchem site was a camp where the catch was slaughtered. It is notable that – with the exception of one humerus – the five identifiable fragments of horse and elk were all pieces of primary slaughter refuse. This indicates that the site was at any rate used as a hunting camp. Besides the reasons mentioned above, the high degree of fragmentation could have been caused to some extent by the smashing of bone to extract marrow.

In addition to hunting the occupiers of this site collected food by fishing. They caught pike, salmonids and fish of the carp family. Pike, in particular, could have been hunted with fish spears such as those known from other Palaeolithic and Mesolithic settlements (Brinkhuizen 1983, 31), just as well as with other fishing techniques.

The *Federmesser* people who used the Wierden site fished for pike and hunted mammals, possibly including wild boar. Assuming that these animals were consumed on the site they fed among other things on the meat and fat of mainly larger mammals, and on fish. The blood of the mammals and the marrow from their smashed bones might also have been used as food. The inhabitants of Millheeze I also fished for pike and hunted mammals, probably including wild boar. The people of Westelbeers additionally ate beaver.

Possible artefacts

Three bone fragments and two pieces of antler from the Doetinchem site, all from square 3, might indicate the use of bone and antler for the production of tools, for example as part of a harpoon for the hunt or for preparing hides. Our determinations could not identify the rounded-off fragments of bone as naturally formed parts of skeletal elements. The rounded-off shapes give the impression that they were artificially made, though this is not certain. The two fragments of antler each show one smooth side, possibly manufactured by man. However, a natural cause such as breaking cannot be ruled out. More generally, and depending on which species the remains represent, the hides, tendons, bone, antler and teeth of mammals at all sites could have been used as raw material for making clothes and tools.

Environment

Assuming that the animals found in Doetinchem were hunted or caught in the surrounding area, they give a picture of a fairly diverse environment. The possible presence of wild boar would indicate woodland. This might have been deciduous forest, mixed forest or coniferous forest with dense undergrowth, or wetter alder-carr wood- and marshland. The elk is indicative of wetland areas and prefers a varied landscape consisting of woods, grassland, marshes and open water. The horse tends to another environment again, with wide open areas. The natural habitat of the brown hare is the open steppe landscape (Angermann / Thenius 1973, 493). In wooded areas it prefers boscages, borders and open areas in the forest and river valleys. It cannot be found in totally contiguous woodland. The mean annual temperature in its habitat must be above 8°C. The finds of pike indicate gently flowing or stagnant water with abundant riverbank vegetation.

In conclusion, the animal presence proved at Doetinchem indicate an environment that is characterised by a certain variation in woodland, open areas and water. Clearly, forestation was in progress whereas open areas persisted. The study of charcoal particles established the presence of at least pine (*Pinus sylvestris*) and willow (*Salix*) (Johansen et al. 2000).

Due to the lack of information on species at the other sites, we can say little about the environment there. It is however clear that, given the presence of pike, there must have been gently flowing water in the vicinity of Wierden and Milheeze. For Milheeze we know that the sites were located along the borders of a lake (fig. 4). The vegetation in this upland area can be described as relatively open betula forest in a matrix of steppe plants (van Leeuwarden / Janssen 1987). The beaver find at Westelbeers suggests a wetland environment (Coles 2006), as found in the valley of the Beerze river that borders the settlement area. The same environment would also be suitable for the elk found in the northern Netherlands (Prummel 2001).

The composition of the Dutch bone material is reminiscent of the Rhineland, and differs from that found in Northern Germany/Southern Scandinavia, where reindeer and giant deer lived, the latter suggesting an open landscape (Baales 2002, 28-31). Also from Koblenz-Metternich a giant deer is known. The ¹⁴C-dating at the time of the eruption of the Laacher See, however, is uncertain (Baales 2002, 27). The fossil forests beneath the pumice in the Neuwieder Basin and the pollen analyses in the Netherlands indicate birch and pine forest (Hoek 1997). The presence of Usselo soils at various higher spots in the landscape and peat formation in depressions suggests a relatively stable environment, at least for part of the period that *Federmesser* hunter-fisher-gatherers were in the Netherlands. One striking point is the probable presence of wild boar at Doetinchem and Wierden, as at the »Plinius site« at Tongeren, Belgium (Bink 2007). This contrasts with the sites from the Neuwieder Basin, where wild boar has been found only sporadically. The fact that the sites are several centuries apart and date from just before the eruption of the Laacher See volcano (about 11,100 ¹⁴C BP) might have some bearing on this.

CONCLUSION

The discovery of sites with cremated animal bone in recent years and the re-evaluation of sites excavated in the period 1950-1970, combined with technology that allows cremated bone to be used to date Late Palaeolithic sites, has led to more information about the use of animals by the hunter-fisher-gatherers of the *Federmesser* tradition in the area that is now the Netherlands. Although the results of dating cremated bone from *Federmesser* sites are promising, there are also a number of anomalies, such as the dating of calcined bones from the *Federmesser* site at Andernach and Kettig, which are generally either too young or too old compared to the unburnt bones (Baales 2002; Kegler 2002; Lanting / Niekus / Stapert 2002). Van Strydonck points to problems with post depositional processes of the calcined bones, especially concerning relatively old and small samples (Van Strydonck et al. 2005).

In spite of the minimal opportunity for identification and the unknown degree of representativeness, the results do add new information to the history of this era. This is the first time that this kind of information has become available in the Netherlands from Late Palaeolithic sites characterised by poor preservation conditions.

The bone assemblages from the coversand area consist of totally calcined and highly fragmented burnt bone. It has been shown that these complexes do not give a representative picture of the fauna originally present and used at the sites. Mainly smaller animal species could be identified in fragmented material. In turn, the larger the skeletal elements, the more difficult they are to determine. This also explains why a rela-

tively large amount of fish was found at the sites investigated. Whether this implies anything of the importance of fish in comparison to mammals for the *Federmesser* inhabitants therefore cannot certainly be said. The very poor identifiability of the fragmented material also means that only by sieving large quantities of material through a fine-meshed sieve can we retrieve archaeozoological information.

At Doetinchem the burnt bone mainly originated from the hearth and the dump. The faunal composition of these two features does not show significant differences. This reinforces the suggestion that material from the hearth was deposited at the dump site. We cannot exclude the possibility that this material comes from another hearth just outside the excavated area. In Wierden, too, the animal remains, combined with the other find material, suggests a nearby hearth.

Findings of primary slaughter refuse, in particular, give the impression that the site at Doetinchem was used as a camp where the catch was slaughtered. Most of the consumption may have taken place elsewhere. The catch included horse, elk, hare and probably wild boar. Fishing yielded pike, salmonids and carp. At least the people at Wierden fished for pike and hunted mammals, possibly including wild boar. Also at the other sites, remains of mammal-hunting have been found. Beaver were at any rate hunted at Westelbeers, and in Milheeze cervids were probably also hunted. Other than the meat and fat of these animals, their blood and bone marrow might also have been consumed. However, the archaeozoological material does not indicate this.

Some fragments from Doetinchem give the impression that bone and antler were used to make tools. Naturally, we can expect that bone, antler, hides and tendons were used at all sites to produce objects, clothing, tents and the like. Cervids like the elk, in particular, would have been important for their hides, and beavers for their fur.

Based on the animal remains found the exploited environment of the sites seems to have been quite varied, consisting of woodland alternating with open areas and gently flowing or stagnant water. This differs from the more open landscape populated by giant deer and reindeer at that time in Northern Germany/Southern Scandinavia. The environment in which the *Federmesser* hunter-fisher-gatherers lived appears to have more closely resembled that in which their *Federmesser* counterparts in the Rhineland lived. Interesting, however, is the more important role the wild boar seems to play in the area of present-day Belgium and the Netherlands.

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Verbrannte Tierreste von *Federmesser*-Fundplätzen der Niederlande

Untersuchungen an einigen spätpaläolithischen *Federmesser*-Fundplätzen (besonders Doetinchem und Wierden) aus der niederländischen Sandregion haben erstmals größere Mengen verbrannter Tierknochen ergeben. Trotz der geringen Identifizierbarkeit der zumeist gänzlich weiß calcinierten kleinen Tierreste und der offenen Frage ihrer Repräsentativität haben die hier vorgestellten Ergebnisse doch größere Relevanz für unsere Region. Demnach nutzten die Menschen der *Federmesser*-Gruppen Elch, Pferd, Wildschwein, Hase, Biber und verschiedene Fische (Hecht, Lachs, Karpfen). Belege für primäre Zerlegungsreste aus Doetinchem zeigen, dass dieser Platz der Zerlegung von Säugern und Fischen diene. Einige Knochen- und wenige Geweihreste könnten auf ihre artifizielle Zurichtung verweisen. Insgesamt erlauben die Tierreste die Rekonstruktion einer weitgehend geschlossenen Bewaldung mit größeren offenen Flächen sowie stehender bzw. schwach fließender Gewässer zur allerødzeitlichen Besiedlung der Region. M. Baales

Burnt animal remains from *Federmesser* sites in the Netherlands

During excavations at sites such as Doetinchem and Wierden assemblages of burnt animal remains from Late Palaeolithic camps belonging to the *Federmesser* tradition have been recovered, the first time that considerable amounts of burnt bone have been found in the sandy area of the Netherlands. In spite of the very limited possibilities for identification and the uncertain degree of representativeness, this study of very fragmented material turned out to be of great significance due to its rarity and informational value. The diet of the *Federmesser* people certainly included the meat and fat of elk, horse, wild boar, hare, beaver, pike, salmonids and carp. Finds of primary slaughter refuse at Doetinchem show that the site was a camp where the catch of mammals and fish was slaughtered. Bone and antler may have been used for tools. The animal remains found suggest that the environment consisted of woods, alternated by open areas and stagnant or moderately flowing water.

Les restes fauniques brûlés de gisements à *Federmesser* aux Pays-Bas

Les recherches menées sur quelques sites à *Federmesser* du Paléolithique final (notamment Doetinchem et Wierden), dans la région sableuse des Pays-Bas, ont livré pour la première fois de grandes quantités d'ossements animaux calcinés. Malgré les difficultés d'identification de restes animaux de petite taille et calcinés à blanc, et en dépit de leur degré de représentativité inconnu, les résultats présentés ici ont une grande incidence pour notre région. Le régime alimentaire de ces groupes à *Federmesser* était ainsi constitué d'élans, de chevaux, de sangliers, de lièvres, de castors et de différents poissons (brochet, saumon, carpe). Les indices de découpe primaire à Doetinchem montrent que ce lieu servait à l'abattage de mammifères et de poissons. Certains restes osseux et quelques restes d'andouillers ont pu être utilisés en tant qu'outils. Dans l'ensemble, les restes fauniques permettent de restituer un enboisement étendu, alternant avec de grandes aires ouvertes et des cours d'eau stagnants ou à faible débit, dans le contexte de l'occupation de l'Allerød dans la région. L. B.

Schlüsselwörter / Keywords / Mots clés

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