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SCHIPLUIDEN

A NEOLITHIC SETTLEMENT ON THE DUTCH NORTH SEA COAST *c.* 3500 CAL BC

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AND PETER F.B. JONGSTE

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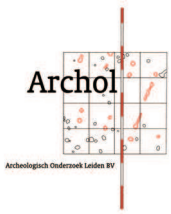

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Contents

4 The archaeological remains: a critical spatial approach

Milco Wansleeben
Leendert Louwe Kooijmans

To what part of the archaeological remains that survived in the soil do our analyses and distribution maps relate? To what extent was the research target of total find recovery of all remains larger than 2 cm realised? How do the remains collected by hand and those recovered from the sieve relate to one another? What factors determine the spatial patterns of the different categories of remains and can any original activity areas still be identified, in spite of the preservation, erosion and recovery biases?

This chapter presents the results of a critical approach to the material basis of the research, and a spatial analysis based on the visualisation of large-scale patterns obtained via a moving average analysis of the primary data.

4.1 Introduction and objectives

The focus of this chapter and the ultimate objective of this investigation is to obtain an understanding of the settlement's original size and spatial differentiation, and of its continuity and/or discontinuity throughout the period of occupation based on the assumption that the distribution of the artefacts in relation to the features provides insight into the organisation and size of the local community.

The analysis is based on a critical approach to the representativeness of the primary data in the form of an assessment of the recovery processes. Two more factors that have to be assessed are the extent to which the recorded spatial patterns were determined not by occupation, but by natural processes, and the degree in which the original patterns – to be interpreted as specific activity areas – are still visible.

In addition to the horizontal patterns, the stratigraphy in the southeastern peripheral zone of the site also yields information that can be used in arriving at a chronological differentiation of the use of space, *i.e.* the dynamic character (or absence of such a character) of the local group.

The general spatial patterns of the different find categories presented here ultimately also yield a spatial context for the specialist analyses in the following chapters.

4.2 A critical analysis of the dataset and the recovery processes

The aim of the excavation of any find scatter is usually total find recovery. Sometimes the excavation method is specifically geared to that aim, comprising meticulous trowelling or systematic sieving through a specific mesh width. Usually, the collection method will however depend on the working methods and accuracy and available time, and the recovered remains will in terms of composition and distribution represent only a proportion of what had actually survived in the soil. We are well aware of this factor, but often tend to ignore or trivialise its implications.

4.2.1 Find collection

At Schipluiden it was decided to collect the remains by hand, partly in view of the site's size and the available capacity and partly on account of vulnerability considerations (use-wear traces, fragile bones). But we also set up a partial sieving programme to check the accuracy of our work. This programme comprised sieving the soil that was excavated (and had already been searched through) from a limited number of 1-metre broad strips running across the dune. So in these strips the aim of total find recovery was realised: all remains larger than the 4 mm mesh width were recovered. On the basis of the remains recovered from these 'sieved strips' statements can be made on the accuracy of the manual collection method, the quantity and composition of the remains that were not recovered and the representativeness of ratios and patterns in the analysis of the recovered remains. It is even possible – and in some cases advisable – to extrapolate the data of such sieve residues to the entire excavation for the purpose of correcting the ratios of manually collected remains. See for example the beads in chapter 9. Such correction is of course not feasible in the case of spatial patterns.

4.2.2 Manually collected remains

The data available for the spatial analysis consist primarily of the remains that were collected by hand from the different layers. The layers concerned were excavated in segments of 1 × 1 metre and per lithological unit, following the geological stratification. Each find unit had a maximum thickness of 10 cm. There where a lithological unit was found to be thicker, a new level was defined after 10 cm, which was assigned the same layer code as that of the level above it.

In the field each layer was assigned a four-digit code to distinguish the layers from the features. The layer codes comprise a prefix (20, 40, 60, 80) referring to one of the four sides of the dune and a suffix referring to the layer concerned (10, 11, 17, 18, 19 or 20) (see section 2.1). Below, only the suffixes will be used in referring to the various lithological units.

The find-collection method involved shovelling the soil by hand. In the design it was assumed that this would already lead to the recovery of all finds larger than 2 cm, providing that the work would be done by skilled field workers, in this case students in archaeology.

The collected remains were during the fieldwork sorted according to find category, counted and weighed. The resulting dataset was used in the analyses discussed in this chapter. It was found that some of the finds had been incorrectly categorised, in spite of the field workers' dedicated efforts. It is difficult to assess the impact of those errors on the identifications, but they seem to have had only little influence on the general distribution maps.

The finds were too numerous for the specialists to process them all. They therefore coded only a selection of the total number, employing for each category a lower limit based on the finds' informative value. In the case of pottery, for example, only sherds weighing more than 10 grams were coded. The lower limit chosen for stone artefacts was 2 grams, that for flint was 'modification' and that for zoological remains 'the possibility of identification to species level'. The distribution maps of the material specialists hence provide selective impressions. The 'field data' is actually the only source that can be used to obtain an overall picture of the spatial distribution of the finds.

The employed basic find-registration method enabled us to draw detailed distribution maps per find category (in numbers and weights) for the individual excavation levels and the individual lithological Units, or combined for all the manually collected remains from certain layers or all layers together.

4.2.3 The sieved strips

A sieving programme was carried out to check the accuracy of the manual collection method. The soil from a strip with a width of one metre in the 6 metre-broad trenches was sieved through a mesh width of 4 mm. In this way the effectiveness of the manual collection method was tested in a number of strips running transversely across the dune. It was assumed in advance that this sieving programme would ensure the recovery of all small artefacts (of 4 to 20 mm), but also any larger ones that had been overlooked during the shovelling.

The efficiency of this time-consuming sieving procedure was assessed already during the fieldwork by studying the results obtained for the first trenches. The data of transverse sections across the dune were visually compared by studying the number of finds collected by hand from the entire 6-m-broad trench in relation to the number of finds collected from the 1-m-broad 'sieved strip'. This comparison is here illustrated on the basis of the flint artefacts from trench 14 (fig. 4.1). The two distribution patterns across the dune prove to be very similar. So the sieving programme yielded little new spatial information. This meant that the excavation strategy could without objection be adapted halfway the fieldwork. Only the soil from the strips in each evenly numbered trench was sieved and no soil was sieved from the oddly numbered trenches, so that the available working capacity could be used elsewhere. The sieving programme can hence be regarded as a 1/12 systematic sample.

4.2.4 The composition of the finds

So before the work was started it was assumed that the manually collected remains, on which the distribution maps and the spatial analysis described below are based, would reliably represent the artefacts larger than 20 mm. In view of the employed collection method, smaller finds would not, or virtually not, end up in this dataset, but would exclusively be recovered via the sieving of the soil from the evenly numbered trenches. After the fieldwork, the correctness of this assumption was checked for the pottery and flint from the sieved strips in trenches 10 and 18. The length (largest measurement) of all the collected artefacts was determined and the size distributions were compared. This was done for the pottery by the first author and for the flint by Annelou van Gijn (see chapter 7).

Flint

The absolute numbers of manually collected flint artefacts are small, but they nevertheless clearly reveal a broad distribution, with a peak in the 12-14-mm fraction (fig. 4.2). The number of small flint artefacts, with lengths from approx. 8-12 mm upwards, is surprisingly high. The finds recovered from the sieve fractions also show a skewed distribution, with a narrow peak at 6-8 mm and a fairly steep decline in the larger sizes, to a maximum length of 36 mm. Relatively few large artefacts were encountered in the sieving, but in absolute numbers they nevertheless exceed the manually collected finds over a long trajectory. With increasing size, the proportion of manually collected finds gradually increases from 50% at approx. 22 mm to 100% at 36 mm.

A dilemma is that increasing the lower limit of the dimensions of the manually collected flint finds causes the distribution patterns of the numbers to become completer, and hence also more representative, but also emptier. For example, 70% of the flint artefacts of the fraction larger than 28 mm were collected by hand. The distribution pattern of these finds may be more reliable, but the number of finds

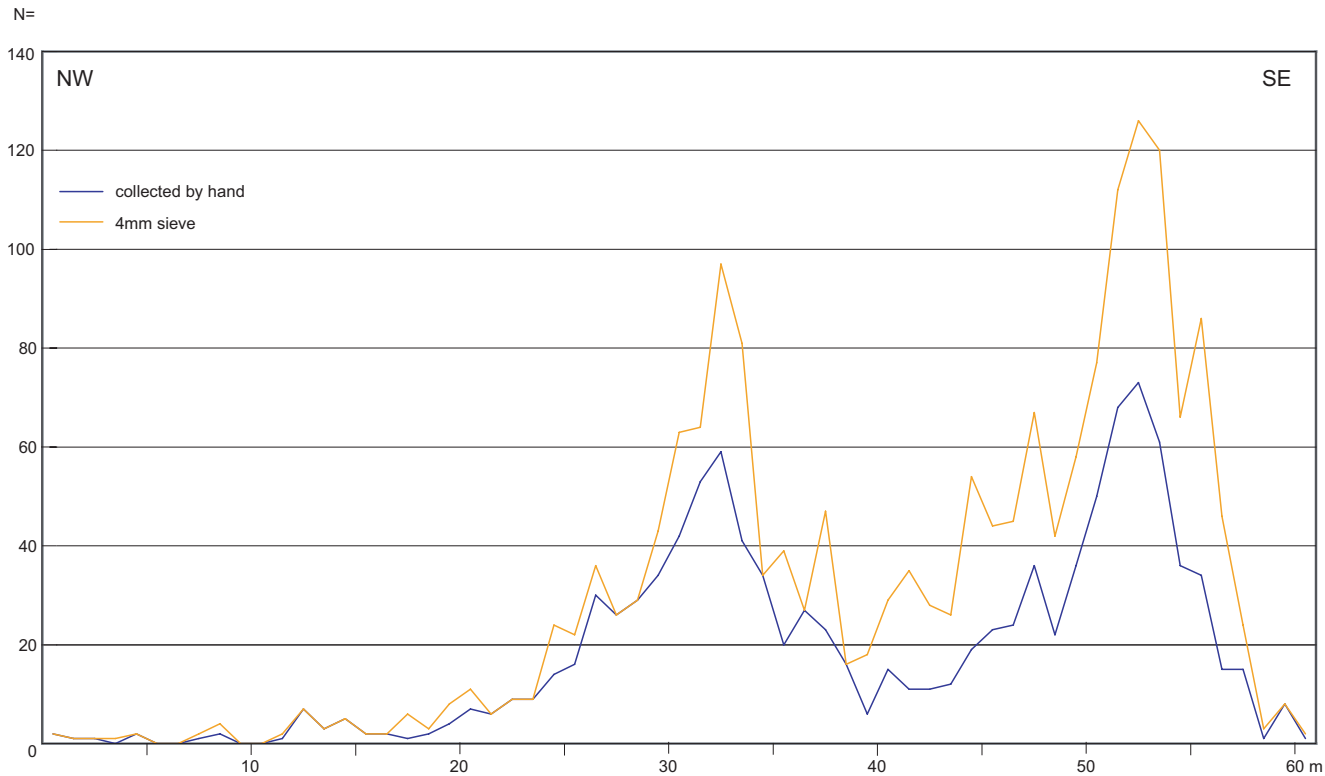

Figure 4.1 Flint, numbers collected by hand and by wet-sieving through a 4-mm mesh of the soil from a one-metre strip in trench 14 dug in a NW-SE section across the dune.

from trenches 10 and 18 is only 22. The majority of the manually collected flint artefacts in the general distribution maps (fig. 4.10) prove to belong not to the >20 mm fraction (as initially assumed), but to the 8-28 mm fraction. That is however also the fraction in which fairly large quantities of additional finds were encountered in the sieving.

Pottery

In the case of pottery the size determination was less reliable than in the case of flint artefacts, largely owing to (secondary) fracture and the poor identifiability of sherds of 2-6 mm. The diagrams should therefore be interpreted with some caution (fig. 4.3). The diagram obtained for the manually collected finds – again based on relatively small numbers – shows a wide range, representing sherds of 8-36 mm. That obtained for the much larger numbers of finds from the sieve residues shows a narrow peak at 4-10 mm, followed by a fairly gradual decrease to a maximum of 64 mm. In the case of pottery, too, the manually collected finds start to predominate only gradually with increasing size. Only in the fraction of sherds larger than 32 mm does the proportion of manually collected finds exceed 70%. The sherds in question, from trenches 10 and 18 together, are only 54 in total. Contrary to what had been assumed in the design, fairly large quantities of small sherds (from 4 mm upwards) were evidently collected during the shoveling. The distribution maps consequently display a substantial proportion of these small pottery sherds.

Maps showing exclusively flint artefacts larger than 28 mm or sherds larger than 32 mm would provide a more reliable picture of the artefacts' distribution. Such maps can however not be drawn on the basis of the field data because not all the individual artefacts were measured during the fieldwork. The distribution maps of the specialists illustrated in the chapters will fortunately bypass these limitations.

4.2.5 Conclusions

A number of conclusions can be drawn from the above comparison of the manually collected finds and the finds recovered from the 4-mm sieve residues.

First of all, the aim to collect all finds larger than the specified minimum of 2 cm by hand was not realised. This does not necessarily mean that the collection procedure was too coarse or too inaccurate; it simply shows us the actual

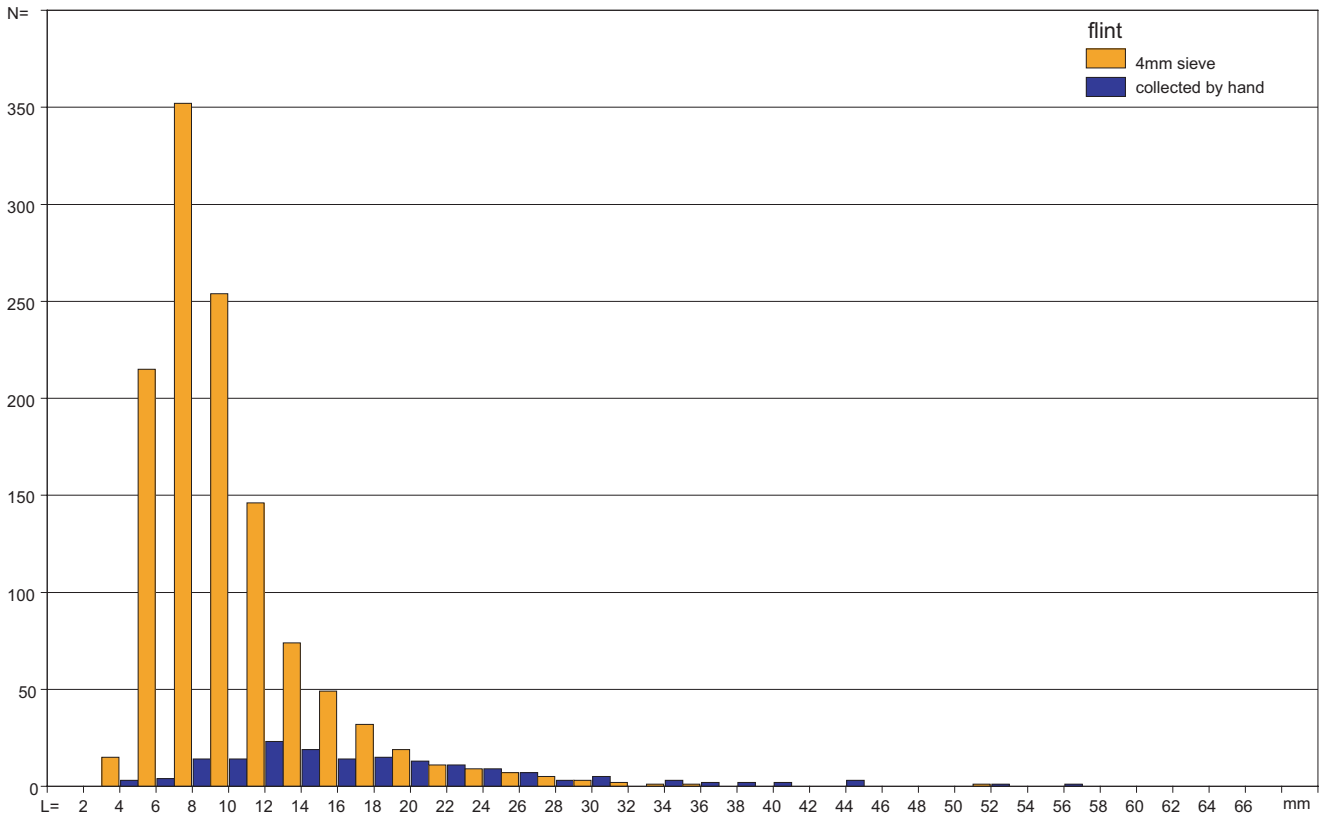

Figure 4.2 Flint, numbers per dimension class (lengths) in trenches 10 and 18. Remains collected by hand and recovered from the 4-mm sieve residues from the rows of segments.

result of the employed method, which has never before been evaluated in this manner. Under the practical conditions at Schipluiden, the lower limit for 'almost total' (approximately 70%) manual find recovery proved to lie not at 2 cm, but more around 3 cm in the case of both flint and pottery.

The second conclusion is that the manual collection with shovels did lead to the recovery of a large number of small finds, but the fraction decreased along with the dimensions. This is of course not surprising: in practice it is impossible to advise field workers/students not to collect such small finds, or to discard any such small finds once they have been collected because the fraction concerned will at a later stage be recovered by sieving. It is however clear that the finds comprise largely overlapping artefact populations rather than individual populations.

In the third place, total find recovery was realised for finds > 4 mm only in the 'sieved strips'. The area concerned covers approx. 8% (1/12) of the excavated area. By comparing the find ratios of this sample with those of the manually collected finds from the entire excavated area it is possible to estimate the actual numbers of finds. This is of course of particular interest in the case of categories of small artefacts such as beads (chapter 9) and certain types of flint artefacts (chapter 7).

The 'actual' ratios may differ substantially from the archaeologically recorded ones. This – needless to say – once again shows that adding up the finds recovered according to the two collection methods has sense only from an administrative viewpoint, not a scientific one.

All this has important consequences for the distribution maps per artefact category of the manually collected finds. Many of the finds illustrated in those maps come from an incompletely collected fraction. The smaller the finds, the less representative they are of the actual number of finds.

The employed collection method implied a systematic discrepancy between the artefacts that were still preserved in the soil in early 2002 (the sample population) and those actually included in the sample that are available for the spatial analysis. This recovery bias cannot be corrected, but it may be assumed to have more or less the same influence on almost all the distribution maps showing *numbers* of finds.

The manual collection of large quantities of small finds along with larger finds of course has a much greater effect on

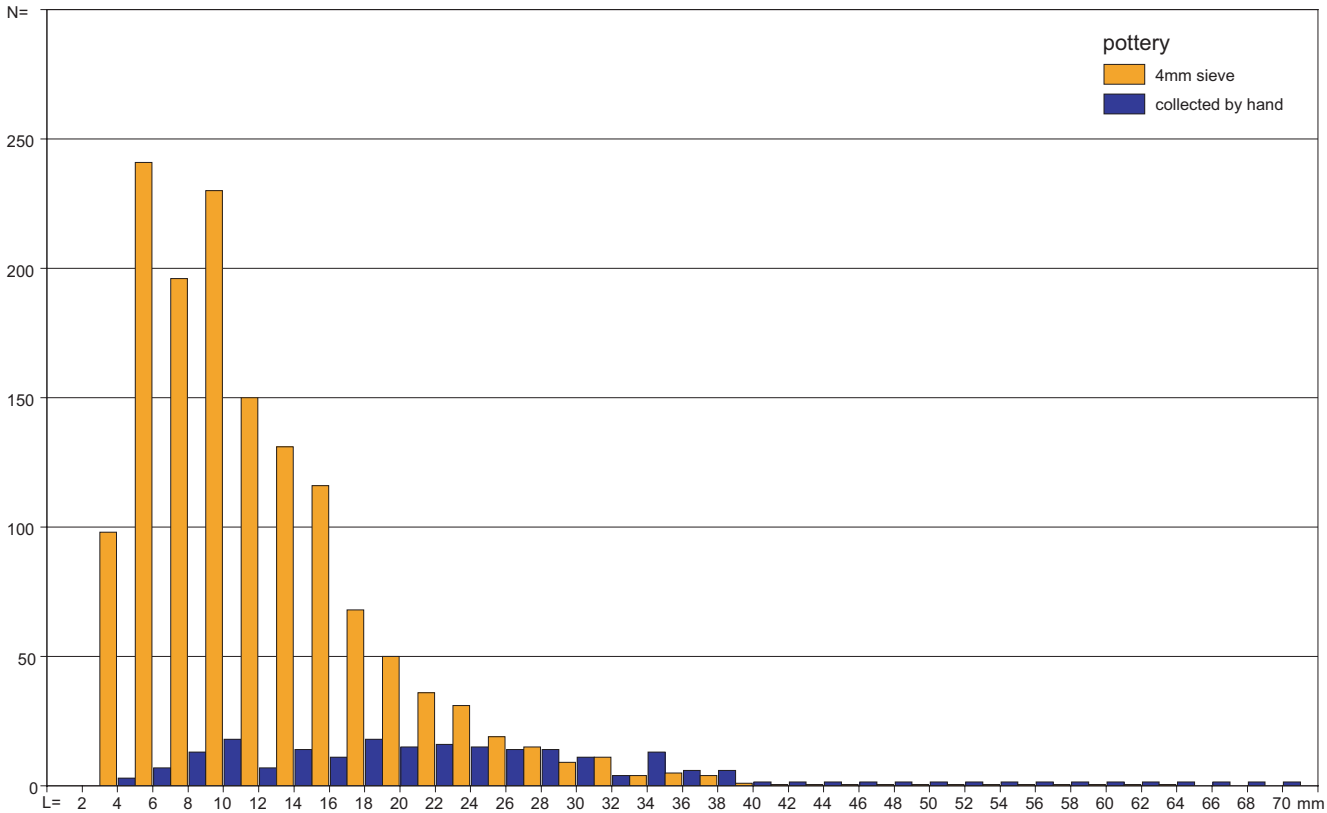

Figure 4.3 Pottery, numbers of sherds per dimension class in trenches 10 and 18. Remains collected by hand and recovered from the 4-mm sieve residues from the rows of segments.

distribution maps based on numbers of finds than on those based on the weights of finds per segment. In principle, the latter are hence more reliable and more representative than the former. In the case of Schipluiden, the two distribution maps of all the find categories are however very similar, implying that the large and small artefacts in each case occurred together, in the same find areas.

Local contrasts in the artefact density per m^2 will have been enhanced by personal differences in working accuracy. Such differences will however have only a limited influence on the larger patterns because a more or less equal percentage of the remains will in general have been overlooked, and the only effect is a weaker general picture. The ideal solution under these conditions is smoothing according to the moving average method.

4.3 Interfering geological processes

4.3.1 Zones of erosion and embedding, weathering and preservation

For a time span of several centuries, largely coinciding with the period of occupation, the dune was exposed and suffered the consequences of natural 'postdepositional' processes such as soil formation, bioturbation, trampling and colluviation, erosion and the deposition of sediments. Insofar as they affected the features, these processes have been described in detail in chapters 2 and 3. These processes, but to a great extent also (selective) weathering, played a tremendously important role in the formation of the find patterns, both during and after the period of occupation. Viewed from this perspective, the site has a concentric structure and five zones can be distinguished in the maps, which are closely associated with the dune's contours from high to low (fig. 4.4):

1) a zone at the top of the dune where the entire occupation level has disappeared due to erosion in much later times and the artefacts remaining on the dune and their distribution patterns were lost entirely;
2) a surrounding zone in which part of the occupation level has disappeared and the find densities are hence proportionally lower;
3) a zone in which the entire occupation level has survived, but where selective weathering and other postdepositional processes have been of dominant influence;

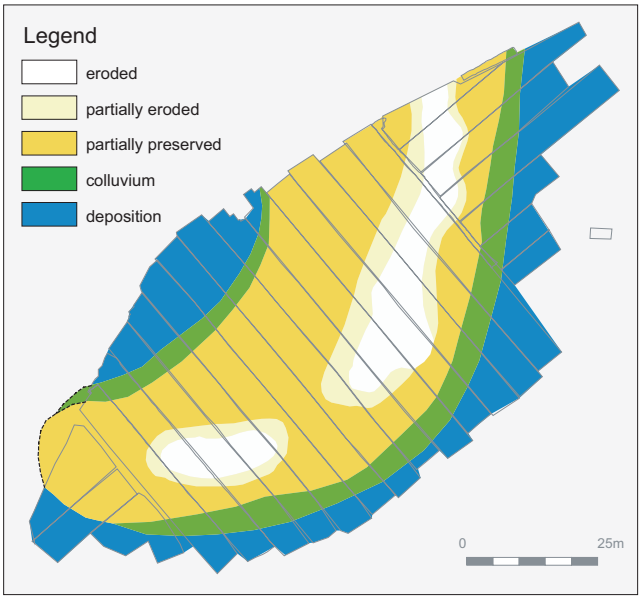

Figure 4.4 The five zones of preservation distinguished on the dune. In the 'partially preserved' zone the 'occupation layer' was not eroded, but organic remains were not, or poorly preserved.

4) a colluviation zone at the foot of the dune, where remains washed down from the dune accumulated and became mixed with primarily deposited remains. This zone has been affected by the aforementioned distortion processes to a limited extent;
5) a deposition zone in the surrounding aquatic deposits in which distribution patterns and the ratios of the different find categories have survived virtually unchanged.

The limits between these zones are naturally vague, but nevertheless quite useful, certainly as contexts for interpretations.

4.3.2 The features as a frame of reference

Like the archaeological remains, the features, too, reflect former activity areas. The features moreover present the advantage of not having been affected or moved by selective weathering, *etc*. It should however be added that all features that were shallower than 40 cm have disappeared due to the formation of the occupation level (Unit 20). By a stroke of luck, the erosion of the top of the dune however nowhere extended beyond the 'features level', so, in an entirely different form, the features – contrary to the find scatters – do provide a representative picture of activity areas high up the dune, and in particular also on top of it.

As we were particularly interested in the places where the standard domestic activities took place, we focused on the clusters of large postholes, which are assumed to represent house sites, as argued in chapter 3. The areas containing the large features (pit fills) we left out of consideration as the pits concerned show a more scattered distribution and we assume that they were (also) dug at the periphery of the occupation area and outside the farmyards. A smoothed local density analysis was then performed to visualise at a higher level of abstraction the concentration areas of postholes extending deeper than 20 cm beneath the excavation level and having a cross-section of >20 cm (fig. 4.5). This revealed four distinct clusters (A-D), the same as those that were already distinguished in a more impressionistic approach (section 3.8.3). The smaller clusters (E-K) did not come out in this analysis. For their further interpretation, in particular that of the divisions, we refer to the final conclusions (section 4.9).

These 'posthole areas' largely coincide with zones 1 and 2 distinguished above and partly extend into zone 3. Only the fringes of the find concentrations originally associated with those zones have survived, in particular the waste-disposal areas in zones 4 and 5.

These posthole clusters, representing primary activity areas and possible farmyards, will below be compared with the concentration areas observable in the find distributions, and will play a role in the interpretation of those distributions.

4.4 Method of spatial analysis

4.4.1 Spatial analysis techniques

In the spatial analysis efforts were made to visualise increases and decreases in the find densities as distinctly as possible, and to explain the patterns on the basis of the aforementioned formation processes: where do geological or research factors play a role in the final picture and where are there indications of different activity zones?

In the distribution maps, grouped classifications were used for both the counts and the weights of the finds. The quantities are represented by a limited number of colours, increasing in shade intensity. The classes were distinguished by a technique implemented as natural break in MapInfo with which the differentiation at low find densities was made more distinct than that at high find densities.

The moving average method was used to smooth the sometimes quite substantial differences between adjacent segments. These differences appeared to relate to differences in the accuracy of the excavators, local preservation and small-scale deposition patterns (<1 m), whereas our aim was to identify preservation zones and larger activity areas. With this technique the level of generalisation can be adjusted. For Schipluiden we decided to calculate a moving (unweighed) average of the counts and weights for segments measuring 3 × 3, 5 × 5 and 9 × 9 m. When such a template is enlarged, local details gradually give way to more general trends in distribution (figs. 4.6a-d). A disadvantage is that limits that were originally sharp and clearly defined become vague. But allowance can be made for this in the interpretation. The

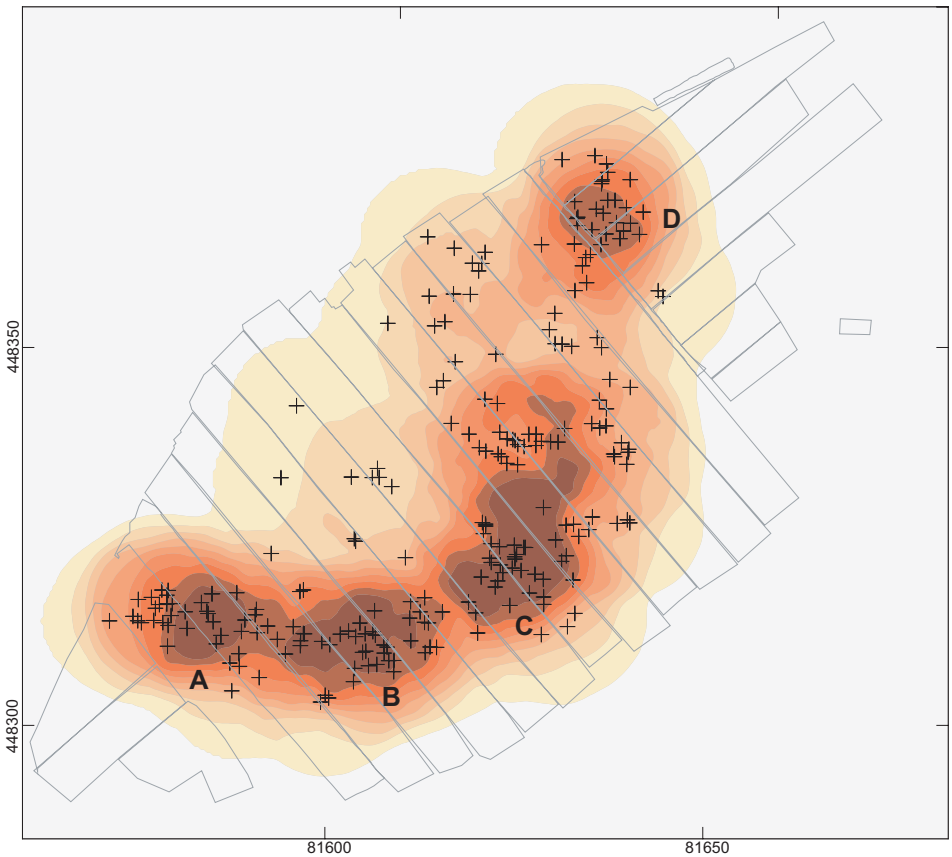

Figure 4.5 Smoothed results of local density analysis of postholes deeper than 20 cm with diameters >20 cm showing four distinct clusters A-D (scale 1:1000).

moving average technique was applied only to the three most important find categories, notably pottery, flint and bone. In the spatial analysis of Schipluiden different types of distribution maps were placed side by side to obtain a good visual impression of the relative find densities. The different visualisations complement one another.

4.4.2 Spatial analysis of stratigraphic sites

The Schipluiden site is a dune with remains stratigraphically embedded in (natural) deposits along its flanks. It was not possible to determine the chronological span of the remains with any greater accuracy than a few (two to three) centuries (chapter 2).

First the different lithological units and the number of levels in which they were excavated were visualised. It was found that finds had not been uniformly assigned to the different layers during the fieldwork. The assignment varied from trench to trench due to our advancing insight (during the excavation and the analysis) into the site's stratigraphy, local (geological) factors or unclear limits between individual layers or erroneous interpretations. Layer assignments that were evidently incorrect were corrected where possible before this analysis. Seven layers were ultimately identified in the spatial analysis (fig. 4.7). Unit 19N will be considered separately here due to its less clear stratigraphic assignment.

It was not easy to determine relations between the site's geological stratification and human activities (phasing) (see chapter 2). This can probably best be illustrated by the following example. Units 15/16 consist of a colluvium comprising deposits accumulated by aeolian action and rainwash that were affected by trampling. This colluvium was identifiable as a separate layer only above Units 17/18. It extended laterally into Unit 20. Colluviation will certainly have occurred in the area of Unit 20, too, but it was not identifiable as such in that Unit. Some of the finds recovered from Units 15/16 made their way into those units from higher layers. They may in principle therefore date from any time in the entire preceding period of occupation. So the finds cannot be indisputably dated to a specific phase. Some important units (Unit 20) span the entire period of occupation, whereas others (Units 15/16 and 11) to varying extents contain secondarily admixed older artefacts. The study of the pottery (section 6.5.2) incidentally showed that this factor was not that influential in practice, and it was

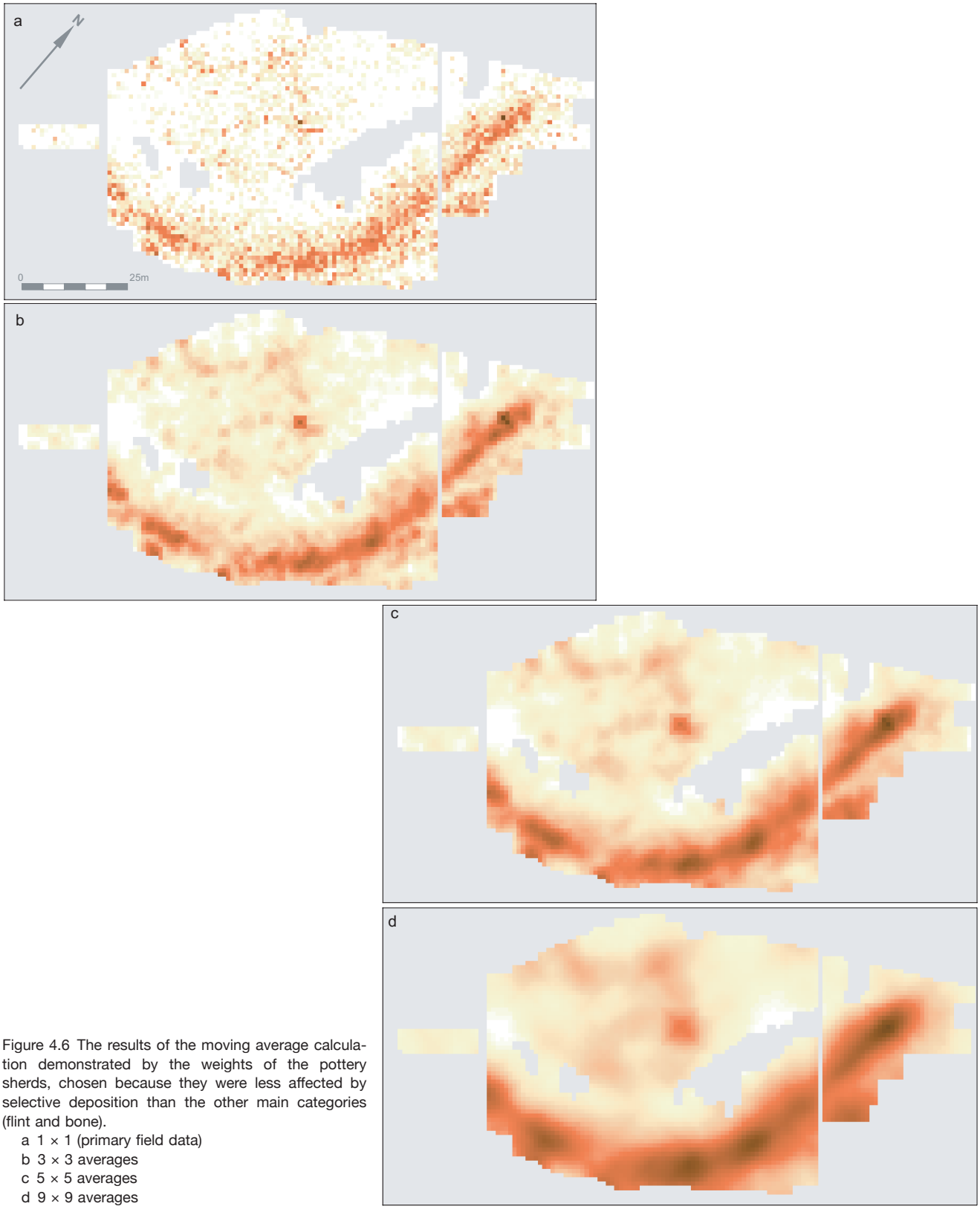

Figure 4.6 The results of the moving average calculation demonstrated by the weights of the pottery sherds, chosen because they were less affected by selective deposition than the other main categories (flint and bone).

a 1 × 1 (primary field data)
b 3 × 3 averages
c 5 × 5 averages
d 9 × 9 averages

therefore ignored in those analyses. Only remains from the southeastern side of the dune could be unambiguously phased on the basis of the local stratigraphic sequence of Units 19S, 17/18, 15/16 and 10/11.

In the spatial analysis of Schipluiden all the stratigraphic data were first of all combined and the outcomes were studied per find category. After that attempts were made to add a dynamic, diachronic component based on the phased distributions in the southeastern peripheral zone.

4.5 RESULTS

4.5.1 Layer thickness and erosion

The 'occupation layers', which had an overall depth of at most 50 cm, were excavated at a number of different levels. This number of levels (spits) can be used as an indication of the thickness of the overall find layer (fig. 4.8). The layer was thickest on the flanks of the dune, both on the fairly steep southeastern side and on the less steep northwestern flank. There proved to be a relation between the thickness of the find layers and the numbers of finds per square metre. Thicker find layers were excavated in more spits, which led to higher find densities in particular in the case of the colluvium and the trampling horizons.

At the top of the dune Dunkirk I erosion had caused major gaps in the distribution patterns. Clearly visible is the zone (1) where the occupation layers had completely disappeared due to erosion and no segments were excavated. This zone comprises four irregular linked areas, in which Unit 00 was directly, erosively based on the virgin dune sand (Unit 25). These areas represent the (originally) highest parts of the dune. Outside this zone the influence of erosion was still visible in a transitional zone with a width of 3 to 4 m, in which an occupation layer was excavated that was found to be entirely devoid of finds (fig. 4.9). Next comes a zone (2) with a width of 5 to 6 m with a low find density. This is best illustrated by the flint distribution map, which shows substantially lower find densities next to the eroded areas (fig. 4.10). This find category suffered comparatively little influence of selective weathering.

The spatial differentiation of the erosion makes it more difficult to interpret the artefact distributions. In the following discussion of the spatial distributions of the different find categories, figures 4.8 and 4.9 should therefore be used as frames of reference.

All the finds that were recovered by hand from the various layers were first of all collectively indicated in a single distribution map. The individual maps hence represent several centuries of occupation during which the lower limit of the area suitable for occupation (the boundary between the dune and the surrounding swamp) moved up the dune flanks, *i.e.* inwards in the maps.

4.5.2 Flint (figs. 4.10, 7.1)

In total, more than 15,000 flint artefacts with an overall weight of more than 53 kg were collected by hand (table 4.1). Flint is one of the few find categories to have a distribution map that is not affected by selective weathering. This find category therefore provides the best impression of the distribution of material remains on the dune slopes.

Like almost all the spatial distributions, that of the flint artefacts shows large numbers of finds on the southeastern side of the dune, in a zone with a width of almost 10 m with a remarkably sharp boundary along the low side lying just within the aquatic deposits. The flint artefacts were evidently

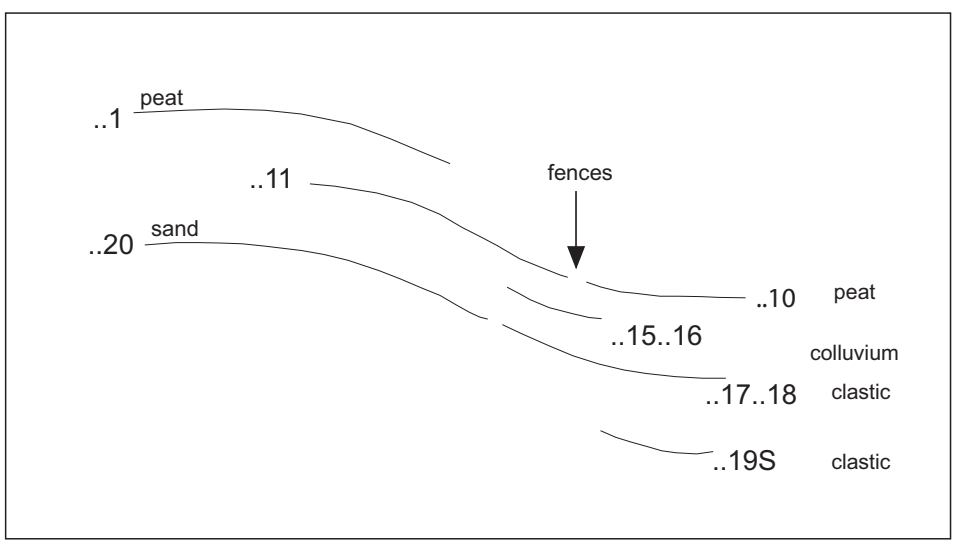

Figure 4.7 Schematic model of the sequence of the successive lithological units on the southeastern slope of the dune.

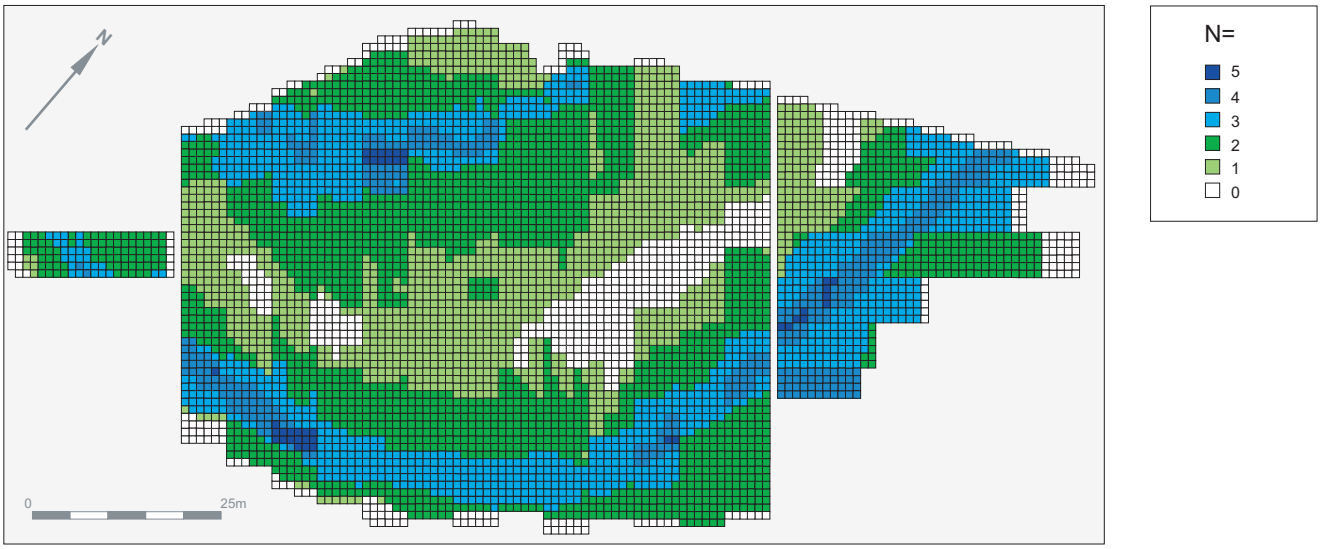

Figure 4.8 Number of excavated spits per segment.

collected by hand	N=	weight (kg)
flint	15,401	53.4
pottery	29,318	155.1
bone	73,187	161.8
stone	4,587	47.7
charcoal	5,650	2.4
loam	657	2.9

Table 4.1 Categories of manually collected archaeological finds; total numbers and weights.

discarded on the flank of the dune and/or ended up there as a result of colluviation. Substantially fewer flint artefacts were found on the less steep northwestern flank. This cannot be attributed to postdepositional processes. A western and a central concentration of finds visible in that area most probably represent activity areas. Flint finds were scarcer in a northerly direction. On this side, too, virtually no flint artefacts were found in the low-lying wet area next to the dune.

A few segments with higher find densities are observable in the find zone on the southeastern side, especially in the maps based on find weights. They are even more distinct in the moving average maps. At an increasing degree of generalisation an unmistakable concentration emerges in the southwestern corner (B) and three less distinct concentrations at the centre and in the (north)east (C, D). The remains concerned appear to represent refuse from adjacent activity areas on the dune.

In the top part of the dune the complete and partial – and irregular – erosion is an important factor affecting distribution patterns in a zone with a width of around 15 m. We assume that the limits of the described find scatters high up the dune slopes were determined by erosion, and that they originally lay within this zone further up the slopes.

As classes with equal widths were used in the moving averages basic map, the degree of differentiation is less at low find densities, and some isolated segments with exceptionally large numbers of finds clearly stand out, even at an increasing degree of generalisation, such as find no. 1930 (trench 16, segment 282, 74 flint artefacts, 28.5 grams). These segments indicate a specific activity or deposition.

4.5.3 Pottery (figs. 4.11, 6.9)

More than 29,000 sherds with a total weight of 155 kg (table 4.1) were collected by hand. Pottery is less suitable for identifying activity areas on the dune than flint because for the time that it lay exposed at the surface, the pottery was subject to trampling and selective weathering by varying moisture conditions and frost.

In contrast to that of the flint, the distribution of the pottery shows a conspicuous narrow band with a width of around 5 m with higher find densities at the foot of the southeastern flank. This band largely coincides with the colluvium (Units 15/16) and the area where the fences stood. It is a zone combining special deposition and favourable embedding conditions. Within this zone a number of find concentrations are distinguishable: a distinct (double) concentration in the (north)eastern corner (D), a series of smaller concentrations (C) in the central part and another double concentration (B) at the western end. The pattern is

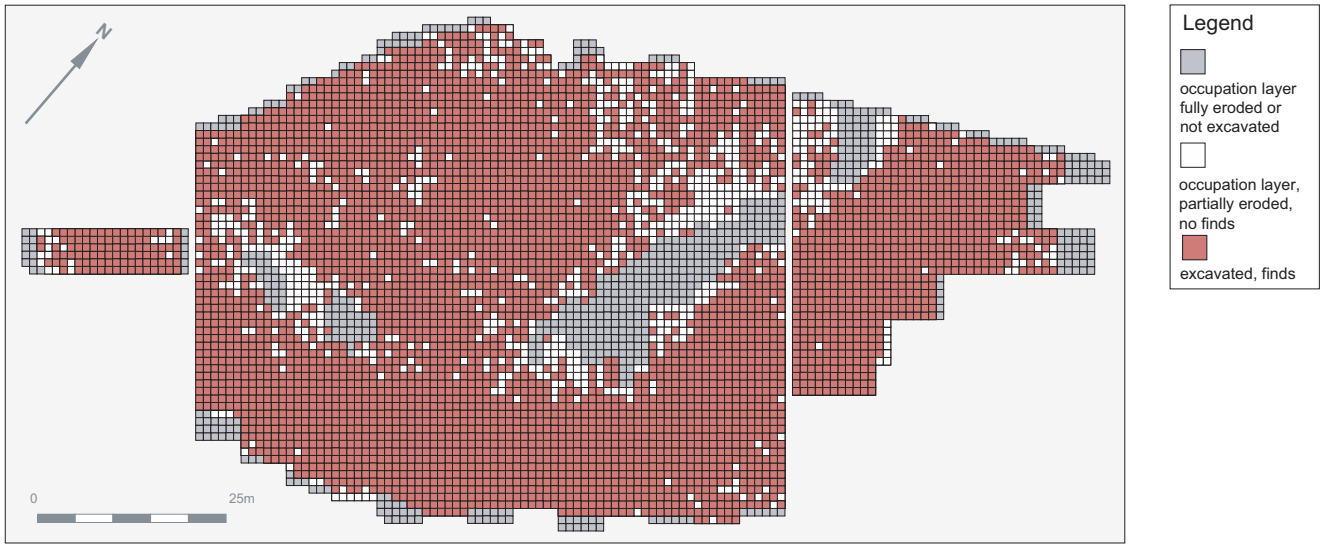

Figure 4.9 Presence or absence of manually collected finds.

somewhat more differentiated than that of the flint artefacts. In the northeast, at some distance from the foot of the dune, in the sedimentation area and next to the trampling zone, is another isolated find concentration that was only partly excavated. (D*). Generally speaking, pottery was found in the aquatic deposits at much greater distances from the dune than flint artefacts. This cannot be attributable to selective preservation; instead, it must be a consequence of differences in disposal. It would seem that fractured pottery was deliberately thrown (far) away, in a classic toss zone. The flint artefacts will to a much greater extent have been affected by natural processes (colluviation) in the areas where they were discarded.

The parts of the northwestern flank of the dune outside the eroded zone contained a uniform, thin find scatter that was devoid of concentrations, even in the moving average maps. There, too, the find scatter extended into the marshy zone outside the dune. We assume that this side of the dune formed part of the area where the occupants performed their daily activities, and that the find densities were substantially reduced through selective weathering between the period of occupation and the time when the remains became buried beneath the surface, which will have obliterated any patterns originally present. This makes one segment with an exceptionally large number of finds at the centre of this area quite remarkable. This segment, which yielded 262 sherds with a total weight of 891 grams (nos. 7095, 7098 and 7681, trench 17, segment 304) remained clearly visible in all the generalisations.

The distributions of the pottery likewise seem to show the fringes of find areas of which large parts higher up the dune have been obliterated by erosion and selective weathering. The pottery patterns differ from the flint patterns in that they display more detailed concentrations on the southeastern flank and extend further into the low surroundings of the dune. In overall layout they are however quite similar.

4.5.4 *Bone* (figs. 4.12, 22.1)

In total, more than 73,000 bone fragments with an overall weight of almost 162 kg were collected by hand (table 4.1). The segments with the largest concentrations yielded more than 1000 (small) fragments (estimated count), or a weight of almost 2 kilos. Preservation was an important factor in determining the distribution pattern: bone was found almost exclusively in the wet peripheral zones of the dune and was almost completely absent in the dry sandy deposits. The sharp upper limit was determined by preservation. Two concentrations, one in the southwest (B) and the other in the northeast (D), seem to be the outcomes of deposition in a late occupation phase (see section 4.8.4).

The distribution maps obtained for bone closely resemble those of the pottery finds. The remains were indisputably concentrated along the southeastern edge of the dune, in a zone with a width of around 5 m which as it were enclosed the entire dune on that side. The southwestern and north-eastern ends of this zone lay within the limits of the excavated area. This zone with high densities lies a little further away from the dune than that observable in the pottery maps and is also larger. As in the case of the pottery, the generalised maps reveal a (double) concentration (D) in the (north)eastern corner of this zone and a second, narrow zone with a high

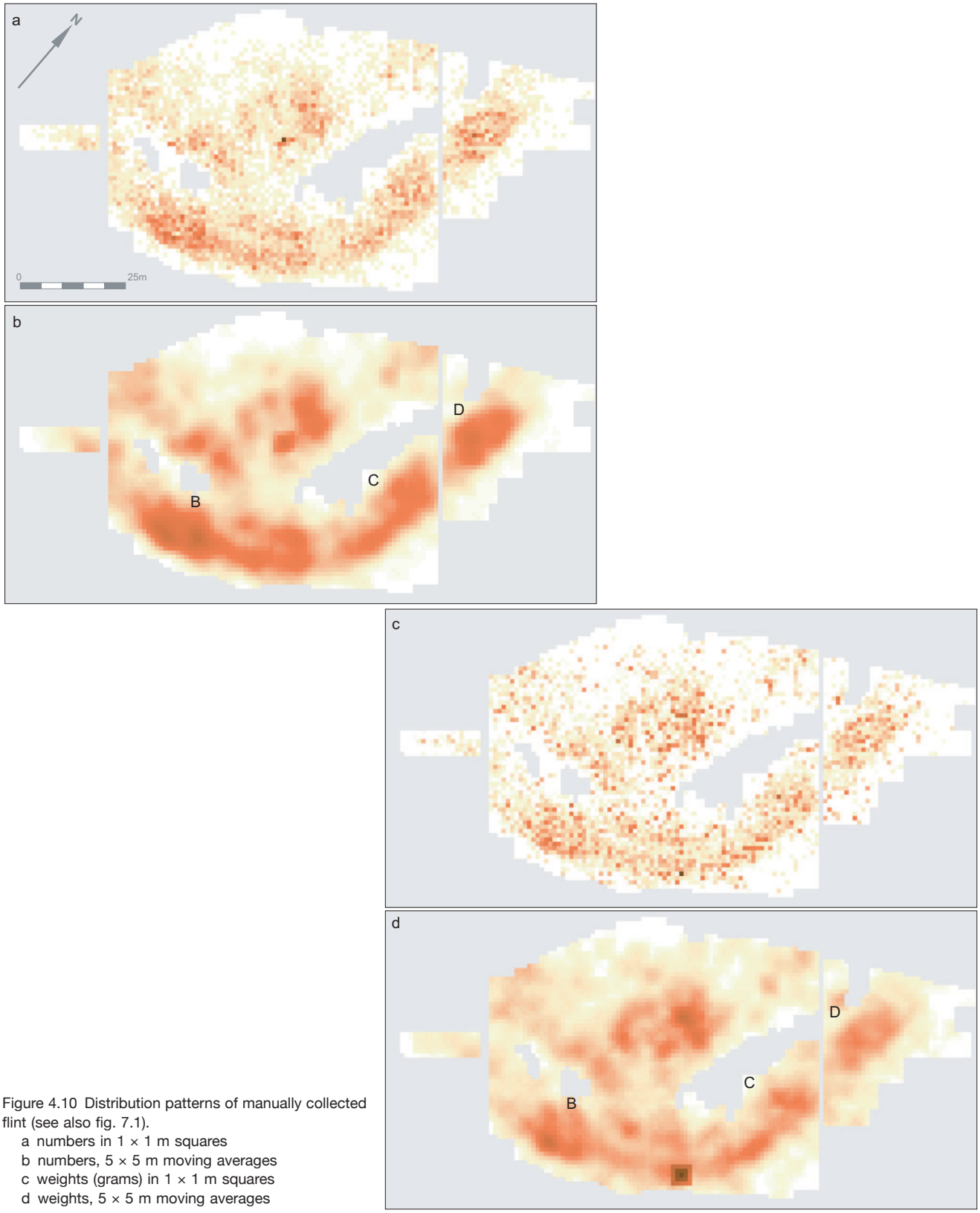

Figure 4.10 Distribution patterns of manually collected flint (see also fig. 7.1).
a numbers in 1 × 1 m squares
b numbers, 5 × 5 m moving averages
c weights (grams) in 1 × 1 m squares
d weights, 5 × 5 m moving averages

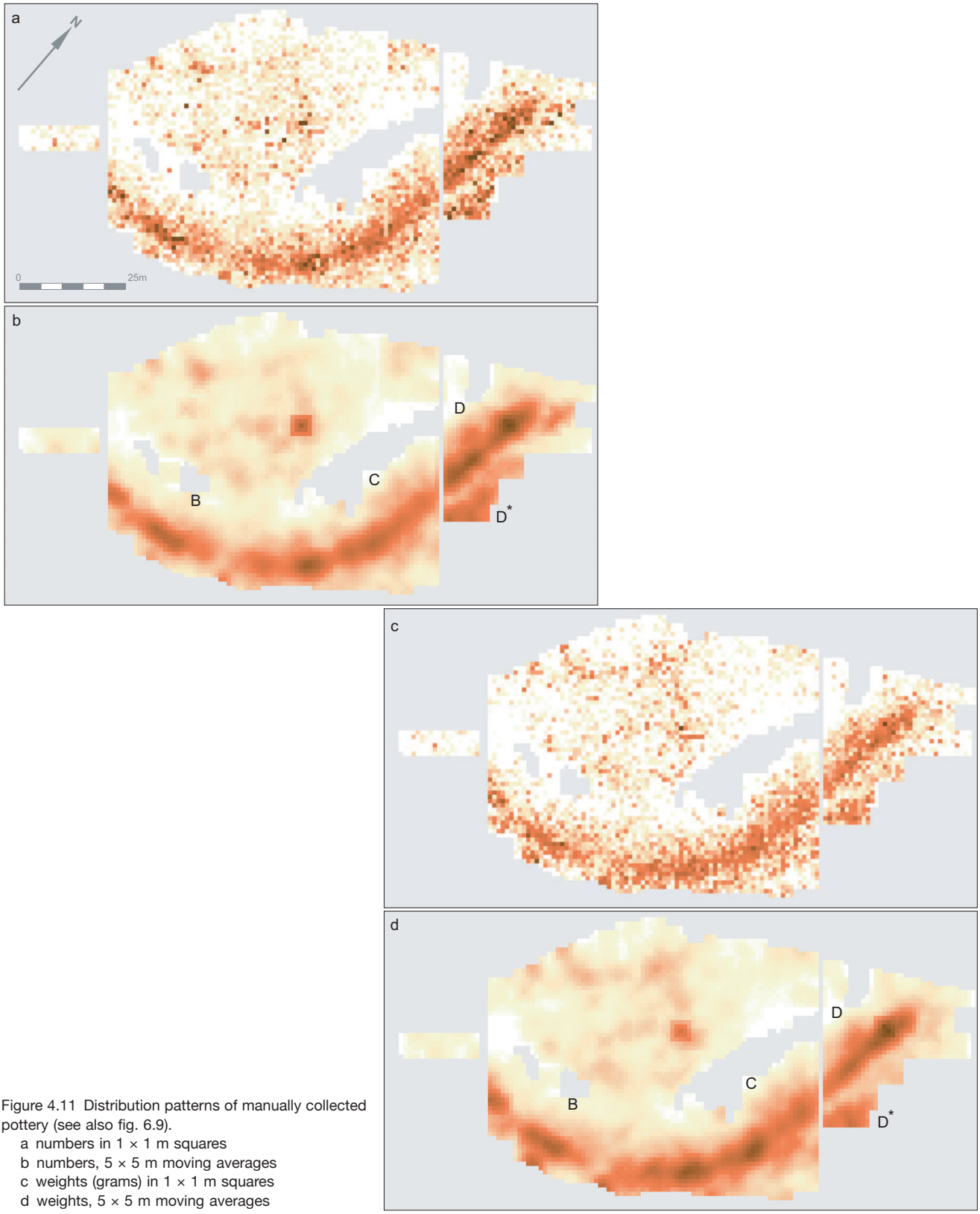

Figure 4.11 Distribution patterns of manually collected pottery (see also fig. 6.9).
a numbers in 1 × 1 m squares
b numbers, 5 × 5 m moving averages
c weights (grams) in 1 × 1 m squares
d weights, 5 × 5 m moving averages

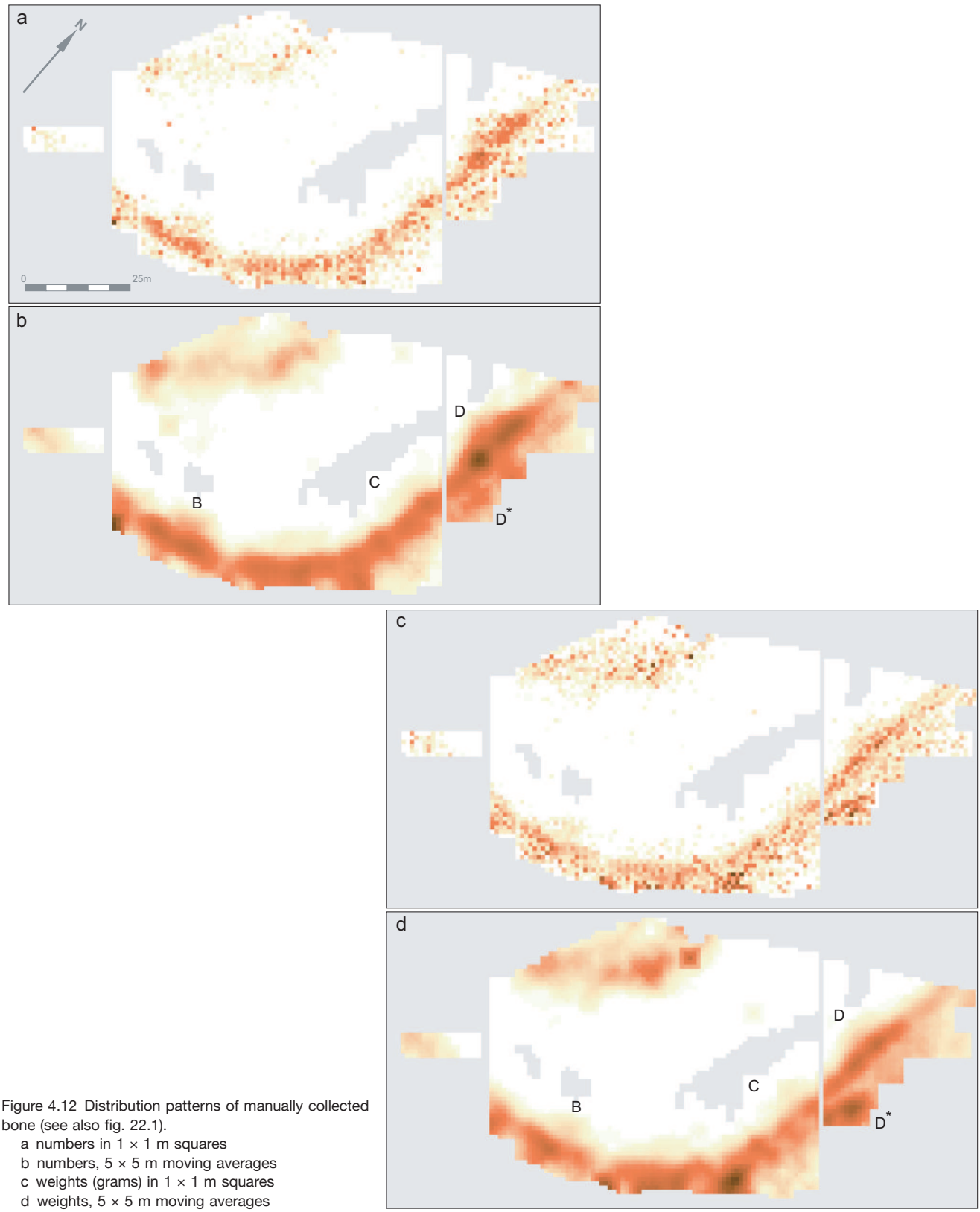

Figure 4.12 Distribution patterns of manually collected bone (see also fig. 22.1).
a numbers in 1 × 1 m squares
b numbers, 5 × 5 m moving averages
c weights (grams) in 1 × 1 m squares
d weights, 5 × 5 m moving averages

density of finds in Units 17/18 (D*). Whereas the distributions of the flint show high densities on the slope of the dune, those of the bones and pottery sherds on the contrary point to disposal next to the dune. The central part of the find zone shows a series of unclear, poorly pronounced densities (C), but a distinct separate concentration is observable in the west (B).

Another conspicuous aspect of the bone distributions is a find density that is modest in an absolute respect but nevertheless quite high in relative terms in the low-lying area northwest of the dune. This density stands out more in the distribution based on weight than in that based on quantities, implying that the finds in question are comparatively large fragments. This is in marked contrast with the pottery and flint distributions, which are both conspicuously empty in the northwestern area. The only conclusion that can be drawn from this is that we are to assume different, separate disposal processes for the three find categories. Viewed in this context, the observed more subtle differences between the bone and pottery distributions on the other side of the dune may also be seen to represent differences in disposal, all the more so as they cannot be explained in terms of preservation.

4.5.5 Stone artefacts (fig. 6.1)

In total, more than 4500 pieces of stone were coded, with an overall weight of more than 47 kg. The largest stone artefact (no. 1300, part of a grindstone) weighs 3.7 kg. The distributions of this find category were hardly affected by selective weathering, but they do show the consequences of a research factor. The small pebbles (<1 cm) that naturally occur in sand were not always properly distinguished from anthropogenically used/modified stone. That distinction was made in quantitative terms only in the lithic analysis (chapter 8). This factor affected the distributions on the dune in particular, and those based on quantities more so than those based on weight.

The distributions of the lithic artefacts closely resemble those of the flint artefacts in that they reveal a broad zone with high find densities along the south side that does not extend far into the aquatic deposits beyond the dune, and small numbers of finds on the northern flank. A find concentration clearly visible at the centre of the southeastern side (C) corresponds to one of the concentrations observable in the pottery distributions. There are also two less conspicuous concentrations in the (north)eastern and southwestern corners (D and B). The dune itself revealed only a thin, diffuse scatter, part of which consisted of natural stone.

4.5.6 Charcoal

5650 charcoal particles with a total weight of around 2½ kg were collected by hand. The interpretative value of the distribution of this find category is very limited. The charcoal was collected in a very unsystematic manner, and in some areas features rich in charcoal strongly influenced the find densities. This is typically a distribution that must be corrected on the basis of the sieve finds.

The distribution map shows a very thin scatter with slightly higher densities only in the waste-disposal zone along the southeastern edge. At the centre of this zone is a concentration that coincides with concentrations (C) in the pottery and lithic artefact distributions.

4.5.7 Daub

657 lumps of daub (approx. 3 kg) were identified as such. Daub (and clay) likewise provides a fairly unreliable picture because it will in many cases not have been identified as such in the field and in the processing of the finds.

The daub seems to be restricted to the central part of the southern flank and a concentration just to the east of it, but it is questionable whether any significance should be attached to its absence in other parts of the dune.

4.6 The results of the sieving

The soil from one row of segments in all the evenly numbered trenches was sieved through a sieve with a mesh width of 4 mm (section 1.3.2). The finds recovered from the sieve residues were also counted and weighed per working unit. The resulting find densities provide a complementary spatial impression of the fraction between 4 and approximately 30 mm. Soil from Unit 10 (peat containing large quantities of coarse plant remains) and Units 17/18 (a deposit with a high clay concentration) was not systematically sieved on account of those units' specific conditions. No sieve data are available for Unit 19S either, as this layer was not shovelled in 1 × 1 m segments.

The number of finds recovered from the sieve residues can be termed high, especially considering that the sieving programme covered only 1/12 of the excavated volume of soil. In terms of weight, the finds however constitute only a small proportion of the overall find assemblage (table 4.2).

Distribution maps were made of the results of the sieving, for both the individual layers and for all layers together. These maps were visually assessed to see whether they

4 mm sieve	N=	weight (kg)
flint	7,264	2.0
pottery	9,663	6.5
bone	53,554	7.7
stone	3,011	1.0
charcoal	92,392	4.3
loam	31	< 0.1

Table 4.2 Categories of archaeological finds collected by sieving through a 4-mm mesh; total numbers and weights.

showed any (ir)regularities relative to or deviations from the above distributions obtained for the manually collected finds.

In terms of both quantities and weight, the distributions based on the results of the sieving differ little from the general distributions of the flint, pottery, bone and lithic artefacts. The flint and pottery finds show a more uniform distribution on the dune. The fine fraction was evidently distributed more diffusely across the occupation area, but some sieved segments nevertheless contained comparatively large numbers of finds, especially lithic and flint artefacts. These distributions confirm the distribution patterns of the manually collected finds.

Charcoal clearly constitutes an exception (fig 4.13), having been only incidentally collected by hand. Charcoal was encountered in large quantities in the sieve residues, up to more than 3000 particles and 180 grams per m^2. So the sieved segments yielded complementary spatial information for this find category. Charcoal was very uniformly distributed across the entire dune; its distribution seems to have been influenced only by the (partial) erosion at the top. As in the case of all the other find categories, the largest quantities were found on the southeastern flank. A few segments with particularly high charcoal concentrations probably represent hearths. The uniform scatter across the entire dune supports the assumption that the human activities took place in areas all over the dune.

Virtually no loam whatsoever was found in the sieve residues. Being soft, it evidently did not survive the sieving process.

4.7 SITE STRUCTURE

Together, the distribution maps of the different find categories provide a good impression of the site's general structure. Occupation and deposition evidently took place across the entire dune, but also in a zone outside it, to a distance of more than 20 m from the dune, making the total area of the site not 0.5 ha but 1 ha. Although the site was occupied for only a few centuries, fairly large, diffuse concentrations have nevertheless remained visible, thanks to the fact that the remains became buried relatively soon after the end of occupation. This points to a fixed main layout of the site throughout the entire period of occupation. There are only very few small-scale find concentrations, with high quantities or weights of finds, in a single segment. They may represent specific activities in the final occupation phase, whose remains suffered little postdepositional disturbance.

Many remains ended up on the relatively steep southeastern slope of the dune and in the adjacent aquatic deposits. The limits of this zone were observed in the southwest and the northeast. Within this zone the distributions of the different find categories show three clearly distinct sections with a few concentrations coinciding with three of the four main clusters in the postholes distribution: one in the southwest (B), one at the centre (C) and one in the (north)east (D). The dump zone of cluster A seems to have coincided largely with trenches in which finds could not be systematically collected. We assume that these concentrations in the waste-disposal zone spatially represent the adjacent activity areas on the dune. The patterns differ

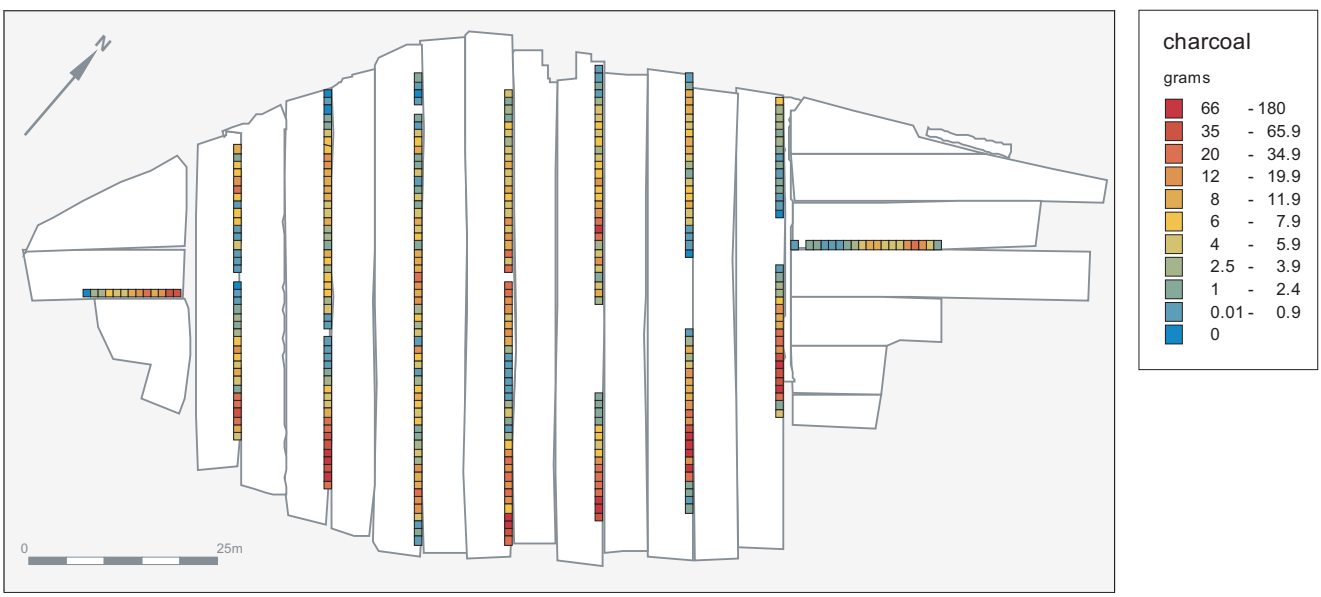

Figure 4.13 Distribution of charcoal (weight in grams) recovered from the 4-mm sieve residues.

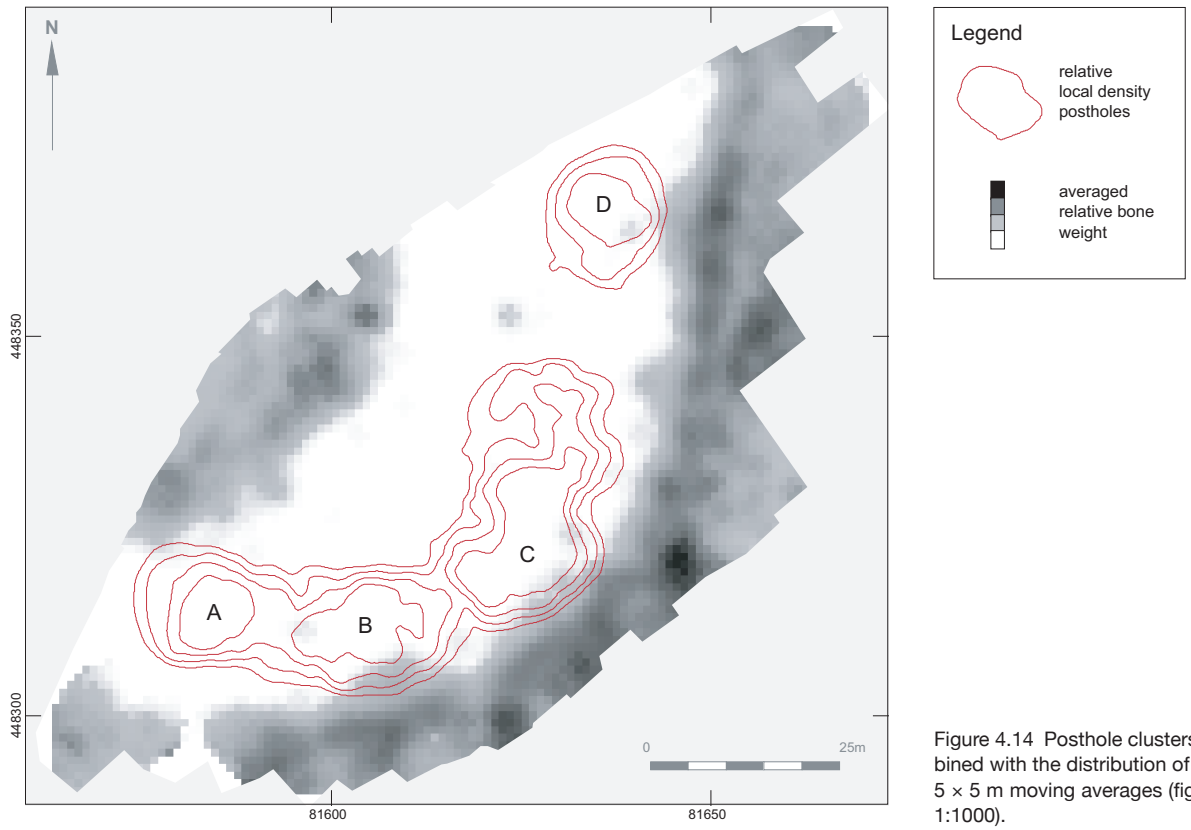

Figure 4.14 Posthole clusters (fig. 4.5) combined with the distribution of bone weight in 5 × 5 m moving averages (fig. 4.11d), (scale 1:1000).

somewhat from one find category to another, but those differences are attributable to differences in deposition and preservation (figs 4.14).

The narrow zone D* with high densities of pottery and (somewhat less clear) bone in the northeasternmost corner is associated with a path, represented by the trampling zone in Unit 18 (phase 2a).

Much less refuse was discarded on and alongside the less steep northwestern slope. This indicates that this part of the dune was used for a shorter length of time and/or it had a marginal position within the settlement.

During the period of occupation already the original deposition pattern was to a great extent obliterated by trampling, weathering and colluviation. The lateral movement of sediment and artefacts led to a decrease in the density of archaeological remains on the slopes of the dune and an increase in their density in the colluvium at the foot of the dune. Besides deliberate deposition and colluviation, the good preservation conditions were an important factor in the formation of the distribution patterns in this zone.

Beneath the peat (Units 10/11 and 01), which had extended across the entire dune area by around 3000 cal BC, the find distributions were fossilised without notable changes. Much later, the erosion that accompanied the formation of the Dunkirk I deposits (Unit 0) led to the formation of several large gaps in the distribution patterns at the centre of the settlement, and only those in the peripheral zones have survived. This makes it difficult to interpret the site in terms of organisation and the size of the local community. Fortunately this is to some extent compensated by the phased information provided by the aquatic deposits.

4.8 Phasing (fig. 4.15)

Distribution maps of the three most important find categories (flint, bone and pottery) were made for each phase (combination of units). Those maps were compared with one another and with the general (overall) distributions. The patterns are difficult to interpret because they are diffuse and because of the sharp boundary between the layer concerned and Unit 20. Only the pottery distributions are illustrated here. There are also substantial differences in the numbers of finds from the different phases (table 4.3).

4.8.1 Phase 1 (Unit 19S)

In Unit 19S the finds were not collected by hand in segments of 1 × 1 m, but with the aid of a digging machine in larger

		N=			%		
phase	Unit	flint	pottery	bone	flint	pottery	bone
1-3	20	8,140	9,429	8,345	52.8	31.5	11.3
3	10	157	580	5,132	1.0	1.9	7.0
3	11	4,287	3,752	6,291	27.8	12.5	8.5
2b	15/16	2,021	5,162	19,335	13.1	17.2	26.2
2a	17/18	723	9,770	31,697	4.7	32.6	42.9
1-2a	19N	71	625	2,387	0.5	2.1	3.2
1	19S	6	639	632	0.0	2.1	0.9
Totals		*15,405*	*29,957*	*73,819*	*100*	*100*	*100*

Table 4.3 Categories of archaeological finds; absolute numbers and percentages per phase and lithological unit.

segments (see section 1.3.3). The distribution map of this unit (fig. 4.15d) therefore differs from the other maps in a cartographic respect.

Relatively few finds are available from this earliest phase. Like the scatters of the later phases, the thin find scatter has a length of at least 70 m along the southeastern edge of the dune. Insofar as it was recorded, the scatter is very uniform, with a slightly greater density of finds on the dune flank. The finds concerned are almost all fragments of bone and sherds of relatively large dimensions, which were evidently discarded in the gulley that was at this time gradually filling up with sediments. One find for example comprises three sherds with a total weight of 515 grams.

In total only six pieces of flint were found. This small number may be partly – but certainly not exclusively – attributable to the collection method. One possibility is that flint was not discarded in water; flint will have been a scarce commodity and will have been used and reused for as long as possible. The number of flint finds from phase 2a recovered from the clay of Unit 17/18 is also rather small.

The find patterns in Unit 19N also span phase 1, but they will be discussed under phase 2a on the assumption that the younger remains will prevail in this layer.

4.8.2 Phase 2a (Units 19N and 17/18)

Large quantities of bone and pottery were found along the entire southeastern side of the dune, over an area with a length of around 150 m. The limits of this refuse zone lie beyond the limits of the excavated area; the boundary of the find scatter was not observed in the trenches in the sedimentation area either. Bones were even found in the small trench that was dug 20 m from the foot of the dune to obtain samples for pollen analysis (trench 40). So in this phase a broad zone of the surrounding deposits formed part of the settlement site.

The distribution of flint artefacts is very limited and diffuse. The pottery and bone distributions likewise reveal few variations in density. Two vague concentrations – D and D* – separated by a narrow strip with a slightly lower find density along the trampling zone can just be made out.

The numbers and densities of the finds recovered on the northwestern side (19N) are much lower than those on the southeastern side, but the ratios of the different find categories are comparable. This makes it more likely that the northwestern side was an area with a low deposition intensity than that it had some other function.

4.8.3 Phase 2b (Units 15/16 and part of Unit 20)

The colluvium (Unit 15/16) yielded a large number of finds in a high density, in roughly the same pottery and bone ratios as the finds recovered from Units 17/18. It comprised a narrow zone with a width of only 5 to 6 metres surrounding the dune on both its northwestern and its southeastern side that lay by definition directly above Units 17/18. In the north the limit of the find scatter was determined in the excavation; in the southwest the density of finds gradually decreased, the actual limit lying somewhere beyond the boundary of the trench. This narrow strip shows no interruptions, but fairly randomly distributed small areas with slightly higher concentrations of finds, especially flint and bone, are observable. This being such a narrow strip makes it difficult to interpret this differentiation. Units 15/16 are however the natural continuation of Unit 20, the ‘occupation layer’ on the dune body. The patterns in Units 15/16 may therefore be assumed to be the continuation of the pattern at the base of Unit 20, especially because the base of Unit 20 – and Units 15/16 – became buried by Unit 11 during phase 3 already. This does not hold for the higher part of the dune.

4.8.4 Phase 3 (Units 10/11)

Phase 3 is represented by the finds recovered from Units 10 and 11. Unit 11 yielded large quantities of flint, pottery and bone, but not quite as many finds as the previous units (table 4.3). Unit 10, which lies further away from the dune, yielded only few finds. The finds were concentrated in a zone along the former foot of the dune, above the base of Unit 20 and the colluvium of Units15/16, extending over a width of around 25 m (both units together). The limits of this zone were clearly observable in both the north and the southwest in the case of all the find categories. Within this zone the

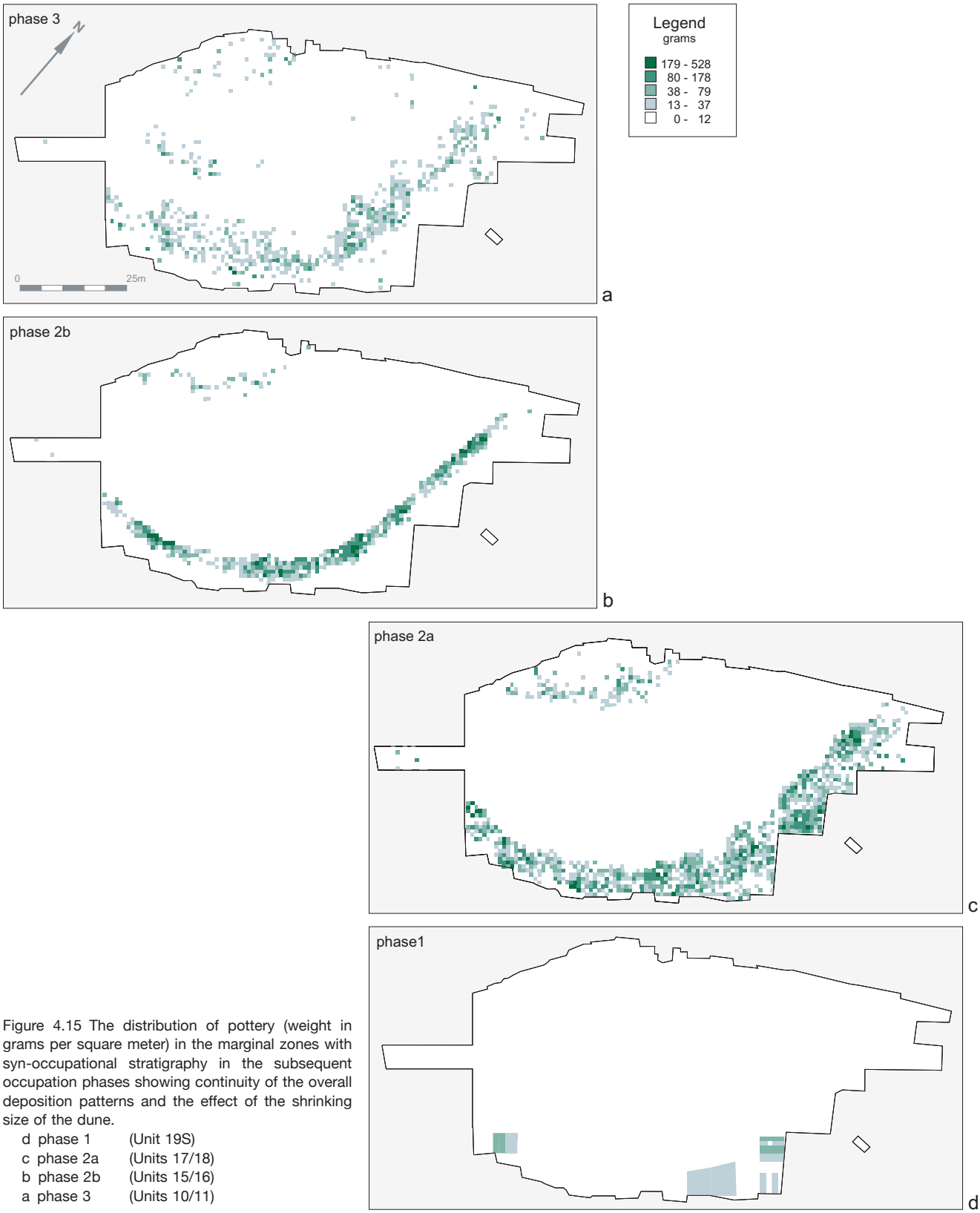

Figure 4.15 The distribution of pottery (weight in grams per square meter) in the marginal zones with syn-occupational stratigraphy in the subsequent occupation phases showing continuity of the overall deposition patterns and the effect of the shrinking size of the dune.

d phase 1 (Unit 19S)
c phase 2a (Units 17/18)
b phase 2b (Units 15/16)
a phase 3 (Units 10/11)

flint and bone distributions showed one concentration in the southwest (A) and one in the northeast (C), but the area between the two (B) also yielded many finds. This can be classed as a waste disposal zone, at some distance from the dune. The discarded objects are mainly bones; pottery was discarded in much smaller quantities and flint is almost completely absent.

The find scatter of Unit 11 of course continues in the distribution of the remains left behind in Unit 20 in phase 3. In the case of flint the remains in question can however not be distinguished from the other remains; pottery and bone remains have largely disintegrated.

4.8.5 Conclusions

Assuming that the disposal of objects in the aquatic deposits bordering the southeastern edge of the dune was directly associated with the occupation activities on the adjacent part of the dune, we can, on the basis of those embedded objects, assign chronological depth to those activity areas, as visualised in the posthole clusters.

In the first place, this zone was over its entire length evidently used for the disposal of refuse in all phases. From phase 1 until the end of phase 3, refuse was discarded next to clusters B, C and D. This means that the whole dune area was in use throughout the entire period of occupation; there was no movement of occupation centres across the dune within that period. The boundary of the refuse zone in the southeast shows that the activities covered a wider area in phase 2a (and Unit 20), extending beyond the limits of the excavated area, than in phases 2b and 3. In phase 2b the northern boundary clearly lay within the excavated area; the southwestern limit is diffuse. The two limits of this zone in phase 3 were both clearly visible. This slight reduction in the size of the occupied area will have been the result of the gradual burial of the lower parts of the dune by sediments.

Secondly, the most important find concentrations (B, D) of the different phases coincide, in each case separated by an area with thinner find scatters. This we regard as another argument in favour of long continuity, from phase 2a via 2b to phase 3.

In the third place, these find concentrations coincide with the identified posthole clusters, which means that the chronology of the entire occupation period can be applied to them. This further supports the assumption based on the analysis of the postholes, notably that this settlement comprised a number of locations where small houses were built and rebuilt on several occasions (section 3.8.3).

4.9 INTERPRETATION AND CONCLUSIONS

4.9.1 Methodical conclusions

Collecting remains by hand (with a shovel and incidentally also a trowel) inevitably leads to a fairly unsystematic sample of the remains surviving at the site. The ‘sieved strips’ proved a good test to visualise and quantify this. The extent to which the maps based on find numbers and find weights agree with one another shows that the recovery bias had little impact on the spatial analysis. All the maps were moreover affected by this factor in the same degree. The only exception concerns charcoal, which was not systematically collected by hand.

This bias is however an influential factor as far as the ratios of the different artefact categories are concerned, in particular the ratios of beads, small flint artefacts and remains of fish, birds and small mammals.

Smoothing of the maps on the basis of moving averages proved to be ideal for revealing trends in distributions and for eliminating small-scale, partly research-dependent variations. Visual comparison of many distribution maps made via different approaches using applied software led to a good understanding of the spatial structure of the site.

4.9.2 Interpretation of the distributions

The general find patterns were largely determined by natural factors, in particular differential weathering, erosion and colluviation. Nevertheless, a main deposition pattern relating to the activity areas represented by the clusters of postholes is identifiable on the dune. The occupants made intensive use of the entire dune and its peripheral zone in all phases. The area concerned decreased slightly – but not that much – in size towards the end of the occupation period. Throughout the phases there were four clusters of postholes (A-D) or farmyards with next to them the fringes of activity areas in the northwest and associated waste-disposal areas in the southeast. They seem to have remained in the same places and to have been in continuous use in all the phases. These three combined concentrations of finds and postholes have diameters of several dozen metres. They represent areas where a multitude of domestic activities were evidently concentrated around structures that were rebuilt several times (see section 3.8.3) and next to which refuse was discarded. This leads to the conclusion that there were at least four farmyards or households certainly from phase 2a onwards, but possibly already from phase 1 onwards.

Several separate activities appear to be represented in the waste-disposal zone, and all in the same pattern in all phases (2a-3). Flint was evidently very rarely discarded, and mainly on and at the foot of the dune. This implies that this raw material was economically used and – not surprising in this environment – in scarce supply. Pottery was found at greater distances from the dune and must have deliberately been discarded in the adjacent swamp. This holds to an even greater extent for the bones of slaughtered animals whose meat was consumed.

The less steep northwestern flank of the dune had a special function in all phases. In the earliest occupation phases (1 and 2a) wells were dug here. The scarcity of flint and the small number of postholes moreover point to less intensive use, though large amounts of slaughtering remains were discarded here. Hygienic considerations may have played a role. This part of the site may have been fairly swampy at an early stage already, as indeed suggested by the facies of Unit 19N.

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