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Persistent traditions: a long-term perspective on communities in the process of Neolithisation in the Lower Rhine Area (5500-2500 cal BC)

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The Late Mesolithic – diversity in uniformity?

‘The distinct regional variation which emerges in the Neolithic has its roots in the historical traditions of regionally-based Mesolithic communities.’ (Armit/Finlayson 1992, 672).

‘...one cannot understand the transition without understanding the state of hunter-gatherer adaptations that preceded it...’ (Zvelebil/Rowley-Conwy 1984, 104).

5.1 Introduction

In order to understand the process of Neolithisation in the LRA it is important to gain better insight into the preceding Late Mesolithic, since the last communities of hunter-gatherers living in this area formed the socio-cultural context in relation to which the transition to agriculture took place. These groups should not be seen as the uniform hunting and gathering ‘background’ to the changes taking place with the introduction of agriculture. In fact, the diversity existing within Late Mesolithic groups in relation to the various landscapes they inhabited and exploited formed a variable and heterogeneous ‘backdrop’ to the process of Neolithisation. This chapter discusses different aspects of Late Mesolithic communities, based mainly on the evidence from excavated sites and in relation to their setting in the landscape. The aim is to analyse whether differences and similarities observed may be interpreted as meaningful with respect to Late Mesolithic diversity and therefore of importance to our understanding of Neolithisation in the area. This chapter first presents a brief introduction of the Late Mesolithic chronological and material framework, followed by the introduction of the site-based dataset. Subsequently analysis focuses on several ‘scaled’ aspects of Late Mesolithic sites in the landscape. Finally the results will be compared and interpreted in terms of settlement systems and repercussions for Neolithisation.

5.2 Chronological and cultural context

As a period, the Late Mesolithic has received little attention. It is generally studied from the perspective of the preceding earlier Mesolithic phases. Little is known of Mesolithic settlement systems and mobility (Crombé/Cauwe 2001, 55), although these are of importance for understanding Neolithisation. The lack of attention is caused in part by problems of identification related to taphonomy and limited dating resolution (see Chapter 4). Recent publications of several sites with distinct Late Mesolithic occupation phases have greatly contributed to the corpus of

information (e.g. Louwe Kooijmans 2001^{a,b}; Peeters 2007; Verhart 2000; Verlinde/Newell 2006) providing new opportunities to enhance our understanding of this phase.

5.2.1 Mesolithic chronology

The chronological subdivision of the Mesolithic has been subject to many changes (Lanting/Van der Plicht 1997/1998, 105-112; Verhart/Groenendijk 2005, 163-165), mainly relating to problems in obtaining associated ¹⁴C dates and issues of taphonomy, such as a lack of stratified sites. This is why typo-chronology, with its coarse-grained resolution, remains one of the main tools for the identification and dating of Mesolithic occupations (see Crombé/Cauwe 2001, 51).

Previous subdivisions based on point types defined five stages of the Mesolithic in the study area (Newell 1973; Arts 1989). However, the proposed cultural groups within these stages (e.g. the De Leijen Wartena complex) are no longer recognized. Moreover, some implements originally regarded as chronologically limited proved to be in use for much longer (e.g. Arts 1989, fig. 8; Crombé 1998; 1999). Finally, not all diagnostic artefact types are omnipresent. The recognition of these problems ultimately led to a subdivision into three phases only (Verhart/Groenendijk 2005; Verhart 2008; see also Peeters/Niekus 2001). While some (Lanting/Van der Plicht 1997/1998, 136) argue that the Mesolithic may solely be divided in an early and late phase based on the absence or presence of trapezes, the subdivision of Verhart and Groenendijk (2005, 163-165) will be followed here. It is based on a north-south distinction between a Scandinavian-oriented Northwest group and a Rhine-Basin group (Gob 1985; Heinen 2006; see also Newell 1973). Chronologically, Verhart and Groenendijk (2005) distinguish between an Early, Middle and Late Mesolithic. The Early Mesolithic (c. 9200-7500 cal BC) in the south is mainly characterised by the A-point and the occasional use of Hesbaye-type flint. In the North B-points and triangular implements are also common. The Middle Mesolithic (c. 7500-6500 cal BC) is characterised by C-points in the north and by C-points and implements with surface retouch (e.g. *feuille de gui*) in the south. The Middle Mesolithic also sees the initial exploitation of Wommersom quartzite as a favoured raw material (see also Gendel 1984). The Late Mesolithic (c. 6500-5300/4400 cal BC) is characterised by trapezes in both the north and the south and by the use of Wommersom quartzite in the south.

According to Verhart and Groenendijk (2005, 163-164) the adjacent Rhineland sequence (cf. Arora 1976) and the Belgian subdivision (Gob 1981) largely overlap with their sequence (see e.g. Arora 1976; Ducroq 2001; Gob 1981; Vanmontfort 2008^a).

While the tripartite division and general north-south distinction retain their value as a framework, it should be mentioned that a number of factors may influence our perception, both chronologically and regionally. These include the longevity of certain tool types, regional typological groups with a specific material expression, functional choices and stylistic variation as well as social aspects such as identity markers (e.g. Crombé 1998; 1999; 2002; Fischer 1989; Lovis *et al.* 2006^b; Perdaen *et al.* 2008; Vermeersch 1984; Wiessner 1983).¹

5.2.2 Lithic characteristics

From a lithic and material perspective the Late Mesolithic is characterised by the use of trapezes. In the southern part of the LRA, points with surface retouch remain in use (see Huyge/Vermeersch 1982; Heinen 2006), a regular blade-based technology is used (*Montbani*-style) and part of the tools are made of Wommersom quartzite. The northern variant is mainly characterised by broad blades and trapezes, narrow triangles, the absence of surface retouch and Wommersom quartzite, and the occurrence of *Geröllkeulen* (albeit rarely in closed assemblages).

Since trapezes first occurred between 7000 and 6500 cal BC and in the Low Countries from *c.* 6500 cal BC onwards (Verhart 2008, 172) their temporal significance is limited. Newell (1973) and Groenendijk (1997) suggested that broad trapezes may be younger than narrow trapezes, but separating them metrically has proven unsuccessful (Peeters *et al.* 2001; but see Niekus 2005/2006, 81).

Another possible distinction (at least in the south of the LRA) is that between unretouched trapezes and (asymmetrical) trapezes or triangles with retouched bases or flat inverse retouch (*retouche inverse plate* or 'RIP'). Gehlen (2006) argues that these points may be indicative of La Hoguette assemblages. Others (Heinen 2006, 79-80; Manen/Mazurié de Keroualin 2003, 124) argue that RIP points are predominantly present in the area of the *Rechtsflügler* (*cf.* Löhr 1994) west of the Rhine and Meuse, an area associated with the Limburg group. The RIP technique seems to have developed shortly after 6000 cal BC among the local Rhine-Meuse-Scheldt (RMS) groups, although its origins may lie with the left-lateralized trapezoids of southern France (Heinen 2006, 80; see also Lanting/Van der Plicht 1997/1998). Within the LRA, assemblages exhibiting the RIP technique have incidentally been classified as the Ruiterskuil group (Crombé 1998). Around the middle of the 6th millennium (cal BC), the RMS groups produced a new form of asymmetrical point, known as Danubian style or LBK-like points (*sensu* Löhr 1994), falling within the larger group of *pointes* or *armatures évoluées* (see Heinen 2006, 80). These point types may be indicative of contacts with the LBK (see Huyge/Vermeersch 1982; Löhr 1994; Heinen 2006; Vanmontfort 2007). A typical site with such an evolved assemblage is Weelde-Paardsdrank (Huyge/Vermeersch 1982). This type of point may also have been recovered at the site of Polderweg (Louwe Kooijmans 2003), apart from at least one 'classical' LBK point (see De Grooth 2008, 225). It is not clear whether the LBK-like points evolved out of trapezes with RIP or out of other asymmetrical points such as Bavans points (Heinen 2006). Similarly, it is not known whether the slightly larger points of the LBK itself were an inspiration for or a result of this development. The sometimes striking resemblance and contemporaneous dates of both seem to indicate some form of contact between the LBK and local Mesolithic groups (see Robinson 2008; 2010). Heinen (2006) even argues that the later RMS groups were the producers of Limburg ware (*cf. infra*). The evidence for this is however unconvincing, mainly because of problems of association (see also Otte/Noiret 2006, 98; Vermeersch 2006).

Although the typo-chronological developments of the Late Mesolithic are still poorly understood, it is clear that with the advent of the LBK farmers in the area some changes took place (see Vanmontfort 2008^a). There may have been differences between earlier Late Mesolithic groups and those in contact with farmers. The RIP technique seems emblematic for this contact phase. It should

thus be considered to which extent a further subdivision of the Late Mesolithic (analogous to French and German chronologies) in a Late Mesolithic and a Final Mesolithic would be an appropriate improvement.²

5.2.3 *The end of the Late Mesolithic*

While the Late Mesolithic may generally be described as characterised by a trapeze-based industry and starting around 6500 cal BC, its end date, 5300/4400 cal BC (Verhart 2008; Verhart/Groenendijk 2005), offers a range of approximately a thousand years. This period is characterised by a number of (partly synchronous) developments that are geographically distinct, yet not entirely exclusive. These will be briefly introduced below.

It is important to note that our classification of developments strongly depends on our definition of Mesolithic, Neolithic and Neolithisation (see Chapters 2 and 3). While the economic contribution (of domesticates and cultigens) has become an important factor in distinguishing between Mesolithic and Neolithic (*cf.* Zvelebil/Rowley-Conwy 1984), it was argued earlier (Chapter 3) that multiple factors may determine to what extent we are dealing with Mesolithic or Neolithic communities in a social and developmental sense. This should be viewed against the backdrop of a regional ecological context and in relation to the geographical diversity existing within the settlement system (see also Chapters 7-8) and differs from the chronological discussion. A good example is the fact that in the Dutch chronology the first use of pottery around 5100 cal BC is recognized as marking the start of the Swifterbant culture, which later on also sees the introduction of domesticates and cultigens. The early part of this culture is however best characterised as a ceramic Mesolithic (Louwe Kooijmans 2001^a, 445; 2007^a, 296). This would be similar to the earlier use of this terminology for the ceramic phase of the Ertebølle culture and in line with the interpretation of Swifterbant as a 'Final Mesolithic' in Belgium (Crombé/Vanmontfort 2007, fig. 10). Economically, an important distinction is the appearance of domesticates in the Swifterbant faunal spectra, occurring between 4700 and 4450 cal BC in the southern part of the LRA and around 4200 further north (Louwe Kooijmans 2007^a, 297) and the degree to which domesticates and cultigens contribute to subsistence. We are therefore dealing with a shifting and multi-dimensional transition between the Mesolithic and Neolithic (see Van den Broeke *et al.* 2005, 30; see Chapter 3), the intrinsic aspects of which should be clearly defined. A general framework may be sketched from south to north.

5.2.3.1 Early Neolithic developments in the loess zone (5300-4900 cal BC)

The Neolithic in the LRA begins with the appearance of the LBK in the Rhineland and adjacent Belgian loess area, from *c.* 5300 cal BC onwards (Lanting/Van der Plicht 1999/2000, 13-14). Evidence of interaction between these farming communities and indigenous hunter-gatherers exists in the form of contact-finds (*e.g.* Louwe Kooijmans 2003). This suggests that an availability phase (*cf.* Zvelebil 1986^a) started. Although the direct impact of the appearance of LBK farmers on the regional Late Mesolithic population remains unknown, it is plausible that

the *Siedlungskammer* along the southern limits of the LRA over time, although perhaps not initially (see Vanmontfort 2008^a), acted as hubs around which the process of Neolithisation evolved and intensified.

Both the material records of the LBK and Late Mesolithic (if present) do not testify to important changes. Perhaps some of the developments taking place at the end of the LBK, such as the less rigid approach to settlement location choice (Amkreutz 2010^a), testify to increased forager-farmer interaction. Others, such as Golitko and Keeley (2007) argue that the increase in fortifications (*Erdwerke*) and burial traumata at the end of the LBK also distinctly relate to conflicts with indigenous hunter-gatherers.³

Forager-farmer interaction may also have helped to shape the transformations taking place at the end of and after the LBK. For the east a development may be sketched that involves a transformation of LBK into Grossgartach and later Rössen communities, entailing distinct changes in settlement pattern, site location choice, distribution networks, house traditions, crops etc. (Dohrn-Ihmig 1983; Stehli 1989). In the west the Blicquy group points to similar albeit less marked changes (*e.g.* Jadin 2003; see also Robinson 2010). It should be noted though that evidence is meagre. In the LRA currently only an evolved Rössen settlement at Maastricht-Randwijck is known. There is also evidence of hiatuses both in the Rhineland and the Belgian Hainaut loess area between the LBK and subsequent groups which contrasts with the continuity witnessed in their respective source areas in the Upper Rhine Plain and Paris Basin (Villeneuve-Saint-Germain culture). This may imply that instead of developments taking place in relation to interaction, areas were probably also temporarily abandoned.

Limburg and La Hoguette ware

Apart from the developments outlined above there are two additional phenomena, that may represent ‘actors’ in the transition between the Late Mesolithic and Neolithic in the southern part of the LRA. These are groups with Limburg and La Hoguette ware. Both have been hypothesized to be spatially and temporally related aspects of indigenous traditions in contact with the LBK (Constantin *et al.* 2010; Louwe Kooijmans 1998^a; Raemaekers 1999, 138). A related phenomenon is *Begleitkeramik* of La Hoguette which is found both in isolation and in relation to La Hoguette ware (Brounen/Hauzeur 2010).

Over time our knowledge regarding these groups and the degree to which they may be regarded as independent entities has increased, especially with respect to the La Hoguette group (*e.g.* Manen/Mazurié de Keroualin 2003), for which an independent nature and even a pastoral economy have been suggested (Kalis *et al.* 2001). However, at the moment it not possible to further define the exact role of these groups in relation to both the LBK and Late Mesolithic. The presence of these groups suggests that the characteristics of the period in the southern part of the LRA were not exclusively the result of interaction and developments between the LBK and its successors (Grossgartach, Blicquy, Rössen) and an indigenous Late Mesolithic population but that other actors were involved as well (Amkreutz *et al.* 2009).⁴

5.2.3.2 Neolithic developments on the coversand and in the Meuse valley (5300-4200 cal BC)

While evidence for interaction and change in the Late Mesolithic remains limited, the evidence of contact finds such as points, adzes and later *Breitkeile* suggests increased interaction between foragers and farmers in the early fifth millennium. For the zone north of the loess a distribution of LBK finds up to 30 km from the settlement area has been documented (Van der Graaf 1987). A number of sites yielding Limburg, La Hoguette and *Begleitkeramik* pottery has been documented in the Meuse valley and coversand area. For Limburg ware the most indicative site is Kesseleik (Modderman 1974). For La Hoguette and *Begleitkeramik* a number of sites has been discovered away from the loess (e.g. Venlo-Ossenbergh; Ittervoort-Damszand; Gassel-Over de Voort), along the Meuse valley, into the riverine district and beyond (Ede-Frankeneng; see Brounen/Hauzeur 2010; Brounen *et al.* 2010). The later distribution of *Breitkeile* shows an expansion which ranges much farther north and cannot be attributed to expeditions alone (Raemaekers *et al.* 2011; Verhart 2012; Van der Waals 1972). The paucity of finds further to the west is remarkable in this respect (Vanmontfort 2008^b; Verhart 2003), and probably relates to source areas and networks of transport and distribution. While these objects signal contact and interaction with farmers of the Rössen culture in and around the Rhineland loess area, their impact upon these communities and with respect to Neolithisation remains difficult to establish. Since evidence for the first domestic animals at Hardinxveld dates between 4700 and 4450 cal BC (Louwe Kooijmans 2007^a), it is plausible that, in terms of the availability and substitution phases as modelled by Zvevibel and Rowley-Conwy (1984), this shifting frontier (see also Zvevibel 1998^a) should be ‘interpolated’ at an earlier date for the southern coversand area and Meuse valley (see also Vanmontfort 2008^b, 91).

The nature of the developments with respect to Neolithisation in the coversand area and Meuse valley is difficult to establish. It is not known to what extent the offspring of the first farmers in the loess zone directly shaped the character of the Neolithisation of the coversand area further north, or whether there were hiatuses in occupation after which subsequent Neolithic groups (of Grossgartach, Blicquy or later affinity) re-settled the area, nor to what extent the indigenous Mesolithic population played an active role. The developments between 4900 and 4200 cal BC are largely unknown for the southern part of the LRA. What is known is that from c. 4200 cal BC, in the Rhineland, Belgian loess region and over large parts of the coversand area up to the riverine district, sites of the Michelsberg culture appear (Louwe Kooijmans 1976^a; Schreurs 2005; Vanmontfort 2004; Verhart 2000). The characteristics of this culture are different from those of the LBK, in terms of material (pottery, flint), houses, its largely ephemeral settlement system, which, however, did include flint mines and enclosures, and to some extent its economy (new emphases in crops types, use of different soil types). Based on these characteristics it has been proposed that the MK economy and settlement system was more versatile and less rigid than that of the preceding Early Neolithic LBK. It might have been easier for indigenous hunter-gatherers to adopt this system (see also Crombé/Vanmontfort 2007; Thomas 1988; Vanmontfort 2004; 2007). For the southern part of the LRA we are clearly dealing with both Rhineland Michelsberg influences for the east and developments originating in the French Chasséen in the west (Louwe Kooijmans 1976^a; Vanmontfort 2004; Schreurs

2005), it is argued that the indigenous population may have formed an important factor in the formation of regional variants of both, such as the Spiere Group in western Flanders (Vanmontfort 2007; 2008^b, 93). The MK in the southern part of the LRA may then represent a ‘melting pot’ outcome of Neolithisation.

5.2.3.3 The Swifterbant culture in the wetlands and wetland margins (5100-3700 cal BC)

A third development is of a more indigenous nature and involves the development of Late Mesolithic communities into the early Swifterbant culture. As a starting date the first appearance of indigenous pottery is recorded at Polderweg and slightly later at Hoge Vaart between 5100 and 5000 cal BC (Louwe Kooijmans 2001^a; 2010^a; Peeters 2007). Swifterbant sites have been documented in the wetland areas of the LRA, including the central river district, the current central Dutch polders (Raemaekers 1999), the Scheldt Basin (Crombé (ed.) 2005^a) and around Lake Dümmer in Lower Saxony (Kampffmeyer 1991). It is difficult to estimate to what extent the adjacent wetland margins and coversand area were part of its residential occupation as well (see Niekus 2009) due to taphonomic factors (see Chapter 4), but it may be argued that the majority of the evidence points to wetland-oriented communities.

As argued above, the appearance of pottery forms only a material change. We are in fact dealing with a ceramic Mesolithic (Louwe Kooijmans 2001^a, 445). Pottery traditions should not be seen as a derivative of agriculture, but as an indicator of changed habits in food preparation, independent of the introduction of domesticates (Louwe Kooijmans/Vanmontfort 2010, 209). Within the LRA the introduction of pottery technology in Late Mesolithic communities, in addition to imports of flint and adzes, formed the first step of a specific Swifterbant trajectory of Neolithisation which, in a later stage, would incorporate domesticates and cultigens. Between 4700 and 4450 cal BC the first domesticated animals appear at Hardinxveld-De Bruin, while the evidence for crop plants (consumption and possible cultivation) dates to the middle phase of the Swifterbant culture, at Swifterbant-S3, between *c.* 4300 and 4100 cal BC (Out 2009; Raemaekers 1999).

5.2.3.4 Simultaneous developments

The three developments sketched above indicate that the process of Neolithisation in the LRA is diverse. These were not isolated processes, but interconnected trajectories. Examples include the early appearance of an LBK arrowhead at Hardinxveld-Polderweg, and Blicquy-like pottery at Hardinxveld-De Bruin (Louwe Kooijmans 2003). Louwe Kooijmans (2010^a) also argues for a southern inspiration in explaining the origins of Swifterbant pottery. Others have pointed out the existence of imports and even *bricolage* in the material repertoire of the Swifterbant culture (Raemaekers 1999). Similarly, recent excavations at sites such as Doel-Deurganckdok and Bazel-de Sluis (see Appendix I) in the Scheldt valley demonstrate a spatial convergence of Mesolithic, Early and Middle Neolithic elements, including Swifterbant ware at Doel. At this moment, however, many of the processes behind the material derivatives of interaction that took place in the early 5th millennium remain obscure.

Despite the limitations, two broad trends may be sketched. A first one developed in the loess area and involves a relatively quick appearance of the Neolithic through the arrival of the LBK. The degree of continuity of this tradition into the first centuries of the fifth millennium and the nature of interaction with the Late Mesolithic is not well determined. However, around 4200 cal BC the Middle Neolithic MK may be interpreted as largely representing the completion of Neolithisation in the loess area, the adjacent coversand landscape, the Meuse valley and several locations in the Scheldt valley (*e.g.* Vanmontfort 2008^b, 91). The other trend involves the largely indigenous development of the Swifterbant culture and subsequent Hazendonk group and Vlaardingen culture, rooted in the Late Mesolithic (see also Louwe Kooijmans 1998^a) and mainly oriented on the wetlands and wetland margins between the Scheldt valley and the Elbe.

One of the keys to understanding the differences in the developments in Neolithisation is a better understanding of the Late Mesolithic substrate. This, in combination with the specific constraints and possibilities offered by the natural environment and distance to the 'Neolithic source areas', may explain part of the trajectories of Neolithisation in the LRA. The remainder of this chapter is aimed at broadening our understanding of these communities by studying a number of interrelated aspects of Late Mesolithic sites.

5.3 Late Mesolithic sites in the LRA

In total 41 Late Mesolithic sites have been selected. These are presented in table 5.1 and in fig. 5.1. The selection is not exhaustive. The main focus is on excavated sites with sufficient contextual information to isolate a Late Mesolithic phase of occupation and/or assemblage. Other sites have only been included if they provided sufficient indications for a Late Mesolithic attribution in combination with additional information, for instance regarding geographical distribution. Sites with a distinct early Neolithic La Hoguette, Limburg or *Begleitkeramik* component have not been included in the list (*e.g.* Bracht-Brüggen, Echt-Annendaal-HVR 183, Ede-Frankeneng, Gassel-Over de Voort, Kesseleik-Keuperheide, Koningsbosch, Linne-Mortelshof-HVR 16, Posterholt-Vinke-HVR 39, Sweikhuizen-de Hei). Although these are potentially contemporaneous with (part of) the Late Mesolithic distribution of sites, there is little qualitative information regarding their role. For more detailed information see Appendix I.

In the light of the palimpsest problem (Bailey 2007; Chapter 4) the choice for excavated sites is evident. While this does not rule out material admixture of other periods - most excavated sites are of course also time-averaged surface collections - it does limit these effects considerably when compared to surface sites. It also offers more control over the spatial dimensions of the settlement and the composition of the lithic assemblage. On the other hand, as may be seen in fig. 5.1, the focus on excavated sites does provide a geographically skewed dataset. This relates to different factors. The paucity of Late Mesolithic sites in the loess area, for instance, may both be a reflection of actual settlement patterns (the Holocene oak-lime forest being largely unattractive for hunting game), as well as relate to problems of identification, such as erosion of the terrace edges (*e.g.* Vanmontfort 2008^a; Verhart/Groenendijk 2005, 237, 244). The large number of sites in the southern coversand landscape and the Meuse valley on the other hand is the result of their occurrence at or near the surface, facilitating discovery,

Table 5.1. Alphabetical list of selected Late Mesolithic sites (and abbreviations) in combination with year, extent of excavation (e) or documentation (d; usually survey) and geomorphological site location. Site numbers correspond with fig. 5.1. Group attributions and exceptions are discussed in text. General abbreviations for multi-period sites: LM = Late Mesolithic; EN = Early Neolithic; MN = Middle Neolithic; SWB = Swifterbant.

site + abbreviation	chrono-cultural attribution	excavation year	excavated (e)/documented (d) m ²	location/group
southern coversand landscape				
1. Brecht-Moordenaarsven 1 (B-M1)	LM	1981-1982	63	coversand dune
2. Brecht-Moordenaarsven 2 (B-M2)	LM	1981-1982	172	coversand dune
3. Brecht-Moordenaarsven 3 (B-M3)	LM	1981-1982	(d) unknown	coversand dune
4. Brecht-Overbroek (I-III) (B-O1-3)	LM	c. 1960-70	c. 129 (e) + (d)	coversand dune
5. Brecht-Thomas-Heyveld (B-TH)	LM	1980	c. 100	coversand dune
6. Dilsen-Dilserheide III (D-DIII)	LM	1991	146	coversand ridge
7. Helmond Stiphoutsbroek (H-SB)	LM/EN	1989	2115 (e) + (d)	coversand ridge
8. Lommel-Molse Nete	LM	2003	85	coversand ridge
9. Lommel-Vosvijvers 3	LM	1982	48	coversand ridge
10. Meeuwen-In den Damp (M-ID)	LM	1986	684	coversand dune
11. Merselo-Haag (M-H)	LM	1988	409	coversand ridge
12. Opglabbeek-Ruiterskuil (O-R)	LM	1971	134	coversand dune
13. Tilburg-Kraaiven	LM	1957-	unknown	coversand ridge
14. Turnhout-Zwarte Heide (T-ZH)	LM	c. 1970-80	2300 (d)	coversand ridge
15. Weelde-Paardsdrank (W-P1/4/5)	LM/EN	1976-1977	337	coversand dune
16. Weelde-Voorheide 3	LM	1995	156	coversand ridge
northern coversand landscape				
17. Bergumermeer-S64B (B-S64B)	LM	1971-1972	1200	coversand ridge
18. Havelte-De Doeze(H-DD-H1-I-II)	LM	1970-1972	765	coversand ridge
19. Mariënberg-Schaapskooi (M-S)	LM	1975-1983	2110	coversand ridge
20. Menstede-Coldinne	LM	1982	102	coversand ridge
21. Nieuw-Schoonebeek (N-S)	LM	1989	243	coversand dune
22. Staphorst-Olde-Meppelerdiep	LM/SWB	unknown	unknown	river dune
23. Tietjerk-Lytse Geast I (T-LG1)	LM	c. 1959-70	c. 140 (e) +d	coversand dune
w. wetlands and wetland margin				
24. Hardinxveld-De Bruin (Hdx-DB)	LM/SWB	1997	345	river dune/donk
25. Hardinxveld-Polderweg (Hdx-PW)	LM/SWB	1997	448	river dune/donk
26. 's-Hertogenbosch-Maaspoort	LM	1989-1990	c. 106	river dune/donk
27. Hoge Vaart (HV-A27)	LM/SWB	1994-1996	1684	coversand ridge
28. Melsele-Hof ten Damme	LM/SWB/MN	1984-1986	100	river dune/donk
29. Oudenaarde-Donk	LM/MN	1984-1987	unknown	river dune
30. Swifterbant-S11/12/13 (SWB-S11-13)	LM/SWB	unknown	unknown	river dune
31. Swifterbant-S21 (SWB-S21)	LM/SWB	1961-1976	385	river dune
32. Swifterbant-S22/23/24 (SWB-S22; S23)	LM/SWB	1961-1976	417	river dune
33. Swifterbant-S61	LM/SWB	1978	75	river dune
34. Swifterbant-S81/82/83/84 (SWB-S83)	LM/SWB	2002	8/ c. 300 (d)	river dune
35. Urk-E4	LM-SWB	1997	880	river dune
36. Willemstad-Volkerak	LM	1966	unknown	sand ridge
river valley/valley floor sites				
37. Jardinga-Johannahoeve (J-J)	LM/SWB	1981;02/3	295	valley floor
38. Liège-Place St.-Lambert (LPS-SDT; DDD)	LM	1990-2000	330	valley floor
39. Namur-Grognon	LM	1994-1995	c. 82.5	valley floor
40. Nijlen-Varenheuvel	LM/SWB	2007	unknown	valley floor
41. Remouchamps-Station LeDuc (RSD)	LM	1980-1983	65	valley floor



Fig. 5.1 Map of the LRA with the Late Mesolithic sites presented in table 5.1. The main LBK settlement clusters are shown by shading.

in combination with intensive research programmes such as the Meuse valley project (Verhart 2000) and Leuven University's intensive focus on the Campine area (Verhart/Groenendijk 2005, 236). The limited number of sites situated in wetland areas is mostly the result of limited access, due their burial beneath thick layers of sediment, sites such as Hardinxveld-Polderweg and De Bruin forming rare exceptions that also accentuate the absence of an organic component at the other locations (Louwe Kooijmans 2003). Processes of sedimentation, in combination with erosion, also limited the chance of discovery of sites in the 'Holocene' parts of North Holland, Friesland and Groningen (Peeters/Niekus 2005, 204). Another reason is the dynamic coastline obscuring evidence of habitation (see also Raemaekers 2003).

Unfortunately the available dataset cannot be considered representative for the whole of the Late Mesolithic occupation in the LRA. Nonetheless, it is the best we have and the distribution of sites does, to a certain extent, allow for comparison between sites and groups of sites. It should be noted that the results should be interpreted as tentative indications of the characteristics of Late Mesolithic occupation that may change as more excavated sites become available. This is especially the case in areas for which only a limited number of sites is available.

5.3.1 Geographical and ecological background

In order to compare the similarities and differences of the sites selected and documented, also in relation to their attribution to groups (see below), it is necessary to briefly sketch the regional geographical and ecological characteristics and context.

5.3.1.1 Southern coversand landscape

The southern Pleistocene upland coversand landscape group incorporates the Belgian and Dutch Campine area, where most sites are situated. The landscape is characterised by a sand-blown topography. Deposition dates to the Saalian and mainly Weichselian glacials (see Van Gijssel/Van der Valk 2005, 54-58; see also Vos *et al.* (eds) 2011, maps 9000 and 5500 cal BC), often with dune complexes or ridges that are bordered by meres (Dutch: *vennen* or peat fens). These are wet depressions (*e.g.* Vanmontfort *et al.* 2010^b, 33) that are mainly *ombrogenous* (rain fed), which contrasts with the meres in the more western sandy Flanders regions which are *geogenous*, receiving most water from the regional water table and additional sources (see Robinson 2010, 36). The Younger Dryas was a period of major dune formation (Vermeersch/Huyge 1982). These dune complexes are often situated on top of Pleistocene gravels and sands (*e.g.* Creemers/Vermeersch 1986; Luypaert *et al.* 1993; Vermeersch *et al.* 1974) with height differences of several meters (see Appendix I). The landscape is further characterised by brook valleys and bordered to the east by the Meuse valley.

Vegetation development at the onset of the Holocene saw a reappearance of dry forest dominated by birch and later pine and hazel in the Preboreal. Hazel expanded rapidly in the Boreal, followed by deciduous trees such as oak (*Quercus*) and elm (*Ulmus*) (Crombé *et al.* 2011^b, 456). Of importance for the Late Mesolithic is the development of an Atlantic climax vegetation (*Quercetum mixtum*) from *c.* 7000 cal BC on drier grounds with alder in the wetter parts (*ibid.*; Van Gijssel/Van der Valk 2005, fig. 3.11). At that time, the Early Atlantic, the forest was already relatively dense. At Meeuwen, for instance, palynological data from the mere indicates that there was a heavily forested environment upon the transition to the Atlantic. This mainly consisted of pine (*Pinus*), birch (*Betula*) and hazel (*Corylus*). Also present were lime (*Tilia*), elm and oak. Herbaceous plant pollen and spores of ferns point to wetter parts. Alder (*Alnus*) and lime appeared and increased from the Boreal-Atlantic transition (Bubel, 2002/2003, 318). At Opglabbeek pollen samples taken from under clusters of hearthstones are indicative of an Early or Mid-Atlantic forested environment (Vermeersch *et al.* 1974, 99-100). The developments that started during the early Atlantic continued throughout the Atlantic period. In the course of the Atlantic species such as oak, lime, elm and hazel increasingly formed the most important components of the upland forests (see Van Gijssel/Van der Valk 2005, fig. 3.12). Alder and herbaceous plants grew in the wetter parts.

There is slight evidence for some open areas. Huyge and Vermeersch (1982, 143, 189) for instance indicate the existence of an open lime woodland with hazel and ivy for Weelde at the end of the Atlantic (see also Munaut 1967, 51). Furthermore, a large-scale study by Svenning (2002, 137) in northwestern Europe points to the existence of heath and grassland in more infertile areas such as on poor sandy soils. While the former example may point to Neolithic agricultural intervention, Svenning also points to large herbivores and fire as ways of managing

open areas, but concludes that in most of northwestern Europe closed forests would have dominated. While the possible existence of some open areas, for instance created by wind falls (gap theory) and the role of herbivores should not be ignored in interpreting the composition and diversity of this forested region, the overall archaeological and palaeo-ecological evidence points to a forested environment (see Louwe Kooijmans 2012^a; see also Van den Brecht *et al.* 1998; Sommer *et al.* 2011). It is plausible that zones with increased bio-diversity – in this type of landscape the meres and brook valleys – would form the most attractive areas, hosting resources such as wildlife, flora and water. This is substantiated by the idea that the closed canopy forests of the Atlantic were relatively unattractive to larger mammals and species such as aurochs, roe deer, red deer and wild boar, due to, among others, a lack of undergrowth (see Groenendijk 1997; Svenning 2002; Verhart/Groenendijk 2005, 237). This would make more open zones such as forest edges and places with open water attractive (see Crombé *et al.* 2011^b, 467 and references).

5.3.1.2 Northern coversand landscape

The northern upland coversand and southern coversand landscape are comparable, in that they are shaped to a significant extent by coversand deposition. The systems of the Hunze, Tjonger, IJssel, Overijsselse Vecht and Eem form the major watercourses (Peeters/Niekus 2005, 202). A difference is the presence of moraine deposits in the subsoil, particularly of the Frisian-Drenthe boulder clay plateau where most sites are situated. The Saalian ice advance covering the area resulted in the formation of the plateau and boulder clay outcrops. The occurrence of periglacial phenomena such as lakes and the many pingo scars on the Drenth plateau date to the Weichselien (Van Gijssel/Van der Valk 2005, 54-57).

The impermeable qualities of the subsoil already led to some peat formation in the Preboreal, but in the course of the Atlantic the rise in sea level further influenced the landscape and groundwater levels of the northern Netherlands. This may have led to peat formation and an increasing wetting of the landscape (Peeters/Niekus 2005, 202-203). It should, however, be noted that this took place mainly from the Middle Atlantic period onwards (between *c.* 6000 and 5000 cal BC) and predominantly affected the coastal areas and water systems, although it also encroached on the coversand area (Berendsen 2005, 73-82, Groenendijk 1997). To what extent areas such as the Drenthe-Frisian boulder clay plateau were affected is not well known (Peeters/Niekus 2005, 203; see also Van Gijssel/Van der Valk 2005, 62, 63 and 68). If we compare the northern coversand area to its southern counterpart (see for example the palaeogeographical map '5500 cal BC'; Vos *et al.* (eds) 2011, 43) then a considerable part of the northern coversand landscape is low-lying, making it susceptible to changes in groundwater level as a result of the rise in sea level (-9 m below NAP around 5500 cal BC; pers. comm. Louwe Kooijmans 2012). The area as a whole is characterised more by small stream valleys and incipient peat formation. It is, however, likely that these are differences of degree, since the southern coversand landscape is characterised by peat fens or meres and small stream valleys as well.

The Atlantic vegetation history and development of the northern coversand landscape is largely comparable to that of the southern coversand area (*cf. supra*), with forests consisting of oak and hazel and other tree types such as elm and ash

and alder in the wetter parts (see also Arts 1989, fig. 5; Niekus 2005/2006, 43). It is not clear to what extent the rising sea levels and increase in peat formation (and the development of *sphagnum*) affected occupation further inland. Earlier (see Newell 1973; Arts 1989) it has been suggested that the loss of land due to marine transgression would have led to an (up to threefold) increase in Mesolithic bands that were being 'pushed' inland. Recent research based on radiocarbon dates, sea level curves and coastlines reveals no indications for an increase in population during the later Mesolithic (Niekus 2005/2006, 80).⁵ There does, however, appear to be a shift in the Early Atlantic from the higher Pleistocene sandy soils (most notably the Veenkoloniën area) towards the wetter parts of the landscape, predominantly the stream valleys. This may (partially) relate to the development of climax vegetation that was relatively unattractive to large game, although this may have been relatively small-scale and additional factors may have been influential as well (Niekus 2005/2006, 80-82). Similar developments have been put forward by Crombé *et al.* (2011^b) with regard to Mesolithic and Final Mesolithic land-use and environmental change in northwest Belgium (see also Vanacker *et al.* 2001).

5.3.1.3 Western wetlands and wetland margin

Compared to the coversand landscapes, the wetland area is of a different nature. The Late Mesolithic sites located in these wetland contexts are situated in the Scheldt-Basin, the Alblasserwaard region, the Swifterbant area and in the wetland-upland border region. This indicates that they are situated in or adjacent to (developing) wetlands. Around 10.000 BP (9000 cal BC) the sea level was still 40-50 meters below NAP. A large part of the North Sea basin lay dry. At the start of the Atlantic, 2000 years later, the present coastline came into existence as the sea encroached ever further inland (*cf.* De Mulder *et al.* 2003, 216-217; Van Gijssel/Van der Valk 2005, 66-68). This transgression of the North Sea and the related rise of the groundwater level mainly affected the lower lying areas such as the central river district, the IJsselmeer Basin and the northern parts of the provinces of Friesland and Groningen. These areas may be characterised as sedimentation basins under influence from both the sea and river systems from the hinterland (De Mulder *et al.* 2003, 16; Zagwijn 1986, 27). A number of coastal and fluvial wetland landscapes came into existence that were buried or eroded again as the influence of the sea expanded, shifting the entire system further to the east (Berendsen 1997, 153-180; Louwe Kooijmans 1985, 25-28; Van Gijssel/Van der Valk 2005, 66-68). These gradients became more or less fixed as sea levels decreased at the onset of the Subboreal (*c.* 4050 cal BC; Gehasse 1995, 194).

The character of the wetlands differed from east to west. The riverine area formed a dynamic environment of deposition and erosion contrasting with extensive bodies of Pleistocene upland to the north and south. West of this area, wetlands comprising riverine elements as well as lakes are characterised by a freshwater peat environment, while further west brackish estuarine conditions existed and even further west a landscape characterised by salt marshes and tidal flats (see map '5500 BC', in Vos *et al.* (eds) 2011; Van Gijssel/Van der Valk 2005). In the IJsselmeer basin and the Scheldt valley similar conditions existed with water and peat formation forming an increasingly important feature of the landscape. The landscape of the Swifterbant area can be characterised as a tidal

area with creeks, levees and backswamps (Ente 1976; Hacquebord 1976; De Roever 2004). The Scheldt valley becomes increasingly characterised by alder carr and peat growth during the Atlantic, turning the area next to the river into a peat fen (Crombé 2005^b; Louwagie/Langohr 2005). Occupation in or near these (developing) wetlands usually occurred on higher elevations such as river dunes. In the Alblasserwaard area these are named 'donken' and some 80 have been documented. These are the outcropping tips of river dunes of Pleistocene origin forming the dry elements in what must have appeared an archipelagic setting (see Verbruggen 1992^b, 119; see also Louwe Kooijmans/Verbruggen 2011). River dunes were also occupied in the Swifterbant area, while the landscape bordering the Scheldt is characterised as coversand with Late Glacial dunes (Louwagie/Langohr 2005). Other raised landscape elements in the wetland margin include coversand ridges (see for instance Hoge Vaart or Maaspoort, Appendix I).

The ecological characteristics of the wetland area differ distinctly from the coversand landscape. For the central river area a variety of ecotones and plant communities in mosaic-like patterns is postulated (Out 2009, 50). The drier parts featured deciduous lime/oak woodland, while the wetter areas were characterised by softwood alluvial woodland vegetation, alder carr, marsh and river bank vegetation. As water levels increased the dunes became smaller and the oak lime vegetation gradually became replaced by a typical marsh forest (*ibid.*, Bakels/Van Beurden 2001). Similar developments may be postulated for the Swifterbant area with a rough distinction between more deciduous woodland in the higher area and an alder carr vegetation in the wetter areas (for more details: Casparie *et al.* 1977; Van Zeist-Palfenier-Vegter 1981; Out 2009, 177). In the Scheldt valley around Doel the wetter parts are also characterised by an alder and sedge vegetation, developing into a fen carr in the Late Atlantic (DeForce *et al.* 2005, 121, 124-126; DeForce *et al.* 2013).

These wetlands provide a rich habitat for flora and wildlife (*e.g.* Bakels 2005; Louwe Kooijmans 2003; Nicholas 1998^{a,b}; 2007^{a,b}; Out 2009; Van der Noort/O'Sullivan 2006). This includes specific wetland species such as waternut and tubers of (white) lily, as well as otters, beavers, fish and waterfowl (*e.g.* Louwe Kooijmans 1993^a; Zeiler 1997). It is evident that the importance of these aquatic resources should not be underestimated. From an economical and functional perspective these were very rich environments that differed from upland environments both quantitatively and qualitatively (*e.g.* Nicholas 2007^a; Van der Noort/O'Sullivan 2006). Despite their internal dynamics they offered a relatively stable and bountiful environment for occupation.

5.3.1.4 River valley/valley floor

River valleys form a final category that is partially regionally defined as well as geographically. It includes four sites with a riverside or stream valley setting. These locations are directly associated with a stream or river (instead of being located on a higher feature in the landscape as is often the case in the group of wetland sites). In two cases this involved the larger valley of the Meuse at or near Liège, in one case the nearby tributary of the Amblève and in another Jardinga on the banks of the Tjonger. Although the valleys have older origins, the sediments mainly consist of Holocene deposits of gravels, loam and sandy loam (see Appendix I).

Recently, archaeological attention has re-focused on river and stream valley locations, both in the Netherlands and abroad (Bell *et al.* 2006; Rensink 2004; Stoepker 1997). It is evident that potential past motivations for settling next to rivers and streams focused in part on the advantages this offered with respect to the diversity of wildlife, botanical resources and water. In this respect these zones are comparable to the wetlands (see Crombé/Cauwe 2001, 50), their floodplains, and especially the riparian areas forming the more important ecotones in the landscape (see also Brown 1997, Chapter 4). For the Atlantic period in particular the river valley environment and associated flora forms a diversification within the (loess and coversand) landscape (see Bakels 1978). This not only concerns the wide range of plant and animals typical for these types of aquatic or riverside settings, but in particular also other animals that are drawn to it. River valleys are thus elements of diversification in the landscape whose richness may provide a buffer function. As with the wetland and wetland margin settings mentioned earlier the importance of aquatic resources and transport should not be underestimated (Ames 2002; Louwe Kooijmans/Verhart 2007).

The rationale behind this category is mainly based on the notion that the occupation of locations adjacent to running water form a characteristic choice in occupation location and potentially a logical complementary counterpart in a regional settlement system. This is governed by the presence of running water and the possibilities it offers. These sites are located in energetic environments, which may impede discovery, either because of complete or partial erosion or subsequent sedimentation (*e.g.* Brown 1997; Gifford 1978; Schiffer 1987; Sommer 1991).

From a geological and ecological point of view these locations should not be treated as *partes pro toto*. Their development, character and scale might differ per river floodplain and stream valley.

5.3.2 Sites and groups

Having introduced the selected sites (fig. 5.1) and the regional geographical and ecological context, the former may be categorized in four groups and a number of exceptions to these. The groups are of a regional character (and hence related to the geographical and ecological context provided above). This does not mean that all site location settings are comparable, only that there are similarities in their mutual backgrounds.

The division in groups is not used as an absolute distinction, but as a framework for comparison. This can only be done when the internal variation within the groups and the exceptions are taken into account. The validity of the groups is therefore variable and this implies that there are also sites that do not fit the profile exactly.

The 'southern coversand landscape group' is quantitatively and qualitatively the most coherent and consistent, with seventeen sites, two consisting of multiple locations, in largely comparable settings. The 'northern coversand landscape group' has a quantitatively smaller data-set, comprising six sites situated in diverse site settings with one consisting of multiple locations. The 'western wetlands and wetland margin' is formed by twelve sites, including some with multiple locations. Sites in this group are situated in a distinct wetland setting such as both Hardinxveld locations, but also include the Swifterbant river dune sites and Hoge Vaart, locations that are situated in a landscape that is gradually becoming more

wet. The valley floor or river valley group consists of three sites in the Ardennes-Meuse area with a comparable river valley setting. Additionally the special activity site of Jardinga was placed in this group because of its brook valley setting.

The division in groups is based on regional arguments and, in one case, the river valley group Jardinga site. Below a brief summary of the group characteristics is presented, followed by a discussion of the exceptions or difficult attributions per group.

5.3.2.1 Group 1: southern coversand

This group is characterised by sites situated on elevations such as coversand dunes and ridges on the southern Pleistocene coversand landscape. These sites are often located in the vicinity of meres or peat fens (Dutch: *vennen*) or small streams. All of the sites selected for this group generally fit this classification. Although there are of course internal differences in site size, duration and composition of features and finds, the overall characteristics are homogeneous and comparable.

5.3.2.2 Group 2: northern coversand

Sites in this group are situated on dunes, ridges and other outcrops (*e.g.* boulder clay) in the northern coversand landscape. Most known sites are situated on the Frisian-Drenth boulder clay plateau. There is some difference in the site settings that will be discussed below. Since the number of sites in this group is much more limited the resulting image is more heterogeneous compared to that of the southern coversand landscape, although differences between occupation in both types of landscape may be more of degree rather than kind (see also landscape characterisation description above).

Mariëenberg-Schaapskooi

This site is part of the group of sites on the northern coversand landscape. The site, characterised by hearthpits (Verlinde/Newell 2006), is not situated on the Frisian-Drenth boulder clay plateau, but further south at the edge of the wide (*c.* 1 km) Vecht valley. Although it is not known whether the nearby meander of the Vecht was active at that time, the site location appears to be associated with the river valley and the high vantage point it offers over it (see Appendix I). Since it is not situated in the river valley next to the stream itself, it is not attributed to the group of river valley sites. In fact its position on a coversand ridge and overall characteristics do not preclude its placement in the group of northern coversand sites.

5.3.2.3 Group 3: wetlands and wetland margin

This group is a generic category formed by sites situated mainly on river dunes in the delta (Alblasserwaard region), the Scheldt valley, the Swifterbant area and the wetland margins of the current Noordoost Polder and southern coversand landscape. For this group it is important to understand that sites attributed to it are situated in 'different degrees' of a wetland setting, as argued above. There is thus a distinction between sites that are situated in a complete wetland environment

and those that are characterised by dry elements in their hinterland or developing wetland conditions. These differences also define some of the exceptions relevant to this group.

Melsele-Hof ten Damme and Oudenaarde-Donk

Both Melsele and Oudenaarde are attributed to the wetland group (see table 5.1). Based on their geographical location this is not problematic, but it is questionable to what extent a wetland situation existed or was present nearby during occupation. Melsele is situated in the Lower Scheldt Basin on a Late Glacial dune in the wetland margin (Van Roeyen *et al.* 1992, 41). A radiocarbon date around 5300 BP (*c.* 4100 cal BC) indicates deposition of brackish sediments. Palynological evidence also points to a brackish environment (*Chenopodiaceae* and algae) with tidal influences. Pollen from these sediments indicate a heavily wooded environment comprising, among others, alder (40%), oak (20%) and lime (10%) as well as herbaceous plants. This points to a wet environment. From 3100 cal BC, the dune is covered with peat. Palynologically this situation may also date to the Atlantic, although actual deposition at the dune only took place in the Subboreal (*ibid.* 45-46). It is thus difficult to estimate to what extent the wetland conditions also characterised the nearby environment during the Late Mesolithic, but the site was at least situated in an area that was increasingly becoming a wetland.⁶

Oudenaarde is situated on a Pleistocene point-bar system of the Scheldt River in the Middle Scheldt Basin (Belgium). During occupation the area became increasingly wet before being covered with peat and clay in protohistoric and Roman times (Parent *et al.* 1987^a, 7-8). The site is situated in the Scheldt valley but the width of this valley may be estimated at *c.* 2 km. It is therefore not appropriate to attribute the site to the river valley group. The site is in fact located between two Late Glacial depressions. In between these there is an area of interspersed 1.5 m high ridges belonging to a fossil point bar system of the Scheldt. Due to the rising groundwater table in the Holocene the depressions were gradually filled up.⁷ Palynological information from the fossil channel indicates a forest consisting of oak, hazel, lime and elm for the Atlantic and Subboreal part of the sequence. In the wetter parts alder (*Alnus*) replaced willow (*Salix*). Macrobotanical remains indicate a wet, riparian environment as well as more ruderal vegetation (Parent *et al.* 1987^a, 10-13; De Ceunynck *et al.* 1985).

Based on the geological and ecological information it is difficult to establish to what extent the site was situated in or near a wetland area during its Late Mesolithic occupation. It is evident that this was the case during the Neolithic occupation. An interpretation as a site situated in a (developing) wetland or wetland margin seems most appropriate.

Hoge Vaart-A27 and Urk-E4

Similar problems of interpretation arise in the attribution of two other wetland margin sites: Hoge Vaart and Urk. The latter site is located on a river dune along an earlier course of the Vecht (Peeters 2007, 209). Until *c.* 4500 cal BC the site was located in an increasingly wet environment with both open water and peat growth. Around 4100 marine influence increased and in part of the area a freshwater tidal regime developed. From 3450 cal BC onwards marine influence decreased again and extensive peat growth took place. This continued until around 3400 cal BC when the entire dune was covered (Peters/Peeters 2001, 17-22, 112, 117). Evidently

the site became a genuine wetland location during the 5th millennium (see also Out 2009, 196), which postdates the Late Mesolithic phase with hearthpits dating between 7000 and 5000 cal BC. While this would potentially allow an attribution to a group of northern coversand sites, its location around 5500 cal BC (see map '5500 cal BC' in Vos *et al.* (eds) 2011, 42) accentuates its proximity to the wider wetland area, while the later developments confirm this position as a wetland margin site.

Hoge Vaart is situated on a coversand ridge, which forms a foothill of higher positioned sandy soils connected with the Gooi and Veluwe areas. To the west the ridge slopes into a flat landscape. To the east an old channel - most likely of the Eem - forms a low-lying area. Early in the Holocene peat formation took place. On top of the peat a colluvial layer of sand, originating from the dune, was deposited in the Boreal or early Atlantic. Clastic, organic and sandy deposits from 5400 cal BC subsequently covered this layer. This indicates that the area became increasingly wet because of the rise in sea level and concomitantly groundwater table. Between 5100 and 4900 cal BC aquatic sediments were deposited. Over time the site became covered with Holocene sediments. After 4500 cal BC habitation was impossible. The vegetation on the dune is characterised by a lime and hazel forest during the Boreal and the Early Atlantic (3BC-horizon).

Unfortunately information on the vegetation of the low-lying area is missing for the Boreal and the Early Atlantic, but alder probably grew in the wetter parts. During the Atlantic, oak increased and the vegetation on the dune opened up, consisting of species such as alder, ash, willow, garden sorrel and ferns. In the low-lying wet area there was marsh and reed vegetation (Peeters/Hogestijn 2001, 27-28; Spek *et al.* 2001^{a,b}). Based on these developments it can be stated that at least during the latter part of its Late Mesolithic hearthpit occupation (*c.* 5500-4850 cal BC; Peeters 2004; Peeters *et al.* 2001, 15) the site was situated in a wetland environment. Before that the area became increasingly wet, indicating a position in a developing wetland, or as a wetland margin site (see Peeters 2007, fig. 3.12).

Willemstad and 's-Hertogenbosch-Maaspoot

Two other wetland sites should briefly be mentioned: Willemstad and Maaspoot. Maaspoot is situated on the edge of the North-Brabant coversand area, bordering on the wetlands of the central Dutch river area (see Verhart/Wansleben 1991). Sites like this have been hypothesized to form possible summer counterparts for sites in the wetlands, like Hardinxveld. Unfortunately the artefactual and contextual information of the site is limited and no Late Mesolithic artefacts or faunal assemblage could be isolated (see Appendix I). The Willemstad site is known for the small wooden figurine that was found there, radiocarbon dated to *c.* 5400 cal BC. The site was situated on a sand ridge in a freshwater tidal estuary. Based on its position on the palaeo-geographical map (5500 cal BC; Vos *et al.* 2011, (eds) 43) the site is situated in the tidal area and may be classified as a wetland location. Unfortunately no further finds or contextual information are available for the site.

5.3.2.4 Group 4: river valley/valley floor

These sites are characterised by a common settlement location in the valley of a river, brook or stream. Their common denominator is therefore a settlement location choice that is directly and distinctly situated in a floodplain or riverine situation. In that respect these sites form potentially interesting counterparts for sites in settlement systems that also incorporate other environments. This makes them of complementary interest in relation to the other groups, most notably the southern and northern coversand landscape groups. Three of the sites in this group were situated next to the Meuse and its tributaries in the foothills of the Ardennes. They are therefore also of distinct regional value. The site of Jardinga on the banks of the Tjonger is clearly a special activity location and therefore of a different nature (see below). The site of Nijlen-Varenheuvell is a potential fifth candidate, but unfortunately has not yet yielded enough evidence for further interpretation (see Appendix I).⁸

Jardinga

Jardinga is part of the group of river valley sites, but is a case in and of itself. It should be considered a special activity site since it represents an aurochs butchering location (Prummel *et al.* 2002). Although the group as a whole is small, this site is functionally different and should not be interpreted as typical for a residential river valley occupation (*cf. supra*). Furthermore it is situated far north, while the other sites are of a general (domestic) nature and located far to the south, along the Meuse and its tributaries.

5.3.2.5 Partial patterns

It is obvious that in the formation of these groups a lot of ground is ‘literally’ not covered. This includes the loess zone in the south, large parts of Flanders outside the Campine area, the central part of the Netherlands (Veluwe area, Gelderland, large parts of Overijssel) and the western part of the Netherlands including the coastal area. A number of reasons for this have been given above (see section 5.3; see also Verhart/Groenendijk 2005). Currently the scarcity of excavated sites with a distinct Late Mesolithic signature in these areas forms a research bias. The sites that are available and their regional connotations may provide an idea of the original variability that may have been present and may yet, at least to some extent, be uncovered.

5.4 The Late Mesolithic – settlement ‘grammar’

Having introduced the dataset and its limitations, attention will now focus on a comparison of the grouped sites with respect to a number of themes. These include a general approach focusing on what may be termed settlement ‘grammar’ (*cf.* Cribb 1991, 2), involving site location choice, site structure and features, and investment (in section 5.4), with the purpose of distinguishing similarities and differences between sites in the documented settings. This is followed (in section 5.5) by an analysis of the artefact assemblages and aspects of raw material choice. The object is to document whether there are perceivable differences in Mesolithic

land-use, mobility and interaction in relation to the environment and between the distinguished regional groups. The reader is referred to Appendix I for further information at the level of the site.

This section focuses on the locations and characteristics of sites in the landscape. Since many details for comparison have become obscured by post-depositional and taphonomic factors (see Chapter 4; Sommer 1991) it is important to combine a number of perspectives in order to establish an idea of the types of sites and settlements that may have existed.

5.4.1 Historical aspects and perspective

Mesolithic settlement models may shed light on land-use and mobility patterns. Much research has been directed at analysing aspects of lithic distribution (Mellars 1976^a), such as spatial and functional properties. For the LRA two general models have been made, based on site size and artefact counts (Newell 1973; Price 1978). These are presented in table 5.2 and fig. 5.2.

In both models site-functions are attributed to the classifications. In Newell's model types A and D are base camps, and B and C subordinate camps, in Price's model types 2,3 and 4 are base camps, 1 is an extraction camp and 5 an aggregation camp (based on the site of Rotsterhaule; Lanting/Van der Plicht 1997/1998, 107). Price also includes group size and duration of occupation (1978, 90-95).

Newell (1973, 402-404) also comments upon features. At type A sites there is a coincidence of the distribution of tools and features, while both find themselves within the distribution of waste. Within type B sites features and tools are located within the maximum distribution of waste. Type C sites might consist of up to three or more concentrations sometimes including a hearth.

The main critique of both models (*e.g.* Lanting/Van der Plicht 1997/1998, 108, 115-116; Niekus 2006, 45; Peeters/Niekus 2005, 222-223; Raemaekers 1999, 130; Verhart/Groenendijk 2005, 168; Verhart/Arts 2005, 240-241; Whallon 1978, 33) is that sites that are often incompletely excavated or analysed, and sites from different periods and regions are combined in an ethnographically inspired settlement model. Moreover, little attention is paid to the fact that sites were frequently reoccupied for different purposes (*cf.* Binford 1982; 2002; see Chapter 4). Artefact distribution and counts therefore also relate to factors such as time, group-size, re-use of locations and diversity of activities.

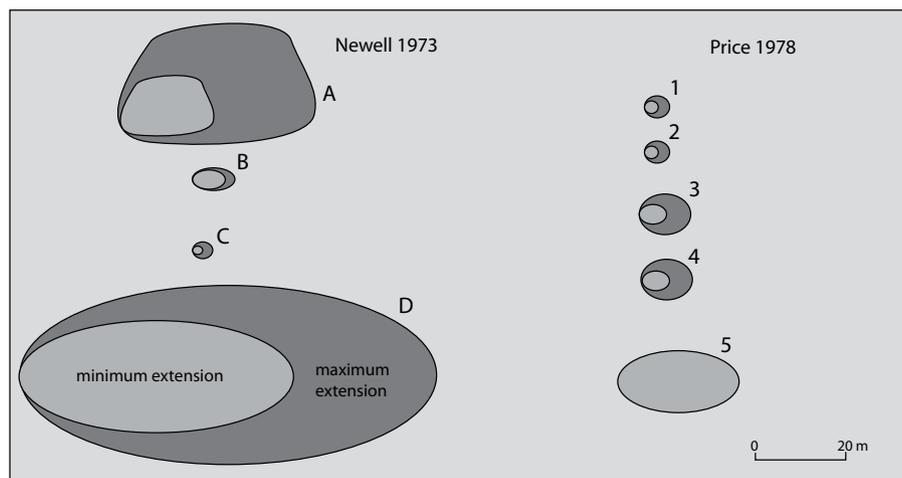


Fig. 5.2 Schematic representation of morphological categories of site types defined by Newell (1973) and Price (1978), including minimum and maximum extents per type.

Newell 1973							(based on 40 sites)
Type	L (m)	W (m)	Ø (m)	surface (m ²)	shape	N artefacts	N tools
A	20.5-40	13-26		266.5-1040	trapezoidal		153-400
B	7-9	4-5		28-45	oval		34-40
C	2-4.3	1.5-3.5		3-10.5	round		6-37
D	60-92	27.2-40		1632-3680	elliptic		5000-5500

Price 1978							(based on 17 sites)
1 (small site)			2-5		circular-oval	< 1000	< 25 tools, predominance of 1 type group
2 (small site)			2-5		circular-oval	< 1000	< 25 tools, low counts for major type groups
3 (medium sites)	5-10	4-8		30-100	elongated-oval	1500-2500	
4 (medium sites)	5-10	4-8		30-100	elongated-oval	2500-10000	fewer scrapers, more cores
5 (large sites)				300 (Rotsterhaule)	incorporating concentrations		

Table 5.2 Typological classification of Mesolithic sites by Newell (1973) and Price (1978).

On the positive side, hunter-gatherer landscape use is tethered to places, which is why a macro-analysis of sites, including artefacts, features and dimensional aspects can be useful if distorting factors are taken into account and questions are aimed not at the level of site function, but at the (larger) scale of general similarities and differences between regional patterns and overall trends in site characteristics in relation to the landscape and environmental situation.

5.4.2 A settlement 'fabric' approach: texture, grain, redundancy

In order to compare the different (structural) aspects of Late Mesolithic sites and their internal relationship a combined and integrated approach is most useful. An appropriate framework for this might be based on the 'fabric' qualities of 'redundancy', 'grain' and 'texture' as introduced by Cribb (1991, 2). Redundancy in this respect reflects the intensity and investment at sites as evidenced, for instance, by features and artefact density. Zooming out, grain results from the (spatial) structuring or patterning ('the weave') of individual elements at sites with respect to one another. Texture finally forms the broadest, geographically oriented perspective and deals with the overall articulation and positioning of sites in the landscape.

Late-Mesolithic sites will be analysed using these concepts as a general framework. Although not all qualities may be recorded at every site, the aim is to understand more of the 'grammar' and variability underlying Late Mesolithic settlement organisation. To remain in the terminology proposed by Cribb (1991) an idea of the actual 'fabric' of Late Mesolithic settlement may be given. In the following these three different and interrelated aspects will be discussed, starting with the landscape scale and subsequently zooming in on site-related patterning.

5.4.3 Site location choice: the texture

The differences and similarities in site locations are informative with respect to the factors that govern settlement in a particular area. These include people's purpose and desires, as well as the possibilities offered and constraints imposed by the environment. Both determine the character of occupation. Ethnographic and archaeological studies have revealed that many factors impinge upon choices of site location, most notably the presence of resources such as water, raw materials,

actual or anticipated biomass as well as archaeologically less visible factors, such as territoriality, mating networks and other socio-cultural aspects (*e.g.* Binford 1978^a;1980; 2002; Jefferies *et al.* 2005; Jochim 1991; Kent 1992; Kent/Vierich 1989; Politis 1996; Watanabe 1968; Wood 2006). These factors, often over prolonged periods of time, lead to a repeated frequentation of certain locations and to accumulation of debris. From an archaeological point of view these locations can be characterised as persistent places (Barton *et al.* 1995; Schlanger 1992). This does not, however, mean that the reason for their chronological depth remained the same through time. Most of the sites in the defined groups yielded evidence for frequent use throughout the Late Mesolithic. Their characteristics in combination with the regional context provide clues pertaining to the nature of occupation and potential differences.

5.4.3.1 Locational characteristics: southern coversand landscape

The majority of sites in group 1 (southern coversand landscape) is situated on the top or slope of Late Glacial coversand ridges or dunes. As argued above this micro-relief characterises much of the region. These elevations are all situated in the vicinity of water in the form of meres or peat fens and streams (see table 5.3).⁹

Most sites are slightly above the waterfront and almost all are exposed to the south. This type of location indicates a strong relation to the local topography which is typical for the Campine area in the Mesolithic (*e.g.* Arts 1989; Deeben/Arts 2005; Van Gils/De Bie 2006; 2008; Van Gils *et al.* 2009, 263; see also Vanmontfort *et al.* 2010^b). Several factors may be mentioned that could be regarded as important for settlement location choice, including the presence of open water, both as a resource and for the biodiversity it creates. Another factor may have been formed by optimal (longest) exposure to sunlight and heat (Van Gils/De Bie 2008), or shelter against prevailing winds (see Deeben/Arts 2005, 151). While the elevations are low, the choice for a southern slope may also relate to the fact that water is usually found on this side. This often pertains to the general layout of the landscape (including dunes and meres or peat fens) and its formation by aeolian sedimentation processes.¹⁰ Furthermore there is the potential presence of

Table 5.3 Geographical setting of Late Mesolithic sites on the southern coversand landscape (see Appendix I and references for additional information).

site	geom. setting	situation/orientation	water	location water	other
Brecht-Overbroek	SW-NE coversand ridge	top/slope, S?	fen/stream	S, (stream), vicinity	part of site complex
Brecht-Moordenaarsv. 2	E-W coversand dune	slope, S	fen	S, c. 50 m.	
Brecht-Thomas Heyveld	coversand dune	top/slope	large depression/fen?	E, 'associated'	
Dilsen-Dilserheide III	SW-NE coversand ridge	slope, S/SW	spring	SW, unknown	Neolithic occupation
Helmond-Stiphoutsbroek	S-N coversand dune	slope, SE	stream	W/SW, direct vicinity	Neolithic occupation
Lommel-Molse Nete	E-W valley slope	slope, S	stream	S, direct vicinity	
Lommel-Vosvijvers	SW-NE coversand dune	below top, S?	stream	S/SE?, c. 60 m.	
Meeuwen-In den Damp I	S-N coversand ridge	slope, W	stream/fen	W, c. 50 m?	
Merselo-Haag	E-W coversand ridge	top/slope, S	stream/fen	S, direct vicinity	
Opglabbeek-Ruiterskuil	SW-NE coversand ridge	top/slope, S	fen	S, c. 15 m.	
Turnhout-Zwarte Heide	coversand ridge	slope, S?	fen	S and SW	
Weelde-Paardsdrank	SW-NE coversand ridge	top/slope, SW?	fen	S/SW, c. 50 m.	pottery
Weelde-Voorheide	E-W coversand ridge	-	-	-	

raw material, specifically locally available rolled nodules, providing an important component of the lithic assemblage.¹¹ Light, water and resources therefore appear to have formed primary conditions for somewhat more extended stays of a more general character (*cf.* Binford 2002, 185-187).

The characteristics of site location choice in this region appear relatively homogenous and are comparable to (contemporaneous and earlier) Mesolithic occupation in neighbouring regions such as Sandy Flanders (compare Crombé *et al.* 2011^b; Deeben/Arts 2005, 150-151; Van Gils *et al.* 2009, 263). A number of factors form the basis for a repetitive use of this landscape that result in similarities in archaeological patterning and are suggestive of continuity in behavioural aspects related to the positioning of sites in the landscape.

5.4.3.2 Locational characteristics: northern coversand landscape

Unfortunately the number of excavated Late Mesolithic sites in this group is low in comparison to the southern coversand landscape. Sites are situated in a variety of locations (see table 5.4).

Sites in the northern coversand landscape lack the distinct homogeneity in settlement location choice that was inferred for sites in the southern coversand landscape. Yet, although the limited numbers demonstrate some variability this does not mean that site location choice was different. As in the south, sites are situated on elevations such as coversand dunes on the foothills of a moraine ridge (Casparie in Beuker 1989), small and steep sandy hillocks (Huiskes 1988) forming the higher part of a belt of sand, or the circular ‘blown’ ridge of Havelte (Price *et al.* 1974). Water is usually found in the immediate vicinity of the site and is sometimes of considerable extent. East of Bergumermeer an extensive low-lying till zone formed a basin in which the later lakes Bergumermeer and De Leyen developed, in relation to which the site was strategically situated in the Late Mesolithic (see Casparie/Bosch 1995, fig. 9). At Havelte the area enclosed by the ‘blown-out ridge’ became increasingly wet during the Atlantic as was demonstrated by the formation of *Sphagnum* peat. Water could also have accumulated there (Price *et al.* 1974, 14). The extensive site of Mariëenberg is located on a ridge several meters above an old meander of the Vecht. Nieuw-Schoonebeek is bordered on both sides by wide valleys within which running fresh water could be found, while the Schoonebekerdiep provided another source of water (Casparie in Beuker 1989, 182-184). The sandy hillocks at Tietjerk were located south of open water, while N-S oriented creeks might have separated the different tops (Huiskes 1988). In contrast to the south, the northern sites do lack a distinct southern exposure.

Table 5.4 Geographical setting of Late Mesolithic sites in the northern coversand landscape (see Appendix I and references for additional information).

site	geom. setting	situation/orientation	water	location water	other
Bergumermeer-S64B	NW-SE, coversand ridge, southern shore	top, exposure, north, south, east	lake Bergumermeer/ De Leyen	NE-S, 100-150 m	nearby knoll occupied (c. 90 m); low till zone
Havelte-De Doeze	circular ‘blown-out ridge’	top eastern part ridge	inner depression	SW, c. 50-100 m	push moraine SE; other localities ridge occupied
Mariëenberg-De Schaapskooi	NE-SW, high coversand ridge	top ridge	valley of the Vecht	W, unknown, possibly immediate	nearby sites; located near valley
Nieuw-Schoonebeek	coversand dune S. extension Hondsrug	two plateaus on top ridge, sharp drop to the east	two wide gullies	N/E, c. 20 m?	ice pushed ridge 1 km S; Schonebekerdiep
Tietjerk-Lytse Geast I	Steep sand hillock(s)	top and slopes	open water; creeks	immediate open water N; creeks W/E	hillocks occupied; peat-land, bog lake nearby

It might be argued that next to the diverse geomorphological settings and the vicinity of water, there is an overall focus on gradient-rich environments. All sites are situated at an ecotone, or the transition of two or more distinct ecological zones. Site location choice in the northern coversand landscape therefore appears less homogenous and perhaps focused on larger ecotones. In combination with the characteristics of the landscape (lakes, moraine subsoil, different drainage patterns and peat growth), it offers a somewhat different picture of Late Mesolithic occupation choice. It concerns a difference of degree, rather than kind, since essentially, comparable locations were sought after.

5.4.3.3 Locational characteristics: wetland and river valley locations

Site location choice in the wetland and wetland margin group as well as in the group of sites situated in river valleys is summarized below (see tables 5.5 and 5.6).

The site of Polderweg is located on the top and slopes of a river dune. The delimitation of the site extent (Mol 2001^a, fig. 2.5) shows a southern orientation, which may have been determined by exposure to the light and heat of the sun as well as the proximity of water (*ibid.* 51). During phase 1 the site was situated at the transition from an area with open water to a peat swamp (Mol 2003). The site was exposed to open water on at least one side (Bakels/Van Beurden 2001, 357). The situation around De Bruin is comparable (see Mol 2003). Crevasse channels linked the site to open water, which is confirmed by the presence of two canoes and a potential landing stage (Louwe Kooijmans/Nokkert 2001, fig. 4.27). The other sites are situated in what may best be termed an increasingly

Table 5.5 Geographical setting of Late Mesolithic sites in wetlands and wetland margins (see Appendix I and references for additional information).

site	geom. setting	situation/orientation	water	location water	other
Hdx-Polderweg (phase 0-1)	river dune (donk)	top/southern slope	lakes, marshes, channels	within wetland	De Bruin at c. 1 km; increasingly wet environment
Hdx-De Bruin (phase 1)	river dune (donk)	SE slope	lakes, marshes, channels	within wetland	Polderweg at c. 1 km; increasingly wet environment
Melsele-Hof ten Damme	coversand margin	E slope	floodplain Scheldt	nearby	
Hoge Vaart-A27	N-S oriented coversand ridge, foothill	top and eastern slope	palaeochannel of the Eem valley	E, immediate	dry forest, alder carr, reedlands and open water
Oudenaarde-Donk	ridge, point bar system		floodplain/channel Scheldt	(S), immediate	increasingly wet environment
Swifterbant-S11/12/13	river dune	NE/centre/W top	stream/creek	vicinity	increasingly wet environment (5500 cal BC)
Swifterbant-S21	river dune	N top	stream/creek	vicinity	increasingly wet environment (5500 cal BC)
Swifterbant-S22/23/24	river dune	N/W top/slope	stream/creek	vicinity	increasingly wet environment (5500 cal BC)
Swifterbant-S61	river dune	NW (top)/slope	stream/creek?	-	increasingly wet environment (5500 cal BC)
Swifterbant-S83	E-W, river dune	NE slope	stream/creek?	-	increasingly wet environment (5500 cal BC)
Urk-E4	river dune	SE slope	stream	(S) vicinity	increasingly wet environment until 4500 cal BC

wet environment. Melsele and Oudenaarde, as argued above, may best be termed wetland margin locations (see Van Berg *et al.* 1992; Van Roeyen *et al.* 1992; Van Strydonck *et al.* 1995, table 1). The situation for the Swifterbant river dune sites depended on their individual elevation and location. In general the effects of the sea-level rise in the basin of Lake IJssel, in the form of peat formation, only affected the Swifterbant area from 5400 cal BC onwards. This means that only the last Mesolithic hunter-gatherers would have experienced the formation of wetlands (Deckers *et al.* 1981, 142; De Roever 2004, 6-7). Peeters (2007, 62-64), however, argues that the development of wetlands and the transition to mosaic woodland already started from *c.* 6000 cal BC onwards. Since the Swifterbant sites are located near the main valley of the IJssel-Vecht system, this influence and increasing peat growth from *c.* 5500 cal BC will have been noticeable. These sites should therefore be interpreted as wetland margin locations, compared to wetland sites such as Hardinxveld. Similar changing conditions may be proposed for the site of Urk-E4, located on a river dune surrounded by developing wetlands and Hoge Vaart-A27, situated on a coversand ridge bordering a palaeochannel of the Eem in an increasingly wet environment (Peeters 2007; Peters/Peeters 2001, 17-22, 112-117).

It may be concluded that the Late Mesolithic sites in this group are mostly situated on higher elevations in a wetland or developing wetland area. These range from relatively low dunes or ridges (Melsele, Oudenaarde, Hoge Vaart) to more steep elevations (Hardinxveld river dunes, Urk-E4).

Although Jardinga has been classified as an exception within the group of river valley sites (see above), all sites are situated in the direct vicinity of a stream. The largely comparable Belgian sites are in fact situated in the floodplain of a larger stream or river, at some distance from the actual channel and next to, or bordering on, a fossil channel or small tributary.¹² Both LPS and RSD were positioned at the foot of a slope and are characterised by artificially raised platforms (Gob/Jacques 1985; Van der Sloot *et al.* 2003).

An important factor governing site location choice in the wetlands and river valleys must be the opportunities offered by the rich aquatic environment. This is attested as beneficial to intensive hunter-gatherer land-use, both through ethnographic as well as archaeological research (*e.g.* Kelly 1992; Nicholas 1998^{a,b}; 2007^{a,b}; Price/Brown 1985; Zvelebil 2003^b). For the LRA, the rich organic evidence and seasonal information of sites such as Hardinxveld-Polderweg and De Bruin illustrate the sustainable qualities of these areas (see Louwe Kooijmans 2003). For the river valleys lithic raw material may have formed a further incentive (Bakels 1978; Brown 1997), while in both areas water and streams would have functioned

Table 5.6 Geographical setting of Late Mesolithic sites in river valley locations (see Appendix I and references for additional information).

site	geom. setting	situation/orientation	water	location water	other
Liège-Place St.-Lambert-SDT	floodplain, left bank of the Meuse	in between two fossil channels of the Légia	Meuse, Légia	nearby	located at foot northern slope
Liège-Place St.-Lambert -DDD	floodplain, left bank of the Meuse	bordering depression, possibly fossil channel Légia	Meuse, Légia	nearby	located at foot northern slope
Liège-Place St.-Lambert -Tivoli	floodplain, left bank of the Meuse	bank of fossil channel Légia	Meuse, Légia	nearby	located at foot northern slope
Remouchamps-Station LeDuc	floodplain, left bank of the Amblève	situated on large meander next to a smaller channel	Amblève, tributaries	nearby	foot northern valley slope
Namur	floodplain Meuse	confluence Meuse and Sambre	Meuse, Sambre	nearby	-
Jardinga	floodbasin Tjonger	bank	Tjonger	nearby	peat within boulder clay area/coversand

as corridors for contact and transport (*ibid.*; Ames 2002). These wetland and valley floor sites, as those in the other groups, should not be understood in isolation, but studied in relation to their function in the settlement system of mobile groups, covering other areas as well.

5.4.4 Settlement structure: the grain

Site location choice and topographical situation form a landscape perspective on the characteristics of sites. Zooming in, the (intra-site spatial) structuring of elements at sites with respect to each other (grain, *sensu* Cribb 1991) offers a different scope, related more to occupation behaviour. For the different groups defined a number of characteristics may be sketched. Comparison is unfortunately hampered by post-depositional processes and is quantitatively concentrated on the southern coversand (see Chapter 4).

5.4.4.1 The southern coversand landscape: concentrations, clusters and scatters

In the southern coversand landscape sites are characterised by lithic concentrations of various sizes. Over the past decades many methods have been used to identify these *structures latentes* (*sensu* Leroi-Gourhan/Brézillon 1972), comprising a variety of statistical techniques (*e.g.* Czesla 1990^a, 8-40; Newell 1987; Whallon 1973; 1974). Critique of these approaches has been equally extensive (*e.g.* Kent 1987, 5-8; Stapert 1992, 12; De Bie/Caspar 2000, 29; Chapter 4), based on taphonomic considerations of both natural and anthropogenic character (*cf.* Schiffer 1995). This served to show that the assumptions required for many statistical analyses are often beyond archaeological resolution (Hodder/Orton 1976, 239) and that intricate statistical analyses rarely unravel the many complex processes underlying (lithic) spatial distribution (*cf.* De Bie/Caspar 2000, 29). Their success strongly depends on pristine preservation of the site and a high level of precision in excavation and documentation. With respect to the sites studied here one or more of the above criteria is often not met. Data were often not available digitally and grid- or point-based information was also often missing. The quality of the data and the considerations above have therefore primarily led to a 'visual approach', enhanced by a test case using MapInfo, Surfer and the moving average method.¹³

Moving averages at Merselo-Haag

To test the significance of delimiting spatial concentrations on the basis of distribution plans, the site of Merselo-Haag is used as a test case, based upon the combination of a detailed excavation strategy (25 x 25 cm squares), the considerable extent of the excavation (409 m²) and the fact that most finds were found below the disturbed A horizon, which has been left out of the spatial analysis (see Verhart 2000, 68-72). The analysis was conducted with the aid of Milco Wansleben (Faculty of Archaeology, Leiden).

Based upon the analysis executed by Verhart (2000, 115-127), a total of four (instead of five) concentrations were accepted as spatially significant for the Late Mesolithic.¹⁴ Most important changes involved the recombination of clusters 3 and 4 (see also Verhart 2000, 126-127) and the rejection of cluster 5 (a possible composite tool) in favour of a cluster of burnt flint (6) associated with hearth 4. These units were subsequently measured using the distribution map (Verhart 2000,

Table 5.7 Metric analysis of spatial units defined in the Late Mesolithic zone of Merselo-Haag.

spatial unit	length m	width m	shape
concentration 1	2.4	2	semi-circular
concentration 2	1.2	1.2	circular
concentration 3/4	4.2	2.4	oval
concentration 6	1	0.9	semi-circular (2 units)
scatter	20	8	oval/elongated

fig. 2.25; see Appendix I). Furthermore the encompassing scatter was measured. This could be done tentatively in view of the absence of further concentrations in the testpits surrounding the excavation. This led to the subdivision presented in table 5.7.

Following this, the documented resolution from the excavation plan was generalized by combining the counts per square meter and subsequently ‘blurred’ to 5 m weighted intervals (using MapInfo and Surfer). The effects of the generalization and moving average method can be seen in fig. 5.3 B and C. The combined general counts per square meter projected in 5.3 B confirm and support the distribution and delimitation visible in the 25 x 25 cm units. Furthermore there seems to be a somewhat increased contrast between the western and eastern part of the spatial distribution, which adds value to the initial subdivision proposed by Verhart (2000, 71-78), indicating that the activities in the Early Mesolithic zone may have been of a different nature and intensity. Generalizing the distribution may thus enhance larger scale subdivisions present in the plan. Fig. 5.3 C takes this one step further by ‘blurring’ the distribution at a 5 x 5 m interval. This better visualizes the differentiation present and enables the pinpointing of isolated concentrations. Their density may form an indication of the intensity or frequency with which a site was used. It may also enhance the relationship between large- and small scale activities as well as intra-site place consistency. Of course it should be noted that since we are dealing with multi-period sites, further temporal distinction improves analysis, but this is often not possible.

The moving average results indicate a certain consistency in the size and delimitation of the individual concentrations. This argues against the idea that the dimensions of artefact clustering only result from the resolution achieved in excavation and documentation. Nevertheless – as is shown by the functionally related, yet spatially separate constituents of concentration 3/4 – adjacent phenomena blend into a single shape at a lower resolution. It is thus very likely that some recorded concentrations can be broken down into separate elements at a higher level of detail (see also Czesla 1990^a, 20-37; 1990^b).¹⁵

Metric analysis: an approach

The problems regarding the definition and delimitation of concentrations indicate that a comparative metric analysis of spatial clustering at Late Mesolithic sites can only reveal a very coarse pattern, but also that, to some extent, the concentrations provide information. Nine sites located in the Belgian Campine area and adjacent Dutch coversand landscape were selected. These yielded a total of 36 spatial units that could be delimited and measured. A first problem involved the aspect of delimitation. It was decided to try and incorporate the represented diversity. Three categories were defined for this purpose:

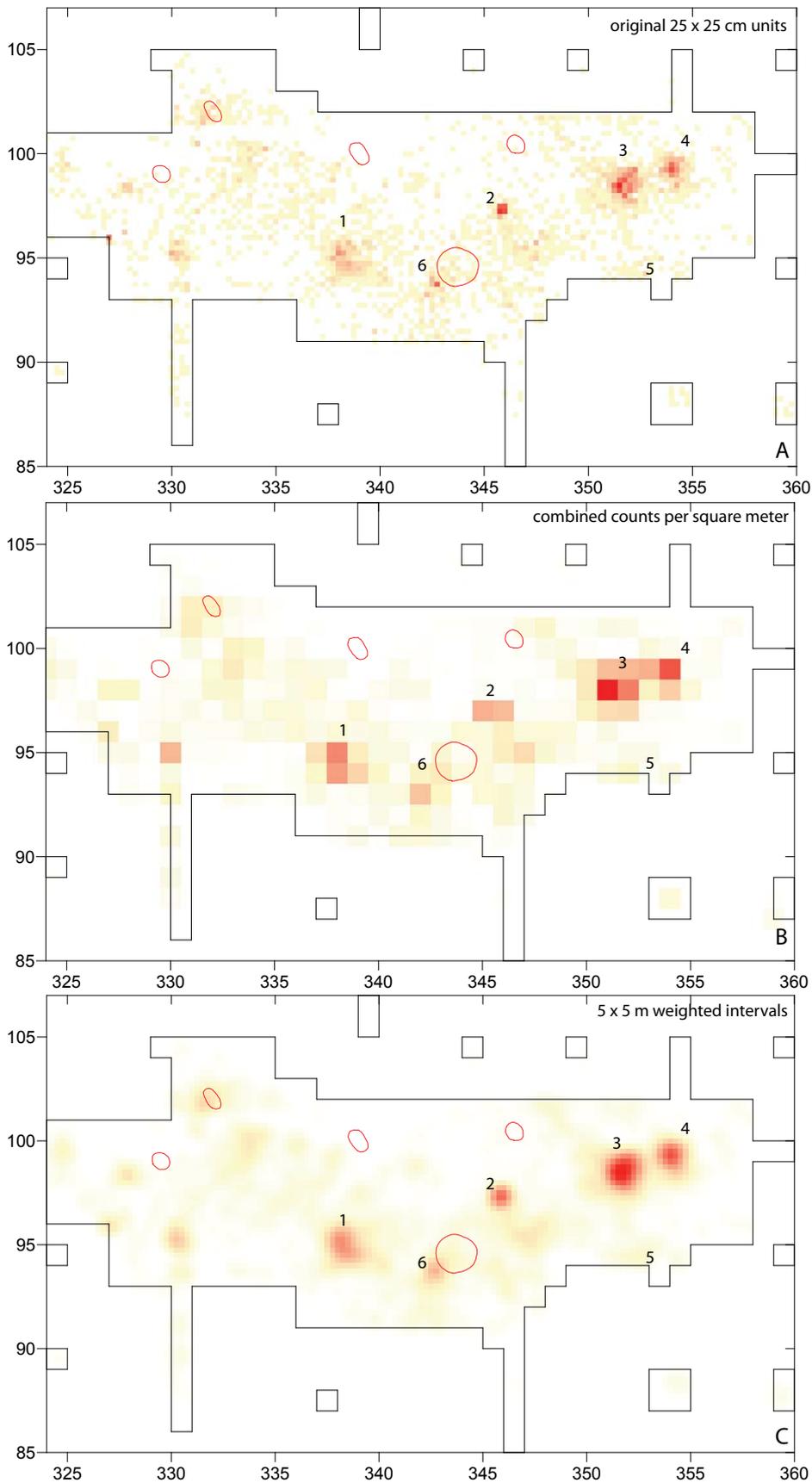


Fig. 5.3 A-C. (A) original 25 x 25 cm distribution of finds at Merselo-Haag. (B) combined counts per square meter, demonstrating general clustering. (C) 5 x 5 m weighted interval showing isolated clustering.

1. The first set of measurements focuses on the smallest spatial units observed within distribution plans of finds. These are termed concentrations.
2. The second set deals with larger more or less homogeneous concentrations of finds, often with one or more accumulations or 'cores' of higher density. These are defined as clusters.

site	spatial unit	length m	width m
Merselo-Haag	scatter	20	8
	concentration 1	2.4	2
	concentration 2	1.2	1.2
	concentration 3/4	4.2	2.4
	concentration 6	1	0.9
Weelde-Paardsdrank sector 1	concentration 1	2.5	1.6
	concentration 2	1.8	1.2
	concentration 3	2.5	2
Weelde-Paardsdrank sector 4	concentration 1	2	1.5
	concentration 2	3	2.5
	concentration 3	3.5	2.5
Weelde-Paardsdrank sector 5	cluster 1	7	3.3
Opglabbeek-Ruiterskuil	cluster H-G	7	3
	concentration H	2.8	2.5
	concentration G	3.6	2.5
	concentration M	4	2
Brecht-Moordenaarsven 2	scatter	14	6.5
	concentration south	4	2.5
	cluster centre	8	5.1
	concentration north	3.5	3.2
Dilsen-Dilserheide III	scatter (testpitted)	60	40
	cluster	8.8	5
	concentration N	2.5	1.25
	concentration south	3.5	2.8
Meeuwen-In den Damp 1	cluster N25E25/(Pilati 2)	10	6
	cluster N11E17/(Pilati 1-1b)	9	5.7
	concentration 1a in N11E17A	3.9	3.9
	concentration 1b	2	2
	cluster S12E8/(Pilati 3)	8	4
	cluster S21E5/(Pilati 4)	7	3.5
Lommel-Vosvijvers	concentration III	4.5	1.5
	concentration II	3	1.7
Lommel-Molse Nete	scatter < 2km (surface)		
Helmond-Stiphoutsbroek	scatter (surface)	300	150
	scatter (excavation)	13.5	7
	concentration	1.5	1

Table 5.8 Metric analysis of spatial units defined for a number of sites in the southern coversand landscape.

- The final set of measurements incorporates both measured and estimated site sizes. This latter category is based upon data from excavations, augering, and survey campaigns and therefore has yielded highly diverse results with respect to site extent. This larger scale of clustering is defined as scatter.¹⁶

Of all units, length (longest axis) and width were measured or documented. A general margin of up to 1 m should be taken into account since the analysis is based upon a visual approach. The results are presented in table 5.8.

The three defined sets of measurements are not readily comparable since they focus on three different aspects of site extent, in some cases retrieved through different methods of documentation.¹⁷ The larger spatial units are, however, often formed by several of the smaller spatial units, occasionally separated by empty zones (*cf. infra*). So there is a certain interrelationship in which the smaller spatial units form ‘building blocks’ for the larger spatial units. The different scales at which these sets of measurements have been documented are combined in fig. 5.4 to visualise these relations.

It is evident that there is a considerable scalar difference between the three groups of measurements, despite the inbuilt inaccuracy. Nineteen spatial units with a length-width ratio of up to 4.5 by 4 m represent the largest group. Demarcated by an evident interval, the next group of eight spatial units falls within a range of 7 x 3 up to 10 x 6 m. The last group starts at *c.* 13.5 x 7 m and includes two outliers of 60 x 40 and 300 x 150 m that are not plotted. These form the total site extent estimates for Dilsen-Dilserheide III and Helmond-Stiphoutsbroek (Luypaert et al. 1993; Arts 1994).

Finally, the dimensions of the shape of the concentrations were also documented (see table 5.9).

Although no absolute trend is observable, circular and semi-circular shapes seem to be largely confined to the group with the smallest dimensions, while oval and elongated shapes tend to characterise groups B and C.

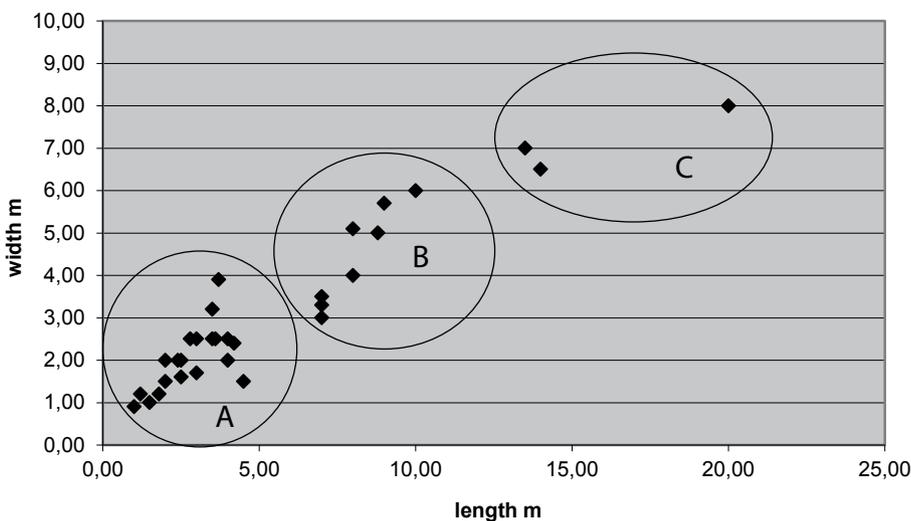


Fig. 5.4 Analysis of length and width of spatially delimited concentrations at sites in the southern coversand landscape. A: concentrations; B: clusters with cores; C: scatters. The two largest scatter measurements form outliers beyond the range of the graph.

Table 5.9 Diversity of shapes per group of dimensions.

shape/group	Group A	Group B	Group C	Total
(semi-)circular	11	1	-	12
semi-circular/U-shaped	1	-	-	1
U-shaped	1	1	-	2
oval	7	5	2	14
oval/U-shaped	-	1		1
oval-elongated	-	-	2	2
Total	20	8	4	32

5.4.4.2 Interpreting concentrations, clusters and scatters

It is clear that more sites with spatially delimited units are necessary to be able to further confirm the pattern and spatial characteristics presented here, yet the data do seem to reveal something of the structure underlying Late Mesolithic settlement in the southern coversand landscape. The constituent elements of this grammar, which are related yet not similar, will now be discussed.

Group A: concentrations

This group is formed by the basic ‘building blocks’ of Mesolithic sites, the individual concentrations of artefacts reflecting a variety of activities. Unfortunately the individual concentrations have only been functionally analysed at a few sites (in most cases this was done for the excavation as a whole or for separate trenches). The few informative sites (notably Meeuwen-In den Damp I, Merselo-Haag and Weelde-Paardsdrank) indicate maintenance, consumption and debitage activities.¹⁸ The general dimensions of group 1 (up to 4.5 m) and its predominant circular shape seem to coincide with the distribution of debitage material in flint knapping experiments, in both sitting and standing positions (see Kvamme 1997, fig. 2, pp. 126). This is further substantiated by the fact that these concentrations also form the nodes of refitted artefacts (*e.g.* Pilati 2001, fig. 6.1; Verhart 2000, fig. 2.42; Vermeersch *et al.* 1992, fig. 32). There is even evidence of the size-sorting characteristics of flint knapping episodes, where the smallest finds cluster in the centre, while larger flakes and debris are found at a greater distance, for instance at Merselo-Haag (Verhart 2000, fig. 2.49-2.51; Kvamme 1997, 125-128). Cores are tossed away even further, as is tentatively demonstrated by the concentrations at Helmond-Stiphoutsbroek and Meeuwen-In den Damp I (Arts 1994, fig. 3; Pilati 2001; 2009).

Another activity underlying the formation of concentrations is waste behaviour. This involves the disposal of primary refuse, such as knapping debris and hearth fills, away from their location of initial use. The character of this secondary refuse (*sensu* Schiffer 1995) may differ (*e.g.* burnt flint, limited artefact size, ash dumps etc.). Unfortunately waste dumps and contemporaneous or anachronistic activity areas need not necessarily be spatially separate as was for example demonstrated at the Federmesser site of Rekem 16 (De Bie/Caspar 2000, 248-249).

The importance of detecting secondary refuse is related to one of the structuring laws defined by Schiffer (1995, 37) presupposing a correlation between an increase in intensity of occupation and a decrease of correlation between use and discard locations. While several sites yielded some evidence for secondary refuse

behaviour, the overall image is one of more or less unstructured *ad hoc* deposition of debris and waste, *i.e.* relatively short-term occupation.¹⁹

It is furthermore remarkable that 11 out of 20 concentrations are associated with hearths or remnants of hearths. Although contemporaneity could not always be established the proximity of concentrations and hearths in general indicates a functional relationship characterised by activities and/or social interaction in need of light and heat. The hearths will be further discussed below.

Group B: clusters

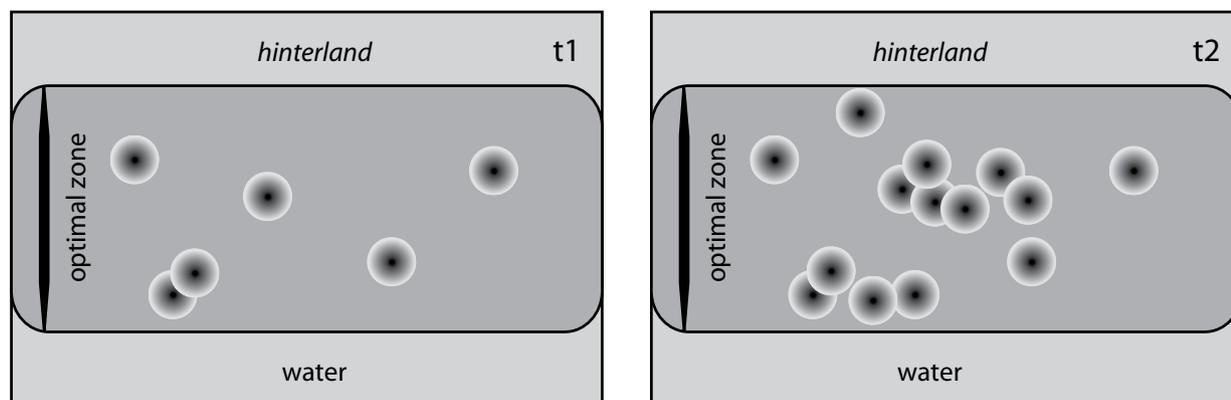
The second group consists of the spatial aggregations of the smaller concentrations discussed above. There is a difference in the extent to which the underlying individual concentrations can be recognized visually. At some sites the excavation strategy and graphic representation do not allow a detailed analysis of the number and size of concentrations. For instance, only two opposing circular concentrations can be made out at Dilsen-Dilserheide III (see Luypaert *et al.* 1993, fig. 5b). Other examples are Opglabbeek-Ruiterskuil (Vermeersch *et al.* 1974; fig. 4) and Brecht-Moordenaarsven 2 (Vermeersch *et al.* 1992, figs. 23 and 31). At other sites accumulations of lithics are visible (sector H-G at Opglabbeek and the central section of Brecht), which may be interpreted as individual concentrations or clusters of concentrations. This also explains why multiple hearths are associated with these clusters.

The dominance of oval shapes in this group may be explained as a result of the ‘linking up’ of partially overlapping concentrations (see fig. 5.5). This effect is enhanced by the local geography (often the slope or top of coversand dunes and ridges), their micro-topography and the functional orientation to bodies of water (streams and peat fens) at the foot of these locations, in combination with repeated visits over time. Through this repetitive behaviour sites develop into site complexes (see also Van Gils 2009, 263; Van Gils/De Bie 2006; 2008; Séara 2006, 279).

While the shape of clusters is based on the topographical and situational aspects of the site, these in themselves do not indicate the mechanisms responsible. Three scenarios may be sketched, most of which yield similar or indiscriminate results (see also Bailey 2007).

The first explanation is the most common and involves the interspersed use of the same location for similar or different activities. The intermixing of (predominantly) lithic artefacts of two different use moments leads to the formation

Fig. 5.5 Development of longitudinal clustering of circular concentrations over time.



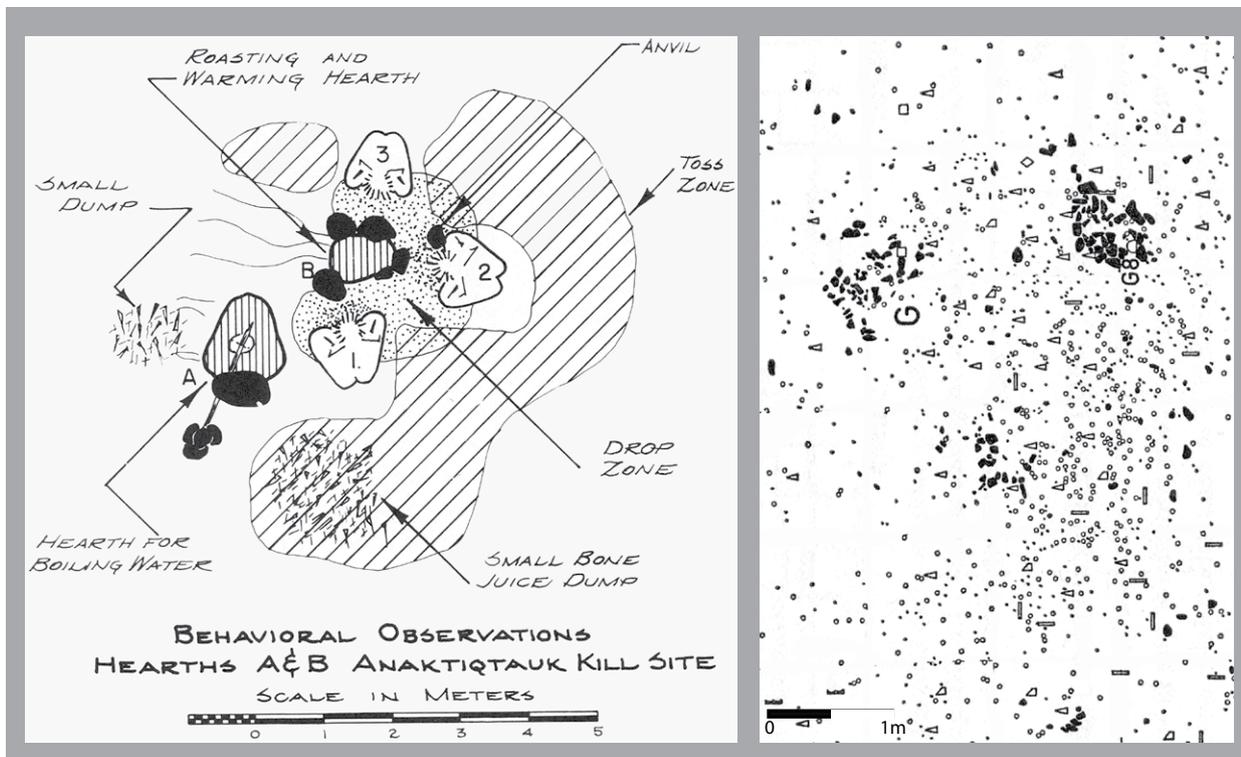
of a palimpsest, the informative value of which is strongly dependent on similarities in the nature of the activities involved. Since most sites discussed here are located on stable surfaces there is often no information available on the time that elapsed between two separate use moments. A variant of this scenario includes clustering of a more premeditated nature, for instance as sites are recurrently visited because they developed into caches of re-usable lithics (see also Schlanger 1992; De Bie/Caspar 2000, 280). Although a selection of the raw materials used in the southern coversand landscape could often be found in the direct vicinity of the sites (*cf. infra*), it is likely that these former surface collections, apart from other reasons for returning, such as site furniture (*sensu* Binford 1979; 1981^b), formed an attractive additional incentive for revisiting a specific location.

A second scenario offers a more synchronic explanation. A sequence of activities centred for example on a hearth may have been responsible for the clustering of concentrations; there may have been an interruption in the debitage activities or the wind might have shifted (see Binford 2002, 159), leading to a repositioning of activities. This was one of the suggestions to explain the empty zone between concentrations 3 and 4 at Merselo (Verhart 2000, 126). Another important variant of this scenario is the hearth model (Binford 1978^b; 2002). In this model people, seated around a hearth, dispose of the waste of their activities in a specific manner creating 'toss and dropzones'. In general light refuse will remain in place while heavier objects are placed or tossed away. This often creates a U-shaped pattern. Many specific and contingent activities may form variations on this template. The model is specifically characteristic for outside hearths. Disposal behaviour inside tents and other dwellings is structured differently (Binford 2002, 157; see also Stapert 1992, 43-44). Within the Late Mesolithic dataset, U-shaped patterns were found at both Merselo-Haag (concentration 1) and Meeuwen-In den Damp. The pattern at Merselo is rather small (2.4 x 2 m), and may be the result of the knapping activities of a single person. The (dispersed) U-shaped cluster at Meeuwen-In den Damp 1 (measuring *c.* 9 x 6 m) comprised a more detailed U-shaped concentration of *in situ* finds measuring *c.* 3.5 to 4 m. In an extensive intrasite study Pilati (2001) tested whether this concentration fitted Binford's hearth model (see Appendix I).

A final explanation for clustering suggests the presence of some sort of structure influencing the distribution of remains of activities. This has for example been suggested for Weelde-Paardsdrank sector 5 and for Meeuwen-In den Damp (Huyge/Vermeersch 1982; Pilati 2001; 2009). This type of clustering is based upon so-called barrier effects characteristic for the bimodal distribution as demonstrated in the ring and sector model (Stapert 1992, 43-44). Contrasting with this Séara (2006, 280) has documented specific 'partitioning effects' related to an empty zone surrounding a hearth at the Early Mesolithic site of Choisey. He interpreted this empty zone as a shelter structure or sleeping area. Unfortunately no intact hearths have been found at Weelde-Paardsdrank sector 5, nor at Meeuwen-In den Damp.

An ethnographic perspective on clustering

An ethnographic observation by Binford at the Anaktiqtauk kill-site (Alaska) provides insight into the dynamics underlying site structuring and clustering of concentrations. It deals with the potential contingent use of multiple hearths (2002, fig. 90). The proposal by one of the individuals seated around the fire



to make some broth resulted in starting another hearth. One could hypothesize that a similar situation existed at the site of Oplabbeek-Ruiterskuil (Vermeersch *et al.* 1974, fig. 4; see fig. 5.6). The remains of the hearths in sector G there are at the same distance from each other and one may even see some differentiation in the activities performed in the different densities of the debris. While marrow extraction as at Binford's site cannot be attested, the acuity of the pattern in sector G in any case suggests a similar short-term activity. The main point here is that apart from sequential developments, clustering of sites may also have involved both instantaneous decisions and short-term behaviour.

Group C: scatters

Scatters may be perceived of as part of the 'texture', the overall spread and composition of artefacts over the terrain (*cf. supra*). They may also include the excavated 'patches', the concentrations and clusters.

Perceived from a landscape perspective (see Foley 1981, 163; see also Chapter 4) scatters are part of the low density 'veil of stones' (see Isaac 1981; Roebroeks *et al.* 1992). Scatters, from this perspective, form concentrations in the overall veil of isolated or semi-isolated artefacts. In contrast to the landscape scale of the veil, scatters do have limits within which higher density patches of artefacts, the classic sites, are located. These patches may be related to the scatter yet they may also have been 'parachuted' on top of it (see Roebroeks *et al.* 1992, 9-14). Thus, there need not be any chronological or functional association between scatter and patch.

The scatters defined here appear to form a chronological and spatial phenomenon, which is largely dependent on the frequency with which sites have been used. The mechanism underlying the formation of this aspect of scatters

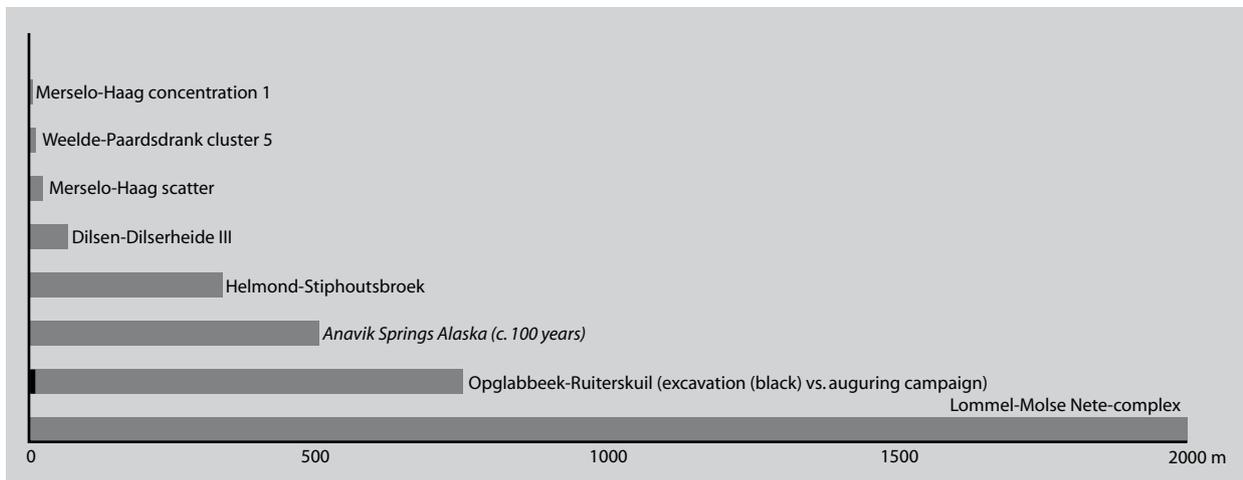
Fig. 5.6 Hypothetical comparison between a short-term activity pattern at a Nunamiut kill-site (after Binford 2002, fig. 90, pp. 154) and sector G at Oplabbeek-Ruiterskuil. Note the similarity in distance between the hearths (black clusters of burnt sandstone) and the increased density of artefacts farther away.

is of a twofold character. The more important factor of the two relates to the maximum dispersal of material radiating out from the constellation of clusters and concentrations, during or after occupation. This can for example be seen at the site of Merselo-Haag in fig. 5.3 (note the lighter zone surrounding the concentrations). There are, on the other hand, also those activities, which take and took place in the vicinity of the site. Yellen (1977, cited in David/Kramer 2001, 259-261) for instance, observed a spatial differentiation between 'clean' and 'dirty' activities at !Kung San sites in Namibia. Dirty activities often required considerable space and took place in the periphery of the settlement. Binford (1978^a; 1991; 2002) and Newell (1987) documented specific characteristics of spatial behaviour and social or ritual organisation at various Nunamiut/Inupiat sites.²⁰ Possible instances of such peripheral behaviour have also been documented archaeologically, although difficulties in identifying such production areas should be taken into account. At the Federmesser site of Rekem, for example, arrow point manufacture appears to have been spatially situated away from other localities and activities. This may be related to gender patterns or social rules (De Bie/Caspar 2000, 282-283). At Merselo-Haag (Verhart 2000, 123) a concentration of backed blades was also situated away from the main concentration.

Scatter, size, shape and development

The size and shape of scatters is also informative. They are usually of considerable dimensions, the smallest (Brecht-Moordenaarsven, 14 x 6 m), clearly being delimited by the size of the trench and postdepositional disturbance (Vermeersch *et al.* 1992, fig. 23). On other occasions their recorded extent has been determined by means of surveying or augering, for instance at Dilsen-Dilserheide III (60 x 40 m) and Helmond-Stiphoutsbroek (300 x 150 m). When interpreting scatter size, it should be realised that it is not the extent of an actual site or settlement that is measured, but rather the dimensions of (Mesolithic) site use of a certain feature or location in the landscape. An ethnographic example of this is given by Binford (2002, 118-119). He documented a temporary Nunamiut hunting camp in a stand of willow trees at Anavik Springs (Alaska). According to Binford the location at Anavik springs, from an archaeological point of view, consisted of a single site extending for half a kilometre across which an uninterrupted distribution of debris could be monitored. This represented the palimpsest refuse of at least 100 years of re-use of the same location. The complex of sites at Lommel-Molse Nete should be understood in a similar vein. The excavated Late Mesolithic concentrations there are part of a site complex extending over at least 2 km along the northern slope of the Molse Nete stream (see Van Gils/De Bie 2003; 2008), including the site of Lommel-Vosvijvers. Similarly the concentrations excavated at Opglabbeek form only a fraction of the recently established extent of the entire site (Van Gils/De Bie 2006, 23, 26).

What is actually documented, rather than a persistent use of a place is the occurrence of consistent conditions in the landscape that promote a certain use of a landscape feature over time (see Amkreutz 2009; Vanmontfort *et al.* 2010). It is thus important to be aware of the place of excavated Mesolithic sites in the overall pattern of land use, as illustrated in fig. 5.7. What is actually excavated is usually but a small fragment of a location, of which the functional use may have remained similar over the years (or even centuries).



As with the formation of clusters, the shape of the scatter is importantly influenced by site location choice in relation to topography (*e.g.* Van Gils and De Bie 2008) and the specific conditions that were sought after. In this light, sites along streams or gullies (as at Merselo-Haag and Lommel-Molse Nete) will suffer less from palimpsest formation since similar conditions for settlement existed over considerable stretches. In contrast sites located for example around more or less isolated peat fens or on isolated outcrops may have a higher rate of overlap of chronologically unrelated activities. In any case, as argued above, it seems that groups were looking for similar conditions rather than a distinct place.

Fig. 5.7 Overall dimensions of recorded scatters (length) as well as one concentration (Merselo) and cluster (Weelde). Note the ethnographically documented Anavik site (Binford 2002, 118) with a recorded time depth of more than a century.

5.4.4.3 Concentrations, clusters and scatters: northern coversand, wetlands and river valley

The elaborate discussion regarding the clustering of lithics also applies to sites in the other groups, although the potential to obtain metric information on concentrations and clusters is often limited (see table 5.10).

For the northern coversand landscape preliminary investigations of Bergumermeer-S64B were only recently completed (NWO-Odyssey project) and no spatial information was available earlier (see Niekus 2012).²¹ At Mariënborg-Schaapskooi nine zones (ranging from 8 x 6 to 90 x 10 m) are indicated within which most artefacts were collected before excavation (Verlinde/Newell 2006, fig. 49). There is no further metric information on them. At Havelte two Late Mesolithic concentrations may tentatively be identified, based on the presence of trapezes and the absence of triangles (Peeters/Niekus 2005; Price *et al.* 1974).²² At Nieuw-Schoonebeek many of the identified concentrations within the overall distribution of artefacts could be related to treefall features (Beuker 1989, 140). Based on the distribution of certain trapezes and other types of artefacts, a chronological and spatial subdivision into two partially overlapping occupation zones was established (A and C; *ibid.* 179-182).²³ At Tietjerk many oval and round concentrations of artefacts were documented. Despite the fact that only 4.6% of the total assemblage of the site could be localized on the groundplan, Huiskes defined and analysed some twenty concentrations, the smallest of which numbers only two artefacts (see Huiskes 1988, table 1). It is evident that many of these concentrations are based on a skewed remnant of the original distribution (see Huiskes 1988, fig. 17). This calls into question both the true extent of most

site	spatial unit(s)	unit type	length (m)	width (m)	N artefacts	shape
Havelte-De Doeze	H1:I	cluster?	9.4	-	-	H1:I: irregular
	H1:II	cluster?	11.1	10.6	H1:II: 757	H1:II: semicircular
Nieuw-Schoonebeek	AB	LM zone	20	7.5	A: 2294 B: 3440	AB: elongated
	BC	LM zone	22.5	10	B: 3440 C: 1911	BC: elongated
Tietjerk-Lytse Geast I	20	concentrations	0.5-5	0.5-3.4	2-290	oval or round
Hdx-Polderweg (phase 1)	1	cluster 1	8	3	-	oval
	1	cluster 2	10	4	-	oval
	1	concentration 1	1	1	-	semi-circular
Hdx-De Bruin (phase 1)	1	concentration 1	2	2	-	-
	1	concentration 2	1.5	1.5	-	-
Swifterbant-S83	1	concentration 1	0.5	0.5	97	semi-circular
	1	concentration 2	0.5	0.5	(97)	semi-circular
	1(tr. 2)	concentration 3	1	0.5	28	semi-circular
Liège-PS-SDT	1	scatter	21	8	c. 10500	ovaloid
Liège-Place St.-Lambert- SDT east	1	cluster	8	4	-	ovaloid
	H50	concentration	1	1	-	circular
	G53	concentration	1	1	-	semi-circular
	H55	concentration	1.5	1.5	-	semi-circular
Liège-PS-SDT west	1	cluster	12	7	-	ovaloid
Liège-PS-S160	1	concentration	3	2	-	semi-circular/dense
Liège-PS-SDT/S160 east	1-5	concentrations	1	1	-	circular/vague
Liège-PS-DDD	1	cluster	5	4.5	1222	semi-circular
	F8	concentration	1	1	-	circular
	F10	concentration	1	1	-	circular
	F11	concentration	1	1	-	circular
	H9	concentration	1	1	-	circular
	3-5	concentrations	1	1	-	circular/vague

Table 5.10. Metric information and artefact counts for concentrations and clusters in the northern coversand group (Havelte, Nieuw-Schoonebeek and Tietjerk), the wetland group (Hardinxveld and Swifterbant-S-83) and several sub-sites of the river valley site of LPS).

of the concentrations as well as their credibility. Only three concentrations yielded over 100 artefacts. It is furthermore remarkable that the contribution of tools is less than 30% in only four cases, which is an unusually high number (see Huiskes 1988, table 1). It is concluded here that several concentrations will have existed at Lytse Geast I, but that their exact number, extent and composition remain largely unknown.

For the wetland group only Hardinxveld and one of the Swifterbant sites yielded metric information. At Polderweg the distribution of flint during phase 1 (Van Gijn *et al.* 2001^a, figs. 6.2-6.4) yielded two vague clusters, the second of which contained a concentration of cores (*ibid.* fig. 6.6). De Bruin (see Van Gijn *et al.* 2001^c, fig. 6.1) yielded two small concentrations in squares 6 and 20. Within the excavation trenches of S83 three small concentrations of flint were documented (Jordanov 2005). For the river valley group, only the well-excavated Liège-Place St.-Lambert site yielded metric information (Van der Sloot *in prep.*, 128, 164 fig. 2, fig. 20-22). Refit analysis indicated the contemporaneity of some of the concentrations in sector SDT (with refits up to 18 m) and there is an overall spatial association with clusters or pavements of stone.

Although the information is coarse-grained, it may be argued that similar principles determine lithic distribution and lithic clustering at different sites. Currently there is not enough detailed information to establish contemporaneity of clusters and concentrations or to determine what specific functional behaviour underlies their development. Such information would contribute importantly to understanding the dynamics behind the development of clustering and sites. For some sites, however, additional elements of settlement structure may be defined.

5.4.4.4 Alternative aspects of settlement structure

Apart from the aspects of lithic clustering discussed above, other aspects of internal settlement structuring may be mentioned. These include the (limited) evidence for spatial structuring at sites with zones of hearthpits as well as indications for a graded use of sites on elevations.

Sites with hearthpits

Several sites in the northern coversand landscape and within the group of wetland and wetland margin sites are characterised by considerable numbers of hearthpits, sometimes grouped in extensive zones (Mariënberg and Hoge Vaart, but also Urk-E4 and Swifterbant-S21 and S22-24). Although these are often the result of long-term repeated use of the site, in some cases spanning more than a millennium (*e.g.* Verlinde/Newell 2006, table 3), a number of interesting principles seem to apply to these sites. The first one concerns the fact that the hearthpits were probably special-purpose facilities for slow-combustion fires (*e.g.* Groenendijk/Smit 1990; Hamburg *et al.* 2001; Peeters/Niekus 2005; Perry 1999; 2002). Furthermore hearthpits rarely cut into each other, indicating that the location of previous pits may still have been known or visible and avoided (Groenendijk 1997; 2004). The clustering of some of the pits may furthermore indicate a restricted time-span of occupation for those areas (see Verlinde/Newell 2006, 208-229 and Peeters 2007). Finally, it has been suggested that at some hearthpit sites there is some spatial incongruence between the area where most of the hearthpits cluster and the main concentrations of lithics (see Peeters/Niekus 2005, 212). It indicates that different requirements and purposes may have spatially governed activities at these sites, although this has been difficult to establish due to problems of association and intermixing (see Chapter 4 and Peeters 2007, 216),

It has been argued that hearthpit sites may have functioned as a socio-cultural marker, since most are situated in the north of the Netherlands (see Peeters 2007, 228-230). This could explain their overall (yet not total) absence at contemporary sites in the south.²⁴ On the other hand their function strongly implies that presence or absence of hearthpits is based upon the spectrum of activities practised at a certain location, or at least the way in which these were executed. So they form an important marker for the Late Mesolithic in the north, compared to that in the south.

The main argument here is that sites with considerable numbers of hearthpits indicate the presence of an additional set of structuring rules or elements that define the layout and character of these sites. Tentatively they therefore differ from those locations where hearthpits are absent. This may be both within settlement systems including hearthpit sites as well as with respect to those areas where hearthpits are largely absent.

Graded use of space

A further element of spatial structuring is a distinctly graded use of space. This could only be properly documented at both Hardinxveld locations, but most likely applies to other prominent locations of limited extent that functioned in the same manner. This was also demonstrated in Chapter 4 in the discussion of archaeological site types. With respect to both Hardinxveld sites, a use of these locations, that entailed a threefold division, could be documented. The top and upper slopes of the dunes yielded most features, including possible sunken dwellings at Polderweg. This area may be distinguished as a habitation area. The lower slope and foot of the dune, bordering on the wetland, may be characterised as an activity area as demonstrated by (colluviated) debris and evidence for fire and dropped waste. This area perhaps saw most of the daily activities of artefact and food-preparation. Finally, the third zone, the wetland margin, also yielded artefacts, often of some size, which indicate the presence of a toss-zone (see Louwe Kooijmans 2003). It should be taken into account that the threefold division witnessed is to a significant degree determined by processes such as slope wash, colluviation and decay, in combination with a slope gradient of 20%. In this respect the patterning observed is of a secondary nature, although it does, indirectly, relate to site-use as well. It is not known whether a similar division was present at other sites: at Oudenaarde the vicinity of the river Scheldt to the site might have led to a similar situation, while the sites at Swifterbant show evidence of use of both the top and the slopes of the dunes.

It is evident that some graded use of space probably applies to all sites that are situated on an elevation, especially when these border on wet zones such as peat fens, or streams. The difference lies in the fact that at both Hardinxveld sites (and probably at similar sites) there is a repeated use of these locations according to the same rules for a period of several centuries. This is a distinct continuity that should be noted and that differs from the way in which sites and site complexes on the southern coversand develop.

5.4.5 Settlement 'investment': redundancy

A final element that may be informative about the characteristics of site structure and patterning is termed 'investment'. Apart from representing intentional investment in a site this also concerns the degree to which locations yield evidence for repeated visits or occupation of sites. In this sense 'investment' relates to the topic of redundancy mentioned earlier. The means to establish this are limited. Radiocarbon chronology is fraught with difficulties related to sampling quality and association of sampling location and material to the features and finds that should be dated (*e.g.* Van Strydonk *et al.* 1995; Crombé *et al.* 2012; see also Chapter 4). Furthermore the taphonomical differences between sites in different regions (Chapter 4) should be taken into account. Whereas the documentation of lithic artefacts will be influenced mainly by location and excavation methodology, the presence of features is strongly influenced by taphonomic processes and soil formation. The archaeological resolution is therefore necessarily low. As will be discussed below the limited visibility of features may predominantly form a problem at sites on the coversand.

Two perspectives may offer an idea of ‘investment’. These include the number and type of features at a site as well as the quantity or density of artefacts. Investment in structures or facilities such as huts, pits, hearths, graves, windbreaks, or spatially delimited and distinct locations such as trash disposal areas etc., form an important indication for the permanency of occupation, or the length of stay at a certain site (see Chatters 1987, 369; Kelly *et al.* 2005, 403). It should be noted that the internal structuring of these elements, is regarded as an even more important indication for the length of stay (Kelly 1992). Furthermore the variability of features as an indicative aspect of site duration and use will be discussed.

The ambiguity of features and facilities as solid indications for permanency should be noted as well and is related to the cross-culturally attested fact that investment in sites is often related to the anticipated length of stay, instead of the actual length of occupation (Kent 1991, 56; Kent/Vierich 1989). Nevertheless, features, facilities and, to a lesser, more time-averaged extent, total amount and density of waste, form indications of ‘energetic investment’ in a certain location, whereas anticipated stay is also informative on the expected potential of a certain site.

5.4.5.1 Density and intensity

It was attempted to establish a site-bound indication of the relative density of artefacts and features, taking into account the many related difficulties. To this end all Late Mesolithic features and numbers of artefacts were positioned against the excavated or documented area of the site. Following this the overall differences in density were also calculated per group. The data and results are presented in table 5.11 and fig. 5.8.

Of course a number of taphonomic or excavation-related factors limit the extent to which sites are informative. At Brecht-Moordenaarsven 3 and Turnhout-Zwarte Heide no excavation took place (see Appendix I). At Havelte only two concentrations could be attributed to the Late Mesolithic, half of one of which was disturbed (Price *et al.* 1974, 32). Although the total extent of these concentrations (225 m²) could be established, no artefact density could be established. Similarly, at Tietjerk not all concentrations were entirely excavated and most artefacts were found on the surface (Huiskes 1988, 46). Only those artefacts that could be traced to the groundplan could be used. At Hoge Vaart-A27 the similarities between the Late Mesolithic and Swifterbant lithic spectrum and the erosion of the Late Mesolithic surface prevented a reliable attribution of lithics to the Late Mesolithic (Peeters 2007, 89, 95-97; Peeters/Hogestijn 2001, 49). The excavated information is limited at sites such as Melsele and Oudenaarde. At the former location no distinct spatial information for the Late Mesolithic was available, while at Oudenaarde the extent of the Late Mesolithic MESO I site was based on charcoal and burnt bone (Parent *et al.* 1987^a, 13).

Taking the distortive factors into account, the observable trends are only general indications. The relatively high artefact density documented for the sites on the southern coversand contrasts with the low density of features and their relatively high density in the other groups. The low density registered for De Bruin and the high density at Melsele are influenced by problems of attribution (see Appendix I). The low density recorded for Helmond and for Jardinga, however, are most

Table 5.11 Excavated area, number of artefacts, and number and type of features per informative site.

sites	<i>exc. area m2</i>	<i>N artefacts</i>	<i>N features</i>	<i>N structures</i>	<i>N graves</i>	<i>N hearths</i>	<i>N hearthpits</i>	<i>N pits</i>	<i>N postholes</i>	<i>N other</i>
Brecht M-2	172	24185	7			7				
Brecht M-1	68	1165								
Brecht M-3		18								
Brecht O-1	67,5	1203								
Brecht O-2	298	1025								
Brecht O-3	61,6	542								
Brecht-TH	100	2982	1							1
Dilsen-DIII	146	5508								
Helmond-SB	2115	1048	1			1				
Meeuwen-ID-1a/1b	684	5890	1			1				
Merselo-H	409	3175	2			2				
Opglabbeek-R	134	2102	3			3				
Turnhout-ZH		2176								
Weelde-P1	129	11877				1				
Weelde-P4	90	9115								
Weelde-P5	100	9298	2							2
<i>tot. southern coversand</i>	4574.1	81,309	17							
Bergumermeer-S64B	1200	123,746	47				13	28		6
Havelte-DD-H1-I/II		>71/737	8			1	7			
Marienberg-S	2110	4502	222		6		216			
Nieuw Schoonebeek-S	243	7649	12				11			1
Tietjerk-LG1	140	653	2			2				
<i>tot. northern coversand</i>	3693	137,253	291							
Hdx-PW-phase 0/1	448	17,695	47	2	5		5	9	26	
Hdx-DB-phase 1	345	384	28	1	1		3	11	6	6
Melsele-HTD	100	14,000								
Swifterbant-S11-13	564	7000	8+			1	6	1		
Swifterbant-S21	385		31			1	31			
Swifterbant-S22/23	490	5690	52+			5	47			
Swifterbant-S83	8	125	5				5			
Urk-E4	880		36+			1	35			
Hoge Vaart-A27	1684.5		100				100			
<i>tot. wetland/(margin)</i>	4904.5	44,894	307							
Liège-PS-SDT	200	10,014	5	2		3				
Liège-PS-DDD	100	1338	1	1						
Remouchamps-SD	65	1842	4	1		2			1	
Namur-G	82,5	1800	2			2				
Jardinga-J	294	34								
<i>tot. river valley</i>	741.5	15,028	12							

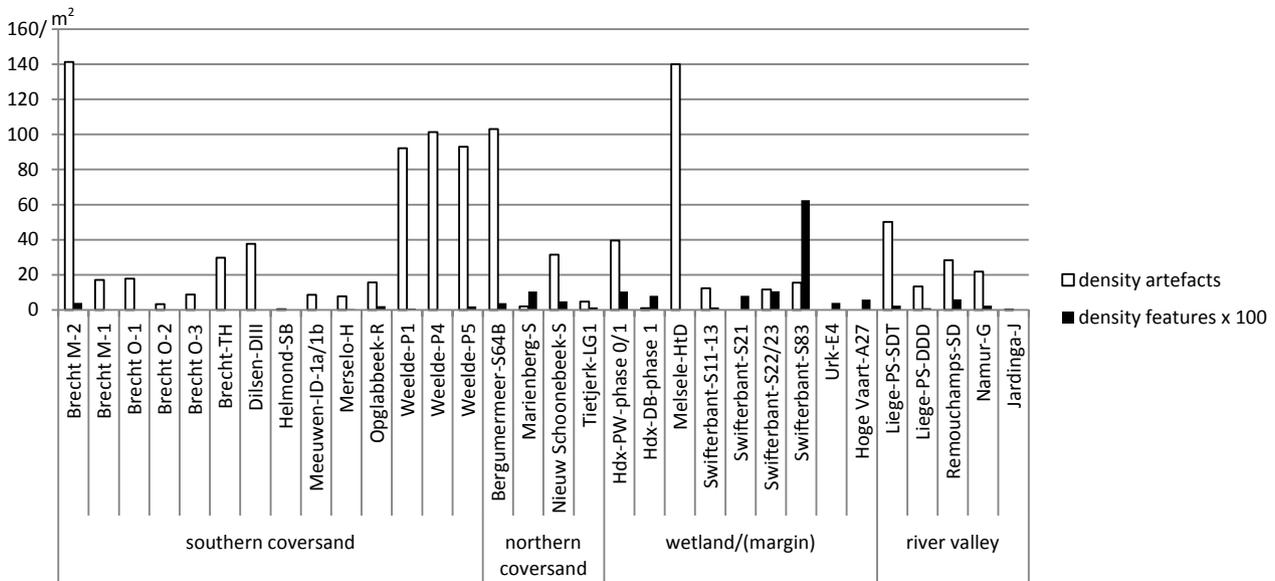


Fig. 5.8 Counts for the density of artefacts and features per m² as documented for informative sites within the four groups defined.

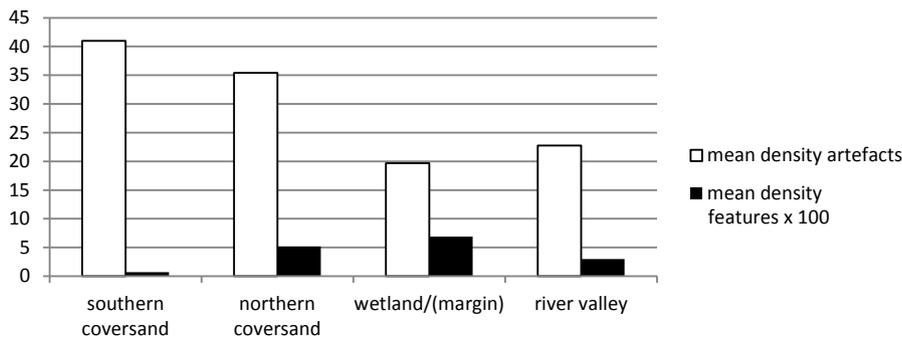


Fig. 5.9 Artefact and feature densities per group, not including the artefact counts for Melsele and De Bruin and the feature counts for S83 (total area excavated: southern coversand: 4574.1 m²; northern coversand: 3693 m²; wetland and wetland margin: 4804.5 m²; river valley: 741.5 m²).

likely related to the specific function the sites had within the settlement system. Jardinga has been interpreted as a kill and butchering site, while Helmond was located at some distance from the main concentration. The high feature density at Swifterbant-S83 is explained by the presence of five hearthpits within 8 m² (Jordanov 2005, 53).

In the counts, omitting outliers, the overall differences are accentuated (see fig. 5.9). The sites in the northern and southern coversand group are characterised by high densities of lithic artefacts, probably formed by chronologically distinct repetitive events (e.g. Crombé *et al.* 2006), while investment in features, especially for the southern coversand, is limited. Some surface hearths and pits may have been obscured by taphonomic processes, but the investments in features on the northern sandy soils, where similar post-depositional processes may be expected, is considerably higher. This is mainly caused by hearthpits which would also have been visible in the south. For Late Mesolithic sites in the wetland and valley floor locations there are less high densities of lithic artefacts and for the wetland sites more of a balance between features and artefacts. This also relates to a better preservation and therefore more precise attribution, but in the case of some wetland/(margin) sites it also appears to represent increased investment in frequently reused locations. The feature densities at the river valley sites are less

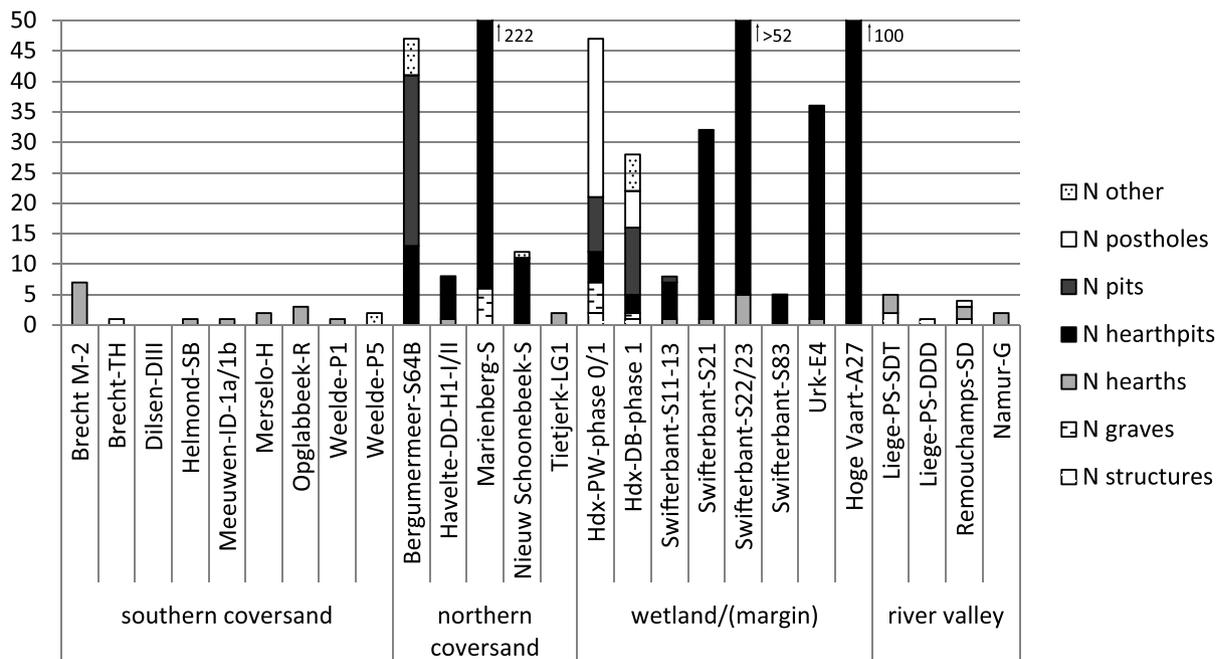
intensive, but qualitatively of a structural or fixed nature (stone platforms, hearth bases).

5.4.5.2 Feature variability

While density only offers a coarse indication, the variability in features is perhaps less prone to taphonomic disturbance. To some extent a greater variability in features may correspond to a wider range of activities performed at a location and signal increased investment. This may be substantiated by ethnographic investigations where the variability in features forms an important correlate for the length of stay (Kelly 1992, 56; Kelly *et al.* 2005, 410). This is often related to subsistence orientation (Kent 1991, 41). Below (fig. 5.10) feature variability has been documented by scoring the number of features within each category per site (see also table 5.11). In fig. 5.10 the interpretation of six ‘graves’ at Mariëenberg is plausible (see Appendix I; Louwe Kooijmans 2012^b). Furthermore six groups of collected structural stones at Bergumermeer have been scored as such. The structural stones at Nieuw Schoonebeek have been scored as one group.

Feature variability on the southern coversand is low, comprising surface hearths and occasional concentrations of burnt bone or hazelnut. This contrasts with the other groups. Hearthpits form an important component on the northern coversand as well as in the wetlands. Furthermore hearths, pits, graves, structural stones (manuports) and concentrations are found in those groups, including postholes and structures in the wetland group. Structures also form a type of investment among the group of river valley sites in the vicinity of Liège. Again, a major factor in the contrasts witnessed is the combination of local taphonomy and excavation methodology, especially regarding the upland coversand areas (Groenewoudt 1994; Verhart 2000; Vermeersch 1989), yet the combination of both the density and variability differences also seem to indicate differences that may relate to differences in past behaviour and site use. It should thus be questioned

Fig. 5.10 Counts per site for features defined. Hearthpit counts for Hoge Vaart, Mariëenberg and Swifterbant S22/23 are respectively 100, 216 and 47. Note that counts above 50 are not depicted.



to what extent 'absence of evidence' might indeed mean 'evidence of absence' at these sites. In order to provide more context for the elements that Binford (2002, 145) referred to as parts of the 'site framework' a number of features will now be discussed for sites in the different groups defined.

5.4.5.3 Hearths and hearthpits

Hearths form an obvious structuring element at sites. They are the locations around which a number of social and functional tasks are executed at all the sites studied. In this respect they act as hubs or anchor points around which an important part of site structuring may take place.

Coversand, wetlands and river valley: surface hearths

Surface or shallow hearths form a frequent phenomenon at sites in the southern coversand landscape, but they have also been documented for the sites studied on the northern coversand, as well as for the wetland and river valley sites. For the southern coversand group eleven sites yielded 21 hearths. Nine other sites also yielded evidence for the presence of hearths in the form of burnt artefacts, dispersed charcoal, concentrations of burnt fragments of hazelnut shells, burnt bone and burnt fragments of quartz, quartzite and sandstone (*e.g.* Weelde-Paardsdrank sector 4 or Meeuwen-In den Damp I).

Apart from the degree to which hearths may be recognized (Sergant *et al.* 2006), the association of hearths to the excavated concentrations and the difficulties in dating form a problem. As was noted previously (see Chapter 4, Crombé *et al.* 1999) many charcoal and other ^{14}C samples on the sandy soils yield aberrant dates due to infiltration, absorption, or apparently unjustified assumed association. Of the twelve dated hearths, four yielded a Late Mesolithic age, four date to the Early and Middle Mesolithic, and four yielded dates that were far too recent. At Brecht-Moordenaarsven even a stratigraphic difference between the hearths could not be confirmed by ^{14}C dates (see Vermeersch *et al.* 1992).

Three hearth types could be distinguished, but it should be realised that we only see those features that were deep enough to be preserved within the current soil stratigraphy. Most are 'surface hearths' or shallow hearths with a depth of up to 4 cm, containing ash and pieces and particles of charcoal. In some cases, however, notably at Merselo and Brecht-Moordenaarsven, 'hearthpits' were defined. In these instances depths cluster between 10-15 cm. The deepest hearth, measuring 34 cm was recorded at Merselo-Haag (Verhart 2000, 78). It should be taken into account that hearthpits were originally deeper than the remaining depth below the plough zone, making the contrast between 'surface hearths' and hearthpits less obvious. It is not known whether there were functional differences between the deeper hearths and the 'surface hearths'. Both sometimes contain some burnt and unburnt flint. One may argue that the deeper hearths are similar to the well-known deep hearthpits from the northern sandy soils, which seem to have been used for subsistence such as food processing or production-related activities (*e.g.* Groenendijk 2004, 22). These pits are, however, very uniform, cylindrical and often *c.* 50 cm deep, with a layer of charcoal at the base and regularly occurring in great numbers (Groenendijk 2004; Verlinde/Newell 2006). This differs from the more irregular to oval, shallow and isolated hearth pits of the southern sandy soils.

It is not clear whether the digging of deeper hearths took place prior to the initial firing, or is the result of the repeated cleaning out of the hearths.

A second hearth type consists of a stone structure or hearth base, on top of or within which a fire was burnt. Dispersed evidence of these types of hearths has been found at Meeuwen-In den Damp and Weelde-Paardsdrank sector 1. The site of Opglabbeek-Ruiterskuil, however, yielded two well-preserved examples of heavily burnt *in situ* hearthstones. According to the excavators the stones were embedded several centimetres in the sand (Vermeersch *et al.* 1974, 91). These stone-based hearths may have had a different function, or were perhaps intended as more permanent structures. The most distinct examples of these hearths are found in the group of valley floor sites at Liège-Place St.-Lambert where a number of cobble bases was constructed for the hearths (Van der Sloot *et al.* 2003, 96-97). Another stone-based hearth was found at Namur-Grognon as well as some indications for similar features at Remouchamps (see Appendix I).

A third variety is formed by secondary refuse as a result of the cleaning and dumping of hearth fills or trampling and blending and has been demonstrated at several sites. These processes resulted in more or less extensive patches of ash, charcoal and burnt artefacts. One of these was recorded at Merselo-Haag as hearth 4, measuring 4 m² and virtually no remaining depth. Some internal clustering was visible including pieces of charcoal. The origins and extent of these hearth dump locations may be related to the 'magnet' effect of a primary dump on future refuse (Binford 2002, 155). Merselo also yielded additional patches of burnt flint and charcoal, which could not be directly related to hearths (Verhart 2000, 79). Similarly at Hardinxveld-De Bruin, a number of concentrations have been interpreted as the remains of hearths or dumps related to activities at the water's edge (Nokkert/Louwe Kooijmans 2001, 81). Another outlier is formed by the dispersed remnants of a structured hearth in sector 1 of Weelde-Paardsdrank. One should be aware of the effects on hearths of so-called processes of smearing and blending described by Ascher (1968), as well as the preventive maintenance and clearing of activity areas (Binford 2002; Boaz 1998).

Northern coversand and wetland margin: hearthpits

Hearthpits have been discussed above in terms of their structuring properties. They appear at sites within the northern coversand group and the wetland (margin) group. Occasionally surface hearths are also found at these sites. The absence of hearthpits cannot be explained taphonomically: surface hearths could have been missed on the northern sandy soils, but hearthpits would probably have shown up in the south.

Sites with large numbers of hearthpits were often used over considerable time spans. As argued in 5.4.4.4 the limited intersection of pits indicates that their locations might still have been visible or known (Verlinde/Newell 2006; Peeters/Hogestijn 2001). The explanation may be that certain conditions for firing had to be met, requiring avoidance of old pit fills (see Groenendijk 2004) or locations with either too humid or dry and loose sand (Groenendijk/Smit 1990; Peeters 2007). The special character of hearthpits is further characterised by their standardized round shapes (40-80 cm) and an average depth of 40-50 cm (Niekus 2005/2006, 44). Micromorphological analysis has yielded evidence for both repeated cleaning and reuse of these features, as well as for a singular use after which the pit was filled again (Hamburg *et al.* 2001; Peeters/Niekus 2005). Overall there is evidence for

long smouldering fires, although there are also indications for quick extinguishing of fires (Hamburg *et al.* 2001, 11). The charcoal in the predominantly dark pit fill often consists of oak, especially in the later phases of the Mesolithic (*e.g.* Verlinde/Newell 2006). The use of considerable blocks of wood indicates that the hearth pits were used for 'slow' fires with a slow combustion (Wandsnider 1997). These could be used for food preparation and industrial activities and were highly manageable (for ethnographic references *e.g.* Groenendijk/Smit 1990; Hamburg *et al.* 2001; Wandsnider 1997). Indications for the use of these pits were found at several sites. At Mariënberg-Schaapskooi eleven hearthpits yielded up to five cooking stones per pit (Verlinde/Newell 2006, table 7). At S22 at the bottom of hearth 4 a fragment of a *Geröllkeule* was discovered (De Roever 1976; 2004; Price 1981, 85). At Hoge-Vaart-A27 phosphate analysis indicated the presence of organic saps from meat, bones or faeces, whereby the latter two might also have been used as fuel (Hamburg *et al.* 2001, 13). Next to finds of burnt animal bones Perry distinguished various species of edible plants in pits at the site of NP3 (Perry 1999). The production of tar (pers. comm. T. Hamburg/ L. Kubiak 2012) is a very probable possible function of these pits (Peeters 2007, 189).

Hearth fills, use and spatial aspects

Burnt flint is only occasionally present within the fill of the hearths, in contrast with the rather high percentages of burnt artefacts at some of the sites studied (between 15% and 51%; however see Sergeant *et al.* 2006). The fills mostly consist of charcoal particles and ash. Identification of charcoal at Brecht-Moordenaarsven yielded evidence for *Quercus*, *Pinus*, *Betula* and *Salix*. Charcoal analysis of Merselo-Haag indicated the use of evenly grown wood with hardly any branches (Verhart 2000; Vermeersch *et al.* 1992). This may be indicative of long-lived fires. A hearth at Helmond-Stiphoutsbroek yielded charred hazelnut shells and two pointed pieces of wood, possibly arrow shafts (Arts 1994). The hearth fills themselves are thus not very informative as to the use of the hearths, but several sites have yielded additional information. Apart from the already mentioned burnt flint several concentrations of charred hazelnut shell and burnt bone have been found, most notably at Weelde-Paardsdrank sector 5. Several hearths or dumps at De Bruin yielded concentrations consisting of combinations of burnt bone, charcoal, clay and fish remains (Nokkert/Louwe Kooijmans 2001, 81). It is plausible that hearths were used for tool manufacture and maintenance as well as various domestic purposes including food processing and cooking.

There is little spatial information available. Verhart (2000, 79) is convinced of the absence of any spatial relationship between hearths and clusters at Merselo-Haag and a similar conclusion has been drawn for the earlier Mesolithic by Crombé (1994). On the other hand many of the Late Mesolithic sites studied here yield evidence for a considerable proximity and overlap of hearths and lithic concentrations. At all sites where hearths are documented the main concentrations of flint are within less than 3 m of the hearths. At Weelde-Paardsdrank sector 1 and 5, Meeuwen-In den Damp and Opglabbeek-Ruiterskuil there is also evidence for activities such as flint working concentrating around the hearths (see Huyge/Vermeersch 1982; Pilati 2001; Vermeersch *et al.* 1974). Perhaps it should therefore be concluded that while the direct association between hearths and artefact clusters remains difficult to establish, they do seem to be at least a spatially integral part of the Late Mesolithic site structure (grain) in the southern coversand landscape.

For the hearthpit clusters it may be argued that the increased labour and time requirements involved in making and firing hearthpits (situating, excavating and cleaning of pits, gathering of fuel, preparing and managing the fire etc.) indicate that an increased investment in site structuring was made at these locations. This may also explain the sometimes suggested spatial distinction between areas with hearthpits and areas with artefacts. According to Schiffer (1995, 37) such a disparity might point to an increase in intensity of occupation.

5.4.5.4 Pits and postholes

Pits and postholes do not seem to occur at sites in the southern coversand landscape. Even in those instances where artefacts or even hearths are vertically situated in or near the C-horizon (as at Opglabbeek-Ruiterskuil and Brecht-Moordenaarsven 2), or where a possible palaeo-floor has been documented no features were found (see Vermeersch 1989, 289). On the northern sandy soils, pits and postholes are scarce. A number of other sites on the northern coversand yielded evidence for pits, although there too decapitation of the soil profile, erosion and soil formation processes will have obscured many features other than hearthpits (Beuker 1989, 128; Peeters 2007, 89). A number of pits at Mariëberg yielded evidence for burials as well as a pit at Dalfsen with cremated remains (Louwe Kooijmans 2012^b; Peeters/Niekus 2005; Verlinde/Newell 2006). At Bergumermeer 28 features were defined as pits. Furthermore Newell (1980, 257, 280) defined so-called drainage ditches related to the presence of potential paths. These claims are currently under review (NWO-Odyssey project led by Marcel Niekus; Niekus 2012). At Havelte-H1 several elliptical and circular features were interpreted as pits. Price *et al.* (1974, 23) suggested a use as storage pits, but this is uncertain. At Mariëberg some smaller features were identified as postholes (Verlinde/Newell 2006, table 7 and 10). Based on these results it may in general be concluded that dug-in features, other than hearthpits, were not a recurrent element of the site framework in this area.

Within the group of wetland and wetland margin sites, Hoge Vaart yielded some features described as deep (hearth?) pits (Peeters 2007, fig. 4.7). Hardinxveld-Polderweg and de Bruin yielded several features that were interpreted as pits, two of which (K5 and K8) were interpreted as hut features (see below). A number of circular pits at both locations are probably hearth features (Hamburg/Louwe Kooijmans 2001, 79; Nokkert/Louwe Kooijmans 2001, 87). The function of the remaining pits at both sites is not clear. At De Bruin these were of variable size (50 x 66 to 274 x 268 m). Some contained loam, ochre or charcoal (*ibid.*). All pits were located near the 'wetland' contact zone at the foot of the dune at a distance of 1-3 m (to avoid water welling up; *ibid.* 89). Polderweg also yielded 26 small features interpreted as postholes or stakeholes (Ø 7-20 cm), one of which even contained the original stake. Some seem associated with the large pits (K5, K7 and K8) and may have served as some sort of superstructure related to either a shelter or hearth (Hamburg/Louwe Kooijmans 2001, 85). De Bruin also yielded quite a number of smaller postholes and stakeholes (Nokkert/Louwe Kooijmans 2001, 98). Four postholes, including two larger ones dating to phase 1, were located at the foot of the dune and might have formed some sort of structure. The others are found on top of the dune in a relatively flat area and seem to represent a palimpsest of rebuilt structures (*ibid.* 99). At Swifterbant-S11 (see Whallon/Price 1976) several

moderately deep pits were found, spatially associated, but not overlapping with hearthpits and shallow hearths (*cf. infra*). It is possible that these pits can also be interpreted as hearthpits due to the variation in size and fill of these features (see Hamburg *et al.* 2001; Peeters/Niekus 2005). At Swifterbant-S21-24 some vague features were interpreted as pits, although it is not clear whether they date to the Late Mesolithic occupation (De Roever 2004, 27). Some of the pits found at Urk-E4 might have belonged to the Late Mesolithic occupation.

The river valley site of Remouchamps (RSD) also yielded some evidence for posts in relation to a dwelling structure (*cf. infra*).

In view of the taphonomic situation at many sites it is difficult to determine to what extent the presence and distribution of pits and postholes is a reflection of past reality. Based on the counts available this type of investment appears to be best represented in the group of wetland/(margin) sites.

5.4.5.5 Dwellings and other structures

Dwelling structures and other facilities form important indicators for the degree of investment in locations and the level of permanency in occupation. This often relates to the durability of these structures, although anticipated mobility in this sense also forms a factor to take into consideration (see Kent 1991, 56; Kent/Vierich 1989). It is likely that some form of shelter existed at many of the above sites, especially under certain seasonal or weather-related conditions. Yet while some of the hearths and artefact distributions may have been located within the confines of some sort of structure or dwelling no primary evidence of this has been found and any previously accepted hut-features must currently be discarded as tree-fall features (*e.g.* Bubel 2002/2003; Crombé 1993; Kooi 1974; Newell 1980). The main reason for the absence of remains of huts or tents are the intensive postdepositional processes preventing the preservation of organic remains and obliterating whatever features originally may have been present. It should on the other hand be expected that the architecture of these groups of hunter-gatherers will have been of an ephemeral nature, due to their mobile character (Binford 1990; David/Kramer 2001, 282, 285; Gamble 1991, 1-4), and many locations may not have had site architecture at all (see also Verhart 2000, 125-126). Identifying the presence of dwelling vestiges, especially on the basis of artefact distribution, remains a problematic endeavour.

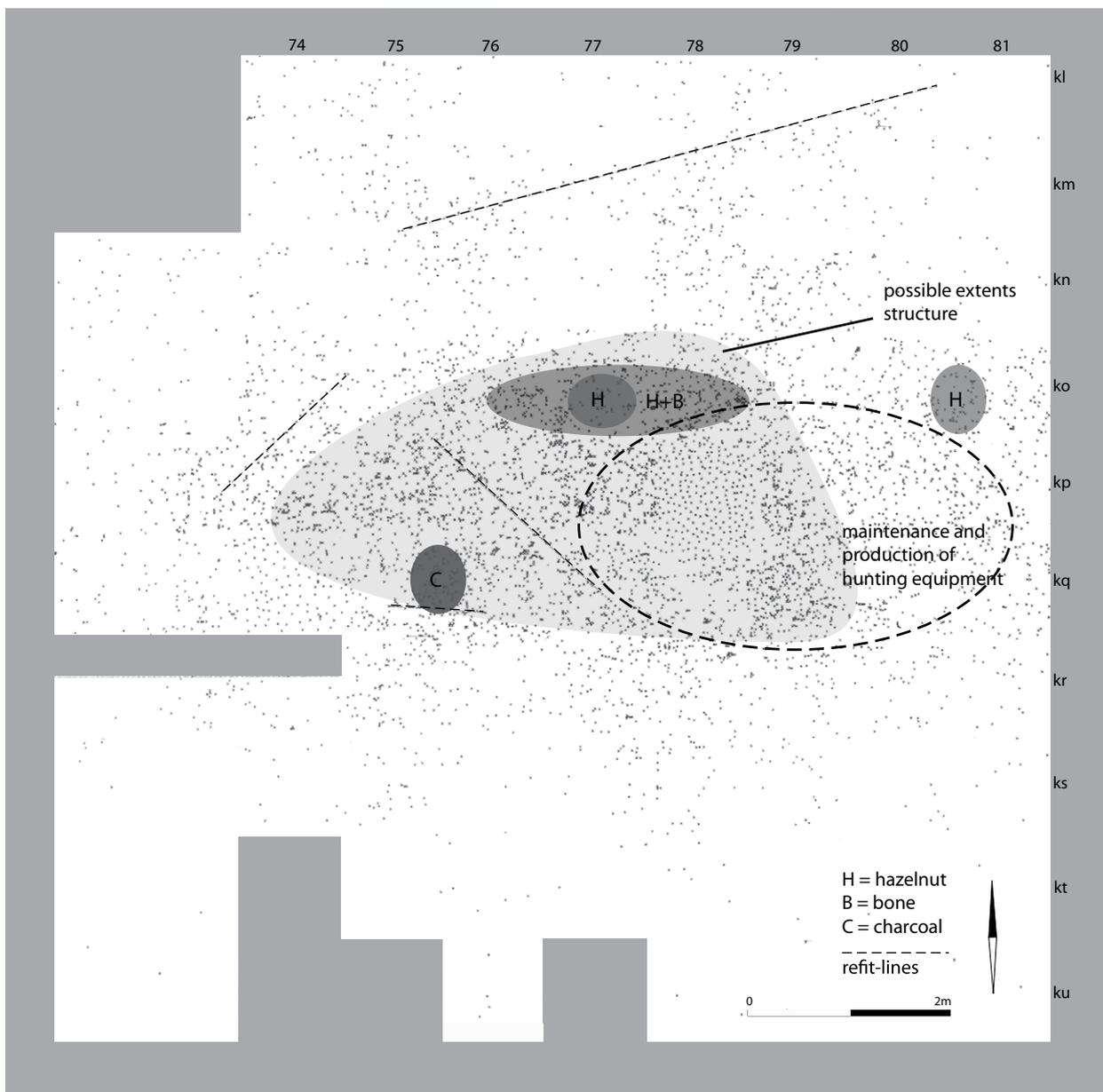
Southern coversand: Weelde-Paardsdrank-sector 5

On the southern coversand only two sites have yielded limited indications for the presence of a shelter (tent or hut), by the distribution of artefacts. The first potential dwelling structure is situated in the well-preserved sector 5 at Weelde-Paardsdrank. It is characterised by a well-defined artefact cluster, measuring 7 x 3 m along the axes. This distinct find pattern suggests a singular short-term activity, yet the quantity and diversity of finds, including organic remains is better in accordance with a more structured frequentation of the location. The excavators suggest that the distinct delimitation of the cluster in this case may be related to some form of shelter (Huyge/Vermeersch 1982, 150, 197). Unfortunately, inadequate excavation of two squares (KP78 and KQ74) and the absence of a clear

hearth structure prevent a spatial analysis with the ring and sector method (Stapert 1992), yet the confined pattern in combination with the relatively undisturbed context are visually suggestive of some sort of barrier (see fig. 5.11).

Contrasting with the opinion of the excavators (Huyge/Vermeersch 1982, 150) the diminution of finds on the eastern side of the supposed structure is not less pronounced. It seems demarcated by a relatively sharp break running through squares KO-KQ79. The distribution of finds to the east and south of these squares may reflect activities outside the structure or (door)dumps of refuse. The latter interpretation becomes more plausible if the location of the slope and fen to the south are incorporated. The working areas were probably oriented to the south and southeast in view of the most economical use of water and sunlight (*cf. supra*). Similarly the low density in squares KQ-77-78 may be interpreted as an entrance oriented to the south. Concerning finds, sector 5

Fig. 5.11 Combined visual analysis and functional interpretation of the spatial delimitation and location of artefacts and organic remains at Weelde-Paardsdrank sector 5. (Adapted from Huyge/Vermeersch 1982, plans 5, 6 and 7).



differs from the other two locations at Weelde-Paardsdrank in its concentrations of burnt organic remains and the highest *in situ* artefact density. A closer look at the lithic distribution seems to confirm a non-random distribution (see plans 5 and 6 in Huyge/Vermeersch 1982; *ibid.* 151). Trapezia are mainly concentrated in the eastern part, both within and outside the main concentration, together with most points and microburins, while blades tend to occur more frequently in the west. Most cores are located outside the supposed structure, while more core rejuvenation flakes are found within. This could relate to preventive maintenance in which larger objects are removed from the activity areas (Binford 2002, 189). The pattern of activities represented in the lithic material seems to point to the production and maintenance of hunting implements, predominantly located in the eastern part of the cluster and possibly associated with fire since 21.2 % of the artefacts are burnt (Huyge/Vermeersch 1982, 150). There is also evidence of further activities (see fig. 5.11). Two concentrations of broken and carbonized hazelnut shells were recovered in the northern part of the cluster, both within and outside of the supposed structure, coinciding with the distribution of calcined fragments of bone.²⁵ In the southwestern part, a considerable dump of charcoal was documented (*ibid.* 151). These organic concentrations are not only indicative of the cooking, processing and – in the case of hazelnuts – possibly the preservation of food, but also point to specific waste behaviour. This is supported by the correspondence of the highest density of lithic materials with a vacuum in the distribution of burnt organic remains (*ibid.* 151).

Southern coversand: Meeuwen-In den Damp I

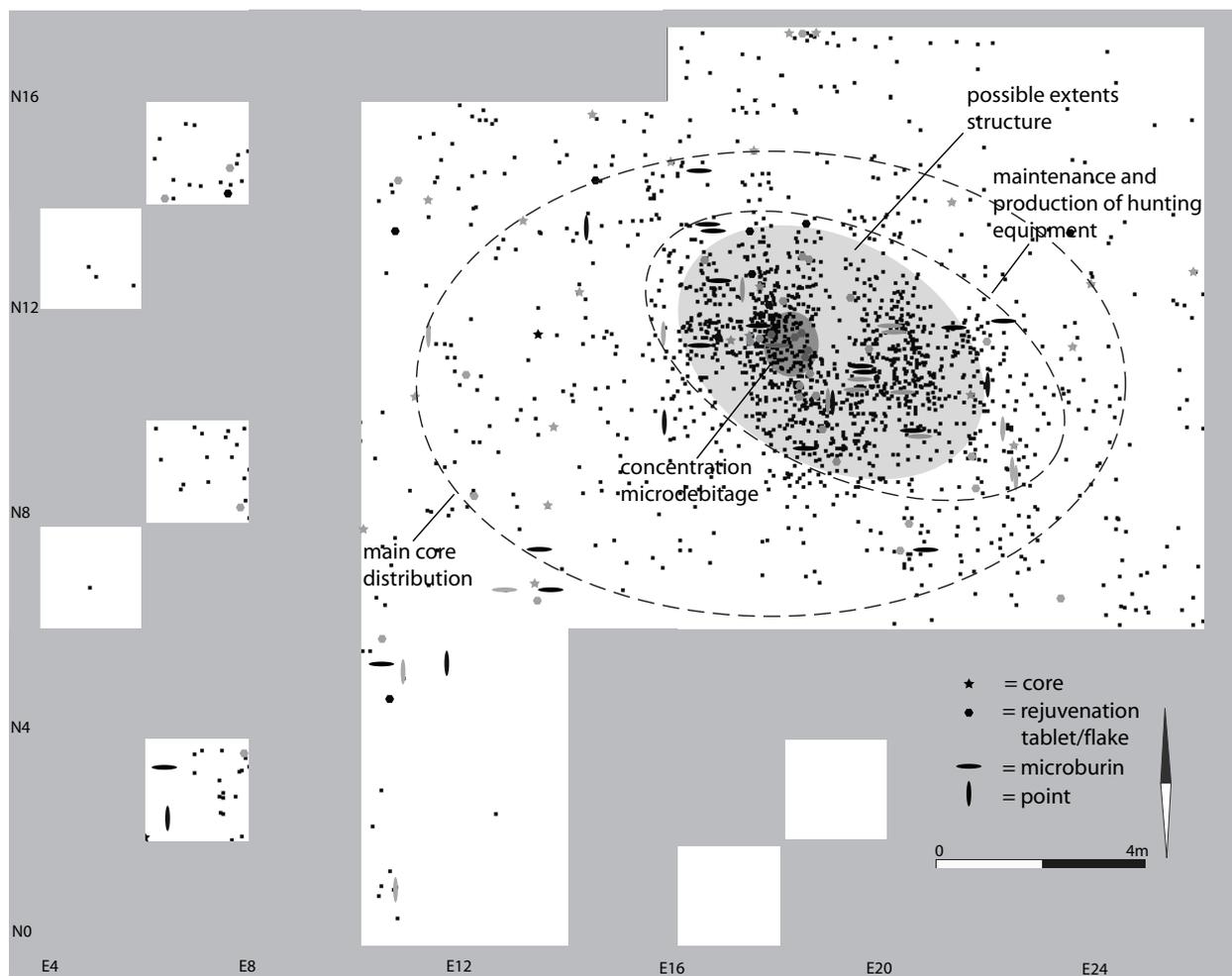
The second possible dwelling structure for the southern coversand landscape is concentration 1a at Meeuwen-In den Damp I. Pilati (1999; 2001; 2009) tested the distribution of finds in an extensive study, both for the sitting model and by the ring and sector method (Binford 2002; Stapert 1992). The potential structure is formed by a vaguely delimited *in situ* U-shaped pattern of c. 4 x 3 m (see fig. 5.12). Although displacement of the finds took place (Bubel 2002/2003), the resulting pattern did not correspond with the distribution of tree falls (Crombé 1993; Pilati 2001). Using the ring and sector method, the horizontal distribution demonstrated an almost completely empty central zone within the horseshoe pattern. More voluminous items were located outward, in line with the sitting model, but no clear bimodal distribution pointing towards a barrier effect could be discerned (Pilati 2001, 110-135). Although no primary hearth feature was found, indicative artefacts such as burnt flint, sandstone, quartz and microburins tend to cluster in the same locations, northwest and southeast of concentration 1a. The cores are found mainly outside the concentration, similar to Weelde-Paardsdrank, in this case roughly forming a surrounding arc, while rejuvenation flakes and tablets tend to cluster in the centre. It is remarkable that the waste products of point manufacture, the microburins, are mostly situated in the centre, while worn-out points are located outside the production area and were thus possibly thrown away (*ibid.*). Within the U-shaped pattern a further clustering of several artefact types and RMUs can be made out, while squares N11-E17/18 yielded evidence for a knapping spot. Refitting evidence confirms the location of a centre of activity in the same square (Pilati 2001, fig. 6.1). Pilati (2001, 133-135) argues, that the 'outside sitting model' is supported by the circular structure

and the knapping spot. Still, he admits that there is no evidence for other activity areas in the circle, neither does the distribution of burnt items shed any further light on things.

His second hypothesis is based on the ring and sector method (Stapert 1992). In this scenario the remains of at least one knapping spot and the central hearth were pushed outwards. There is some evidence for a centrifugal effect, although no clear bimodal distribution was recorded. The U-shaped pattern may, however, still be caused by the presence of a tent wall. The lateral concentric alignments of artefacts located east and west of the concentration may furthermore indeed be interpreted as refuse thrown out of two opposite entrances (see Pilati 2001; 2009). While Pilati (2001) favours the second model, neither of the two interpretations could be confirmed.

It can thus be concluded that at best certain 'hints' of dwelling structures are present at Weelde and Meeuwen, next to many more indications for outside activities. The absence of distinct primary refuse and the limited size of the concentrations suggest rather small and mobile structures, like tents or light huts (see Karsten/Knarrström 2003, 37). These could be transported or made expediently out of locally available material (Binford 1990).

Fig. 5.12 Lithic distribution of Meeuwen-In den Damp I, sector 1a. Symbols in black are not point referenced. (Adapted from figs. 7.8, 7.10, 7.11, 7.20 and 7.21 in Pilati 2001).



Northern coversand: Bergumermeer-S64B

Similar to the southern coversand landscape no unambiguous dwelling structures are known for the north. In most cases taphonomy and site formation processes are responsible for this. Erosion and especially the difficulty in distinguishing between anthropogenic and natural features hinder identification of structures (Crombé 1993; Newell 1980).²⁶ Nevertheless, structures have been proposed for some sites.

The best-known potential dwelling structures have been found at Bergumermeer-S64B (Bloemers *et al.* 1981; Casparie/Bosch 1995; Huiskes 1988; Newell 1980; Newell/Vroomans 1972; Odell 1980; Peeters/Niekus 2005; Niekus 2012). Newell (1980) presented six hut features from this site in a critical review of Mesolithic dwelling structures (see also Appendix I). Their interpretation as hut features is based upon a combination of structural elements (postholes, structural stones), soil discolouration and a statistically attested relationship between the supposed floor area and associated activity areas (Newell 1980, 257-258, 265). The hut features (*c.* 7.2-8 x 4-5.2 m) were visible as elliptical alignments of 17-22 manuported stones coinciding with orange to yellow-orange soil discolourations of 32-100 cm in width and with a depth of *c.* 11 cm (Newell 1980, 258 and fig. 3; see also Peeters/Niekus 2005, 212). According to Newell (1980, 260) the features overlap with both the distribution of complete blades as well as the other classes of features and are regularly and orderly spaced 'on what appears to be an intentional plan' (*ibid.*).

On the basis of the information and plans currently available, several critical comments can be made, relating to taphonomy, association, contemporaneity and credibility. These include the many natural disturbances, problems of '*in situ*' attribution, the limits of statistical testing, post-occupational infiltration of humic acids, which would explain the raised horizons, the location of the features with respect to each other and their age, the absence of a cover until the Subboreal, the long-term use of the site and the presence of earlier and later occupation episodes. A more detailed account of Bergumermeer and a review of the plausibility of its hut features has recently been conducted by Niekus within the NWO-Odyssey programme. With regard to the hut features the main conclusion is that this interpretation should be regarded as highly questionable (Niekus 2012). In this thesis the supposed elliptical features of Bergumermeer will therefore not be interpreted as hut features. The site did yield evidence of intensive use in the form of pits, postholes, hearthpits, and manuports over the entire extent of the ridge, as well as an assemblage of 123,746 artefacts, which is more than ten times larger than most Late Mesolithic sites in the LRA. The long-term use of this location (see Appendix I) should however be taken into account.

Northern coversand: structures at Havelte and Nieuw Schoonebeek?

There is hardly any evidence available at the other sites for the existence of structures. At Havelte-H1 three shallow elliptical pits were found, measuring *c.* 2-3 m in length, 1.5-2 m in width and *c.* 30-50 cm in depth. In one of these a truncated part of the podzol horizon was documented, which suggests that these features may be interpreted as tree falls (Price *et al.* 1974, 23). It has been mentioned though by several authors (Bubel 2002/2003; Crombé 1993) that tree falls excellently meet the basic requirements for dwelling structures. The presence

of artefacts and charcoal within their fills might thus not be postdepositional in some cases. The site of Nieuw-Schoonebeek yielded 39 sizeable stones of different types, probably collected at the nearby Hondsrug ice-pushed ridge. These stones are interpreted as tent weights, in view of their dimensions and weight (Beuker 1989, 161).

Wetlands and wetland margin: Hardinxveld-Polderweg

At Polderweg the oblong pits K5 (8.5 x 3 m) and K8 (6.5 x 2 m), with a remaining depth of 40-50 cm, were located on the slope of the dune. The bottom of both of these features consists of a compacted (trampled?) layer with organic material, yet the fill was largely devoid of finds (see Hamburg/Louwe Kooijmans 2001, fig. 4.7 and 4.8). The features are associated with several postholes (*cf. supra*). Both pits are accepted here as dwelling structures, more specifically sunken dwellings. This is substantiated by a comparison with archaeologically comparable features from other (Late) Mesolithic sites such as Baarn-‘De Drie Eiken’, Tägerup, Møllegabet and Lollikhuse (see Van Haaff *et al.* 1988; Hamburg/Louwe Kooijmans 2001, 95; Karsten/Knarrström 2003, 37; Skaarup/Grøn 2004, 41-74; Sørensen 1992).²⁷ Furthermore, investment in partly dug-in or sunken hut structures has also been documented ethnographically (see Binford 1990, 123). Unfortunately the destructive colluvial processes prevent a correlation of these features with the distribution of artefacts. Possible dwelling structures were also recorded for De Bruin. A large pit (K13a/b) in phase 2 shared some of the characteristics of the hut dwellings mentioned above, but actually consisted of two separate pits and contained a burnt layer (Nokkert/Louwe Kooijmans 2001, 87-88).

River valley: Liège Place St.-Lambert

At Liège sector SDT yielded five stone pavements made up of blocks of sandstone and other river gravels. Three of these (L287, L290, 09-0263) consisted of dispersed concentrations of stones bearing traces of fire and are interpreted as naturally or anthropogenically displaced hearths. The other two (L288, L289) are of similar size, but lack traces of fire. They consist of two layers of sandstone and are well structured. Their interpretation is not clear (see Van der Sloot *et al.* 2003, 96-97), but apart from hearths an interpretation as storage platform is also possible (Cribb 1991, 92-94).²⁸

The fact that these stone structures consist of two layers adds to the aspect of investment and possibly recurrent activities. For most of these structures a correlation with one of the two Mesolithic occupations is possible (Van der Sloot *et al.* 2003, 97-98). No detailed information has been obtained on the spatial relationship between the lithic clusters and the stone pavements, although they seem located north of, and partially overlapping with, the western cluster of lithics (compare Van der Sloot in prep. fig. 3 and Leotard *et al.* 1995, fig. 3). The other stone structure, L500, was found in sector DDD and measured *c.* 4 x 4 m. The structure was angular to rounded in shape and also consisted of river cobbles. The pavement was located north of a depression, probably an old channel of the Légia. The pavement could not be dated directly, but most evidence points to a (Late) Mesolithic attribution (see Van der Sloot *et al.* 2003, 98; Van der Sloot in prep., 162). Importantly, the distribution of lithic finds is largely complementary to the structure (*ibid.* fig. 19-21; see also Appendix I). The interpretation of the pavement is still open. While traces of fire have been found, the size and location

of the structure points rather to a function as a base or drainage system for a tent or hut (Van der Sloot *et al.* 2003, 97). Remarkable is the increased density of the stone pavement in its northern section, which almost forms a circular feature. This is also the area where the largest stones are found (see Gustin *et al.* 1994, fig. 2). The abrupt delimitation of the feature supports the idea that the layout and construction of the pavement was planned. This may have been time-consuming. Similar stone pavements of intermediate size (1 to 2 m) have been found in a comparable river valley context in midwest France at L'Essart near Poitiers (Marchand *et al.* 2007). These have been interpreted as hearths, possibly related to the smoking of fish (*ibid.* 36). There are also several ethnographic analogies for these structures (see Binford 1990, 127-128).

River valley: Remouchamps-Station LeDuc

At this site another stone structure was found, consisting of several accumulations of quartzitic cobbles (up to 50 cm) in a roughly circular configuration. In some parts there was a superpositioning of several layers up to 40 cm. The overall structure is semi-elliptic in shape, closed off towards the valley. In the southern opening of the structure another accumulation of gravels was found in a shallow pit. Within this accumulation a double hole containing fine gravels was discovered. This feature is interpreted as a posthole (Gob/Jacques 1985, 167). Other features comprise a shallow pit (I25) filled with burnt stone fragments. Most gravels had been subjected to heat. On either side the pit was accompanied by a large sandstone block and only a limited amount of charcoal was found. Another feature (C24) was located in the southernmost part of the dwelling and consisted of burnt and fragmented sandstone blocks. Some of these were found at the bottom of a nearby shallow pit (*ibid.* 167). Most of the calcined bone fragments and artefacts such as trapezes and backed blades were found outside the dwelling in the vicinity of feature C24. Other features include a grouping of prepared cores (square E21), associations of psammite slabs and pebbles and the presence of a knapping area around a 'sitting-stone' (square H24; *ibid.*). Overall the evidence points to a partially covered structure (Gob/Jacques 1985, 174) with an internal structuring of activities. Most activities took place outside around the hearths. The excavators argue that the structural investment and the work involved in transporting several hundreds of kilos of stone indicate more than a provisional investment (*ibid.* 174). The stones were probably collected from the bed of the nearby Amblève river.

5.4.5.6 Graves

Graves and deposition of human remains, forming important aspects of mortuary practice and therewith socio-ideological and ritual practices, can, to some extent, be interpreted as an indication of 'investment' in a site, at least in the sense of a place of some (symbolic) importance (*e.g.* Littleton/Allen 2007). Only a limited number of sites yielded evidence for burials dating to the Late Mesolithic (see Louwe Kooijmans 2007^b).²⁹

Northern coversand: Mariëenberg

The site of Mariëenberg yielded six features that have been interpreted as sitting graves, found amidst a cluster of hearthpits (see Appendix I). The features consisted of a shallow funnel-shaped upper part (with unknown function) and a cylindrical lower part (Verlinde/Newell 2005; 2006).

The fill of the pits was remarkable. It consisted of a 30-35 cm layer of thick red-coloured sand within which (groupings of) artefacts were discovered, including several (retouched) blades, cores, blocks of flint, hammer stones and sandstone polishing stones. The number of 'grave goods' varies per feature from 0-22 items (Verlinde/Newell 2005, 11-12; Verlinde/Newell 2006). According to Louwe Kooijmans (2012^b, 414) the red stained sand is probably not redeposited red sand, but resulted from the dissolution and diffusion of a red substance ('ochre') derived from an unknown source and deposited at the same level. The sand was probably quarried at the settlement (it included the settlement waste that was found there) and the artefacts were coloured as well (see Louwe Kooijmans 2012^b, 410-411). Time-wise the features probably date to phase 3 or to the hiatus between phase 3 and 4, roughly around 6000 cal BC. They therefore do not seem related to the domestic areas with hearthpits at the site (see Louwe Kooijmans 2012^b).

The overall evidence indicates that the pits, because of their shape and content, were probably used for intentional deposition and the burial of human corpses (Louwe Kooijmans 2012^b, 409, 415; Verlinde/Newell 2006). Based on comparative research into European Mesolithic burial customs, however, the combination of features remains very unusual within the Mesolithic burial traditions of the LRA (for further information see Louwe Kooijmans 2012^b; Verlinde/Newell 2013 and Appendix I).

Wetlands and wetland margin: Hardinxveld

Next to isolated skeletal remains, Polderweg yielded a total of five graves, two human inhumations (G1, G2) and three dog burials (G3-5), of which one (G3) was in full anatomical articulation (Louwe Kooijmans 2003, 613). G1 contained the remains of an elderly female, buried in stretched position (N-S) and dated to phase 0. The other burials, dating to phase 1, were found on top of the dune, while one of the dog burials (G5) was situated on the slope (Louwe Kooijmans 2003, fig. 77.4). The burial pit was dug right before the occupation of phase 1 and apart from the skeletal remains contained a few specks and one piece of ochre (Smits/Louwe Kooijmans 2001, 421). The second grave contained skeletal remains of two individuals and no clear burial pit. The remains may have been incomplete due to taphonomic activity or may have been purposefully removed. The most complete dog burial (G3) demonstrates the care that was taken in the deposition of these valued animals.³⁰ It is noteworthy that the burials (G2-G5) were located next to and in between other features dating to phase 1.

In a similar position as at Polderweg, a human inhumation (G1) was found at De Bruin, at the top of the dune (Nokkert/Louwe Kooijmans 2001, 99-100). The grave contained the skeletal remains of an adult man, buried in an E-W direction. The other grave (G2) contained an adult buried in a sitting position (Louwe Kooijmans 2003, 613). It is noteworthy that at both Polderweg and De Bruin the

human burials were cross-cut by later pits indicating either unfamiliarity with or a lack of interest in the presence of these graves.

While only two sites yielded positive evidence for Late Mesolithic burials, the presence of undated graves and small cemeteries, assumed to relate to the Swifterbant occupation at Swifterbant-S21-24 and S11-13, suggests that these practices probably had older roots. Furthermore, loose bone material has been found at a number of locations. While for the Swifterbant sites it can often not be specifically related to either the Late Mesolithic or Early Neolithic phase of occupation (see Constandse-Westermann/Meiklejohn 1979, table 1), it should be realised that this phenomenon was relatively widespread (see Louwe Kooijmans 2007^b) and clearly has Late Mesolithic origins. As such it formed part of the mortuary ritual practice, while the deposition of these remains may also have had a structuring effect on the use of sites, or may be interpreted as a means of investing in places.

Recently another Mesolithic site in the vicinity, Swifterbant-Bisonweg, yielded a stretched human interment of approximately the age of the oldest Polderweg burial. Further west, a Mesolithic site (Rotterdam-Beverwaard) situated on a river dune (donk) west of Rotterdam yielded evidence of three pits with a small amount of human and animal cremation remains. These were dated earlier than the burials included here, roughly between 7500 and 7000 cal BC (see Appendix I; Zijl *et al.* 2011).³¹

5.4.5.7 Other elements

A number of other elements may be mentioned that indicate investment in a certain place. These include the structural stones (or manuports) that were documented at Bergumermeer and Nieuw-Schoonebeek, some of the features (large blocks etc.) at Remouchamps and Namur, and the potential fish weir at Jardinga. Another element is formed by treefall features or trunks of trees that may have been incorporated in the site structure (*e.g.* Crombé 1993). Particularly the wetland sites yielded evidence for additional investment. At Hardinxveld-De Bruin a feature (A1) found in the contact zone between dune and water is hypothetically interpreted as a channel in connection with a landing stage for canoes (Nokkert/Louwe Kooijmans 2001, 105). The site also yielded evidence for canoes, paddles (also at Polderweg) and part of a fishtrap. Obviously these are partially non-structural investments that were documented because of the good preservational conditions. On the other hand they also point to investments that are (energetically and time-wise) relatively costly and furthermore are a particular (structural) part of wetland occupation.

5.4.6 Late Mesolithic sites and settlement system in the LRA: *defining settlement grammar*

Above, a number of aspects of Late Mesolithic sites and site use have been discussed. These focused on three perspectives or scales (texture, grain and redundancy; see Cribb 1991) that dealt with the position of sites in the landscape and site location choice, the characteristics and elements underlying site structure and the investment in sites as determined by density and feature variability. As was already stressed a number of times, our perspective is necessarily skewed because of the distinct differences in taphonomy and site formation processes between sites and

in relation to the different groups defined. This does not prevent the detection of larger scale trends and characteristics shared by a number of sites, and per theme it is possible to sketch a general outline and detect similarities and differences. Despite the limitations of the macro-scale variables discussed, these elements provide a preliminary framework for investigating the ‘settlement grammar’ of Late Mesolithic occupation in the study area. Below a characterisation per group is given based on the combined information presented above.

5.4.6.1 The southern coversands: consistent patterning

For sites on the southern coversand there seems to be a distinct link between the factors that characterise site location choice and the structure of these sites themselves. Most sites are situated on the top or the slopes of coversand dunes or ridges, often facing south and in the vicinity of water in the form of peat fens (meres) and streams (*e.g.* Van Gils/De Bie 2008; Van Gils *et al.* 2009). Water, increased biodiversity and raw materials were probably the main incentives for occupation (see Huyge/Vermeersch 1982, 151; see also Randolph Daniel Jr. 2001). Nevertheless, the frequent visits to sites may have taken on a dynamic of their own in a social sense, adding to their development as persistent locations (Schlanger 1992). The frequency and character of these visits is furthermore expressed in the way sites develop. Apart from the potentially structuring and centralizing features of hearths (*e.g.* Séara 2006, 277; Stapert 1992) these sites are shaped by concentrations of lithic debris that cluster on the slope or the top of dunes and ridges, often parallel to the waterfront. These scatters of clusters and concentrations often develop over a considerable stretch of terrain (Van Gils/De Bie 2003). Although some of these concentrations resulted from contemporaneous activities, radiocarbon and typological information point to their development over often extensive periods of time (see for instance Merselo-Haag, Brecht-Moordenaarsven and Weelde-Paardsdrank in Appendix I). They represent accumulations of many relatively short-term and unstructured occupations. It is therefore not so much the persistency of actual places or sites, but rather the consistency in conditions that shapes the formation of these complexes (Amkreutz 2009; Vanmontfort *et al.* 2010; Vanmontfort *et al.* in press). Although severely hampered by taphonomic factors, the short-term nature of frequent repetitive visits to these sites is substantiated by the unstructured characteristics of site development and the relative absence of investment in structures and facilities. Apart from evidence for surface hearths only two sites yielded limited indications for lightweight shelters or tents.

Interpreting short-term stays

A reason for the supposed short-term nature of occupation that characterises the elaborate site complexes in for instance the Campine area, may stem from the local geomorphological and ecological situation. The area is best characterised as mainly densely forested, in the shape of a closed-canopy deciduous Atlantic forest (*e.g.* Bakels 1978; Gregg 1988; Svenning 2002). In this type of landscape locations near peat fens of streams would be the most attractive areas for settlement, because of the proximity of water and occasionally lithic resources, but also because of the diversification in vegetation and the attractiveness to wildlife. Hypothetically these sites may be interpreted as resource patches, acting as nodes in the mobility cycle of the groups inhabiting the area. Although they are rather numerous (*e.g.*

Vermeersch *et al.* 1992, 5; Van Gils/De Bie 2008), they are not very extensive, which would require a residential move as soon as resources diminished. This helps to explain the numerous sites that have been found as well as the fact that they are often extensive, both aspects relating to the frequency of visits to suitable locations over many centuries. These locations, rather than being point-specific, are characterised by the existence of (expectable) consistent conditions, along the extent of a geomorphological feature such as a dune or ridge. It was these consistent conditions that were sought after, instead of particular places (Amkreutz 2009; Vanmontfort *et al.* in press). Recent research in the Campine area of northern Belgium has furthermore pointed out some differences in occupation intensity at some of the sites (Van Gils/De Bie 2008; see also Robinson 2007^b; *cf. infra*). These could be related to a variety of environmental factors such as raw material abundance, reliable availability of water in the depressions encountered, or accessibility of site locations. Next to these push and pull factors social considerations involving territoriality or significance of certain places should be considered (*e.g.* Schlanger 1992).

From a behavioural perspective, similar models regarding the sustainability of environments have been put forward. Ethnographically oriented patch-choice models give some insight into forager behaviour in these situations (Kelly 1995). They assume return-rates are highest upon entering a 'patch' and (gradually) decrease until a point of diminishing returns is reached with rates dropping below the rates of expectancy levels elsewhere (Kelly 1992, 46; see also Sahlins 1972, 33). The subsequent decision to abandon the patch is based upon the cost of moving and encountering another patch (questions of time and energy). Furthermore, it is assumed that foragers do not return to a patch until its resources are rejuvenated (Kelly 1995, 90). When this perspective is applied to the Campine area, it may help us understand the archaeological patterning. The sustainability of the individual areas where resources cluster, such as peat fens and stream valleys may have been low, but at the same time the costs of moving were also low and the overall number of patches ensured regeneration over time. This would lead to a system of relatively high residential mobility (*sensu* Binford 1980).

5.4.6.2 The northern coversands: differences of degree

The recurrent characteristics that shape Late Mesolithic occupation on the southern coversand only partially determine the 'grammar' of sites in the other groups. On the northern coversand a number of sites is also characterised by lithic concentrations and clusters (*e.g.* Havelte, Nieuw-Schoonebeek and Tietjerk). These sites also yielded some hearthpits as well as other features. Apart from these there is another group with sites such as Bergumermeer and Mariëenberg that are characterised by a greater number of structural elements: very high artefact counts at Bergumermeer in combination with a considerable number of structuring elements in the form of pits, hearthpits, structural stones and other features; at Mariëenberg low artefact densities in combination with large numbers of hearthpits and, incidentally, graves (see Louwe Kooijmans 2012^b). Apart from evidence for increased investment in locations, the clusters of hearthpits indicate a degree of spatial structuring. Direct evidence for dwelling structures is scarce.

Based on the characteristics in site location choice, sites on the northern coversand appear to be more oriented to larger ecotones, for instance Mariëberg to the Vecht valley, Bergumermeer to lake Bergumermeer, and Tietjerk and Schoonebeek in between a number of stream valleys. There are, however, also distinct similarities between settlement location choice in this area and the south. Similar locations - elevations in the vicinity of water - were sought after. Furthermore, the overall 'signature' is that of a coversand landscape largely comparable to that in the south, although there are obvious differences in for instance subsoil (moraine deposits), water systems, drainage and, later on, intensity in peat growth (see palaeogeographical map '5500 cal BC'; Vos *et al.* (eds) 2011, 43). Although the limited site evidence available does point to differences in structure and investment at sites, these should be interpreted as of degree rather than kind.

5.4.6.3 Wetland (margin) and river valleys: a different type of occupation?

There is a difference between the type of wetland settings within this group, with Polderweg and De Bruin forming one end of the spectrum. The other sites, most notably those of the Swifterbant cluster, Hoge Vaart and Urk are situated in landscapes that are becoming increasingly wet. Evidently, several of the Swifterbant sites characterised by hearthpits as well as the Late Mesolithic phases with hearthpits at Hoge Vaart and Urk (see Peeters 2007; Peters/Peeters 2001) may be compared to some of the sites in the northern coversand group. The information for Oudenaarde and Melsele is too limited to compare, but positive evidence of dug-in features fails. Where the former sites are characterised by considerable numbers of hearthpits, these are largely lacking at the latter. Favoured by good preservation, Polderweg and De Bruin yielded a variety of other features, including pits, postholes, possible dwelling structures and graves, next to (only) a few hearthpits. This points to a diversified structural investment, corresponding with the use intensity and level of permanency of occupation demonstrated for these sites (*e.g.* Louwe Kooijmans 2003). The structuring of individual elements at sites and their patterning and location with respect to each other can best be studied at the Hardinxveld sites, where there is evidence of intra-site zonation (Louwe Kooijmans 2003, 610). The top and upper slopes of the dunes yielded most features, including the supposed sunken dwellings at Polderweg. The lower slope and foot of the dune, bordering on the wetland, probably formed an activity area as demonstrated by (colluviated) debris and quantities of charcoal indicative of hearths. The wetland margin yielded artefacts, which indicate the presence of a toss-zone (see Louwe Kooijmans 2003). As argued earlier (section 5.4.4.3) this division, although reflective of a zonation in the use of the site, is to a significant extent shaped by (post-)depositional processes in relation to the gradient of the slope. Currently a similar tripartite division has not been documented as distinctly at other wetland sites. At least for the main domestic occupation phase (phase 1, *c.* 5500-5300 cal BC) the zoned use of the site indicates a structured and repeated use of domestic space at the same location according to the same principles. All this time it was the same location to which people returned and which they structured according to the same set of rules. Because of the increasingly limited availability of other suitable places in the surrounding area (see Mol 2001^a) and the continued structured layout it is also likely that we are dealing with the same

group of people. Based upon one of Schiffer's general rules (1995, 37), there is an inverse relationship between increased intensity of occupation and spatial correspondence between use and discard locations. While this does not preclude the factor of 'anticipated mobility' (see Kent 1992; Kent/Vierich 1989) it basically means that the level of spatial structuring at sites that are inhabited for more prolonged periods of time will be greater than that at sites that are not. The dune top sites of Hardinxveld in this respect differ distinctly in character from the sites on the southern coversand.

Additionally, increased investment in sites is also documented for the river valley sites; at Liège in the form of stone pavements or platforms and stone hearthbases, consisting of multiple layers; at Remouchamps perhaps in the form of a covered structure or hut. This may imply as well that these sites, because of their increased investment, potentially saw increased site structuring in relation to more extended stays.

Aquatic perspectives

An important reason for the different signature of the sites in the wetland group, in particular Hardinxveld, may be taphonomy in relation to site location choice. Naturally, a well-preserved site at a small location in the wetlands will leave a different archaeological signature than an extensive upland coversand site. From this it follows that many of the noted differences between the documented sites are gradual, rather than fundamental and relate to the specific local circumstances of preservation. Next to this, however, it is also evident that not all the landscapes in the regional groups defined here are comparable and that regions are characterized by different ecological and geomorphological circumstances, which provide different habitational windows. The differences that are noted with respect to the issues discussed above are most distinct in comparison to wetland locations and in particular the Hardinxveld sites. This may be explained by the fact that the wetland and wetland margin sites are situated in a landscape with a wide array of aquatic resources. These offer different opportunities and margins for occupation and mobility and, as indicated by a wide variety of anthropological and archaeological research (*e.g.* Ames 2002; Binford 1990; Coles/Coles 1989; Kelly 1995; Out 2009; Nicholas 2007^{a,b}; Van der Noort/O'Sullivan 2006), allow for longer stays and a general decrease in mobility. Seasonal information at Polderweg for instance indicated that the site was used in phase 1 as a seasonal base camp during winter and that De Bruin might have functioned as a subsidiary site in various seasons (Louwe Kooijmans 2001^b; 2003). To some extent the wetland and developing wetland landscapes of the Rhine-Meuse delta, the Scheldt valley and the IJssel-Vecht area are an inverse image of the upland coversand area.

Not including the special activity site at Jardinga, the sites in the river valley group, situated near Liège next to the Meuse or one of its tributaries, are also characterised by an aquatic setting, in this case a river or stream. At Liège limited faunal indications point to seasonality (see López Bayón 1994), indicating a human presence in late winter and/or early spring. The faunal and fish remains at this site as well as at Namur also form positive evidence for both the rich environment within which the sites were located and the fact that most of the available resources were indeed exploited. In this respect the river valley locations may also be interpreted as relatively rich and diverse settings, and comparable to

some extent – with respect to their economical opportunities – to the wetlands and wetland margins.

5.4.6.4 Interpreting variability

The contrasts sketched above are based on a limited number of sites and only form a rough indication of the variability that must have been present within the Late Mesolithic. The main contrasts that stand out are found in the type of occupation that characterises the southern coversand landscape and wetland sites such as both Hardinxveld locations. From the perspective of mobility and settlement systems it was hypothesized that these differences potentially related to the different opportunities offered and constraints imposed by the wetland aquatic environment on the one hand and the upland coversand region on the other. This type of model also explains the differences in settlement structure and investment with long-term place-bound behaviour on the one hand and a search for consistent conditions and elaborate site complexes on the other. However, these sites or systems cannot be studied in isolation. They characterise the variability of Mesolithic occupation in different types of landscape, but should also be understood as parts of the settlement system of mobile communities and should therefore be further contextualised, both geographically as well as functionally. In order to create a better understanding of the different types of sites and settlement systems in general, it is important to gain insight into the range of activities that characterises them. In the following section the lithic toolkit of the documented sites will therefore be further analysed.

5.5 Lithic assemblage analysis

This section reviews the technological and typological aspects of the studied lithic assemblages, including raw material composition (Wommersom quartzite and other stone materials).

The composition of the lithic assemblages of the studied sites forms a complementary perspective on Late Mesolithic site use that is relatively less affected by different conditions of preservation in comparison to for instance features, site structure or organic remains. Of course other site-formative and excavation-related distortive factors do apply (see Chapter 4), which influences the comparability of some assemblages.

The aim of the analysis is to discern to what extent the lithic assemblage composition provides information on site use, mobility strategies and the settlement system. This involves the pinpointing of general characteristics of the sites and defined groups as well as differences among them. In combination with the other aspects of sites mentioned above, this may shed light on the diversity between Late Mesolithic sites and the presence or absence of larger-scale contrasts between regions.

5.5.1 Theoretical background

Lithic procurement, stone tool production and artefact use form part of the spectrum of activities performed at sites. The relative importance of these activities within and between different sites may highlight similarities and differences in site use or function. Since all sites to some extent are buried surface collections

(Binford 1987^b), the composition of the lithic assemblages reflects site function only in part, but may be used to detect more coarse-grained patterns between (groups of) sites. This is based on the premise that certain aspects of stone tool technology and the composition of the lithic toolkit relate to activity spectrum, site use and mobility (*e.g.* Andrefsky 2005; Bamforth 1986; 1991; Binford 1983(1976); 1983(1979); Bleed 1986; Kelly 1992; Shott 1986; Torrence (ed.) 1989).³² The aim is to see whether general characteristics may be defined.

5.5.1.1 Curated and expedient technologies and toolkits

Many factors influence community- or agency-based choices in technology and toolkit composition (Bamforth 1991, 217). These include aspects such as tradition, raw material distribution and risk minimization. Since not all of these can be accounted for, partly because of differences in recording (see below), it is necessary to base an analysis on more general 'robust' categories of assemblage types. One of these is the distinction between curated and expedient technologies.

Curated technologies, often characterized as 'efficient', are aimed at the production of formal tools and generally involve extensive maintenance, repair and reuse of material. They are often blade-based and require considerable investment in time and energy. This contrasts with expedient technologies, which are more geared towards an *ad hoc* production of technologically simpler and formally less distinct, often flake-based, tools. This type of technological system is generally more wasteful with respect to raw material (*e.g.* Andrefsky 2005; Bamforth 1986; Binford 1983(1976); 1983(1979); Torrence 1983).

Although characterized by (functional) overlap (*e.g.* Bamforth 1986, 39-40; Kelly 1992, 55-56), there is a general difference between curated and expedient technologies. It should be noted though that while a general distinction between flake and blade contributions to the studied assemblages is possible, this is not absolute as site assemblages almost always include both. Furthermore, flakes are always overrepresented since they form part of the initial stages of blade-based debitage. Another factor is the general absence of use-wear analysis for most sites studied, which limits the degree to which the purpose of unmodified flakes can be determined. This is also the case with blades, although their design in general includes intentionality. Finally, with respect to tools, it is difficult to establish a singular distinction between curated and expedient components. While tool design (see also Bleed 1986; Kuhn 1994) leading to formal tools may be seen as an aspect of curated technologies, not everything that does not classify as a retouched flake falls within this category. Curated and expedient technologies and toolkits with curated or expedient elements do not lend themselves to a black and white distinction. There will be overlap and combinations, yet an emphasis in blade technology and an increased contribution of more formal tools points to (more) curated behaviour. It is therefore the comparison of more general aspects of the lithic assemblage that points to differences between sites and groups. The main implications of these differences between technologies, involving anticipation with regard to future tasks and functional diversity in relation to these, will be discussed below.

Cores and core rejuvenation

An aspect of the distinction between curated and expedient technologies is formed by the contribution of cores. As cores have been interpreted (archaeologically and ethnographically) as regularly transported parts of 'personal gear' (Binford 1983(1979); see also Andrefsky 2005), their contribution and that of core rejuvenation flakes points to the relative importance of a mobile toolkit. Unfortunately, at many of the studied sites no distinction has been made in the types of cores present (blade or flake).

5.5.1.2 Assemblage composition

Another indication of site function and related behavioural aspects is the assemblage and toolkit composition. Observed differences and similarities between the typological composition of (groups of) sites relate to different typological choices. From a general perspective, certain shifts in emphasis between the typological spectra of sites relate to different emphases in performed activities, site function and the settlement system. It should be noted as well that tool morphology is not directly informative on tool function or performed activities. Scrapers, retouched blades and flakes and even points have been used for a variety of tasks. Use-wear analysis has only been performed for a limited number of sites and often only gives a general indication of contact material and motion of performance. This indicates that it is not possible to identify all activities performed, nor to characterize site function based on stone tool typology alone. Again the aim is to detect more general characteristics.

5.5.1.3 Aspects of mobility and site use

Both the technological distinction between curated and expedient industries and the assemblage composition provide information on the activity range performed at sites, site function and mobility. Subsequently it is of importance to relate and interpret these characteristics to ethnographical and behavioural models and theory.

With regard to expedient and curated technologies it is generally accepted that, also in relation to lithic source locations, the relative contribution of flakes and blades may be informative on (aspects of) mobility. Curated technologies and formal tools are often typical for groups with a high(er) level of residential mobility. Tools are often flexibly oriented, multifunctional and can be rejuvenated or redesigned. They are made in anticipation of and preparation for tasks ahead, when the risk of being unprepared is too high. Expedient technologies and informal or non-standardized tools are more typical for groups with a lower mobility and longer residential stays. Tools are used and discarded over a short period of time and are manufactured according to need. This often entails that there is little uncertainty with regard to the availability of lithic resources (see Andrefsky 2005, 226-227; Binford 1983(1979), 275-286; Kelly 1992, 55; Torrence 1983, 11-13).

Although it has been argued that the distinction between curated and expedient technologies is not absolute (Bamforth 1986, 49; Chatters 1987, 341), proportional differences may prove insightful.

Cores and transport costs

Additionally the contribution of cores may prove informative. As regularly transported parts of 'personal gear' (*cf. supra*), cores function as a mobile supply of raw material (Binford 1983(1979), 276-277; Kelly 1988, 719) from which flakes or blades can be struck according to need. Evidently, transport costs and portability form important factors (*e.g.* Shott 1986; Torrence 1983). Cores could also be used as hammers, anvils, cleavers or chopping tools (*ibid.*). Although influenced by factors such as raw material distribution (see Bamforth 1986, 48), it can be argued that cores functioned as important elements for flexibly facilitating mobility and various (unanticipated) tasks.

In contrast other studies in optimization modeling have demonstrated that it is also efficient to carry around small implements such as finished tools and blanks instead of cores (Kuhn 1994, 437). While combinations of both strategies appear likely, the choice to incorporate cores is related to increased flexibility in producing what is needed at a certain time, and, perhaps, the aforementioned bulk of a core.

Implications of assemblage composition

While the technological characteristics introduced above are mainly informative with respect to mobility, the typological composition of the assemblages studied may, in relation to this, provide a more detailed perspective on site function. This is based upon the correlation between assemblage diversity and site type (see Andrefsky 2005, 216-218). According to Kelly (1992; 1995) the degree, frequency and distance of residential mobility have important effects on the character and activities of groups of hunter-gatherers, as evidenced by ethnography. This in turn influences archaeologically measurable variables such as site structure and stone tool technology (*cf. supra*). Shott (1986), on the basis of ethnographically documented groups of hunter-gatherers, has correlated assemblage diversity and mobility. He discovered an inverse relationship between assemblage diversity and frequency as well as magnitude of mobility (see fig. 5.13).



Fig. 5.13 Generalized relationship between residential mobility and artefact diversity. Adapted from Shott (1986, fig. 2) and Andrefsky (2005, fig. 8.5).

The underlying idea is based on the notion that artefact diversity varies in different systems of mobility (see Andrefsky 2005, 218; Binford 1980, 17-19). The basic premise is the difference between a limited length of stay and therefore a limited spectrum of activities, as witnessed in short-term base camps or special activity sites, and more extended stays and a broader spectrum of activities as expected at longer term base camps (see Shott 1986). This difference is assumed to be reflected in the number of tool classes or artefact diversity at these locations.

When applying this modulation to the groups of Late Mesolithic sites selected here, it should be realized that almost all sites have at least some artefacts per designated class, since the assemblages are in fact, at least to a certain extent, time-averaged amalgamations of multiple and divergent visits to the same location. While this limits the degree of detail, the general emphases in the artefact spectrum represent functionally characteristic choices, especially where a distinction in more formal tools and tools of an *ad hoc* nature may be distinguished, or at sites where one or more tool classes are dominant. The absence of more specific spatio-temporal information with respect to the toolkit therefore does not have to stand in the way of analysis (see for example Bamforth 1991, 228).

5.5.2 Characteristics of the lithic datasets

The analyses are based upon the categorized counts of lithic artefacts in the available literature. These were subsequently scored for a number of typological, technological and raw material variables. They are presented in Appendix II for technology (IIA), typology (IIB) and raw material (IIF-H). Before analyzing the results a number of distortions should be taken into account. These relate to dealing with archaeological assemblages shaped by a variety of factors.

Limits of the dataset

First, not all of the typological and technological categories used in the original literature are similar and some categories are not recorded for all sites. This limits the available detail and necessitates the merging of categories (see also Appendix II for site-specific comments). Most general categories do prevail at all sites indicating that a general analysis and characterisation is possible. Other secondary factors include differences in excavation methodology (*e.g.* was surface material included, did sieving take place, what part of the site was excavated, etc.).

Other limitations derive from more primary factors, some of which have been discussed in Chapter 4. Of major importance are spatio-temporal considerations. Especially in the coversand landscape, sites lay exposed and were used for a considerable period of time. This means that in most cases excavations form a spatial selection of temporally diverse uses of the site. These may involve the main use of a location, but also more singular special activity events. Since assessing use time and intensity is often impossible only a 'blurred' generalized image of site use is attainable. Major factors are excavation methodology, site taphonomy and multi-period sites. Next to this, lithic information is restricted by the functional limits of typology in combination with the absence of use wear and the regular lack of an organic component.

Apart from these factors that impinge upon the nature and resolution of the data-set available, the general context (both physical and social) of past site use forms a factor as well. An example is formed by the ecological properties of the

past environment surrounding sites (what activities were likely to occur), or the availability of (types of) raw material. Moreover, it should be taken into account that many aspects of the diversity in hunter-gatherer lifeways, as documented ethnographically (*e.g.* Kelly 1995), may be generalized, but often escape archaeological detection. Technological choices and typological composition in this respect are also (at least partly) influenced by factors such as group traditions and know-how, individual preference and anticipated tasks. This means that from an archaeological and behavioural perspective, the observed characteristics among the studied sites should be interpreted, not as absolute indicators of mobility and site function, but as general stresses in relation to these issues. Also it should be noted that the diversity documented may be rooted in a number of different, non-exclusive factors.

Sites, groups and emphases

The lithic assemblages studied are site-based datasets. These are shaped by the factors mentioned above and are interpreted as generalized images of past site use. The aim in this section however, is to detect regional characteristics for the groups defined above. Therefore intra-group similarities or differences are regarded as indicative of the homogeneity of (generalized) site use in a certain area. Several aspects should be defined.

- In line with the analyses above, the southern coversand group is relatively large and forms a representative sample of site use in that region, while site numbers for the other defined groups are limited. This means that a comparative analysis centres on similarities and differences with respect to the southern coversand group.
- While the assemblage characteristics may be influenced by a number of factors (see above and Appendix II), it is apparent that sites with a special character or with too limited artefact numbers overall should be excluded, because they introduce a bias to the general perspective. Two sites fall into this category beforehand. The first is Jardinga-Johannahoeve in the river valley sites group. This site (see Appendix I; Prummel *et al.* 2002; Prummel/Niekus 2002/2003) may be categorized as a special activity butchery site (of aurochs) on the banks of the Tjonger stream. Its lithic assemblage is limited in counts and range, which confirms its specialized nature, but makes it inappropriate for comparison. The second excluded site is Swifterbant-S83 (see Appendix I; Jordanov 2005). The assemblage derives from two small test trenches and is partly of a Middle Mesolithic date. Furthermore the tool spectrum is (numerically) too small.
- In the analyses presented below sites with a dataset that is quantitatively too limited for the category under analysis will be excluded from consideration. Since this may differ per category and comparison, these exclusions will be mentioned in the text.
- In dealing with the variables discussed below it should be taken into account that while the aim is to detect (regional) characteristics in site use and mobility (*cf. supra*), there may be a range of alternative explanations, not all of which will have materialized archeologically.

5.5.3 Technological characteristics

Below a number of technological characteristics of the studied lithic assemblages will be discussed. As argued above differences in recording limit the degree to which all aspects of sites may be compared. With respect to technology the distinction between blade and flake cores was only recorded at eight sites. Also, often it is not specified whether cores are exhausted or fragmented, if truncated blades are present, or what the character of core rejuvenation products is. For the same reason counts of fragments, chips or debris have been left out of the analysis since these are heavily dependent on excavation procedure and personal attribution. The remaining categories are formed by cores, core rejuvenation products, blades, flakes, microburins, burin spalls and tools. These are presented in fig. 5.14.

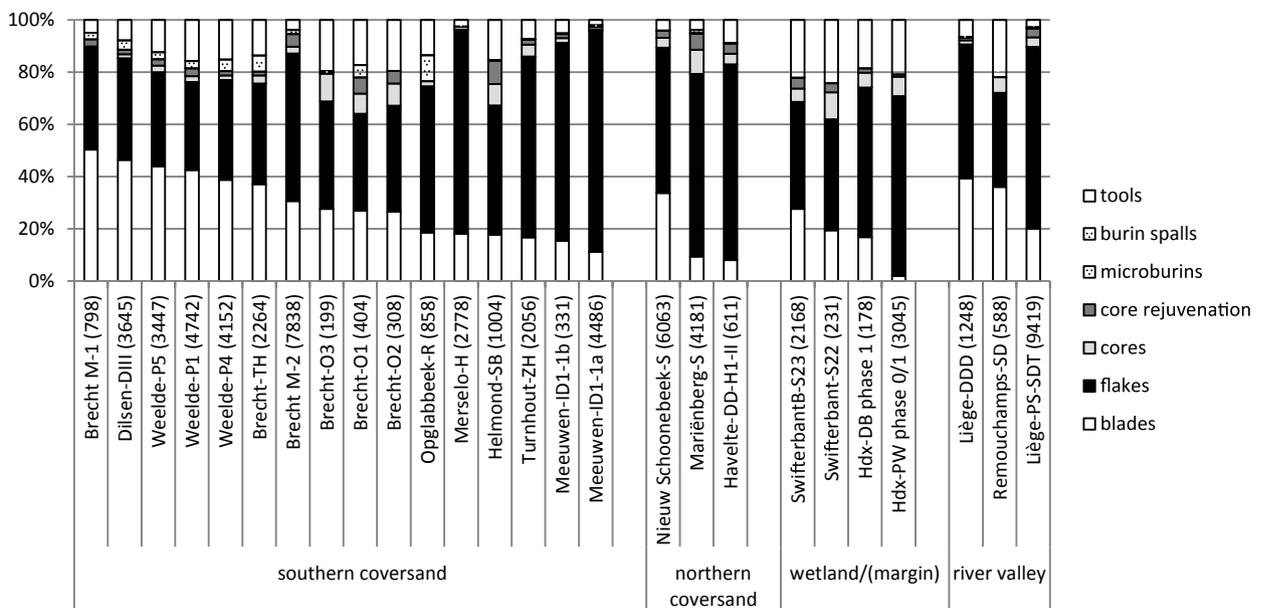
In total 26 sites yielded information on the technological composition of the assemblage, with an emphasis on the southern coversand landscape group.³³ The relatively large contribution of tools for Brecht-Overbroek and Helmond-Stiphoutsbroek may result from the incorporation of surface finds. The overall composition is however not affected.

In fig. 5.15 the results are combined per group. While numerically only the southern group is well represented some of the contrasts are interesting and reflect the distribution in fig. 5.14. Apart from the relatively large tool component at wetland sites, which will be discussed further on, the most apparent technological characteristic is the difference in the contribution of flakes and blades. The contribution of cores and core rejuvenation flakes also deserves mention.

5.5.3.1 Blades and flakes

As argued above blade- and flake-based industries offer a perspective on the type of technological system practised and its potential implications. Fig. 5.16 presents the contribution of flakes and blades per site.³⁴ Sites on the southern coversand are characterised by a considerable contribution of blades, while this is less so for sites on the northern coversand or in the wetland group. This is

Fig. 5.14 Percentages for technological categories per site. Total counts in brackets. See also Appendix IIA.



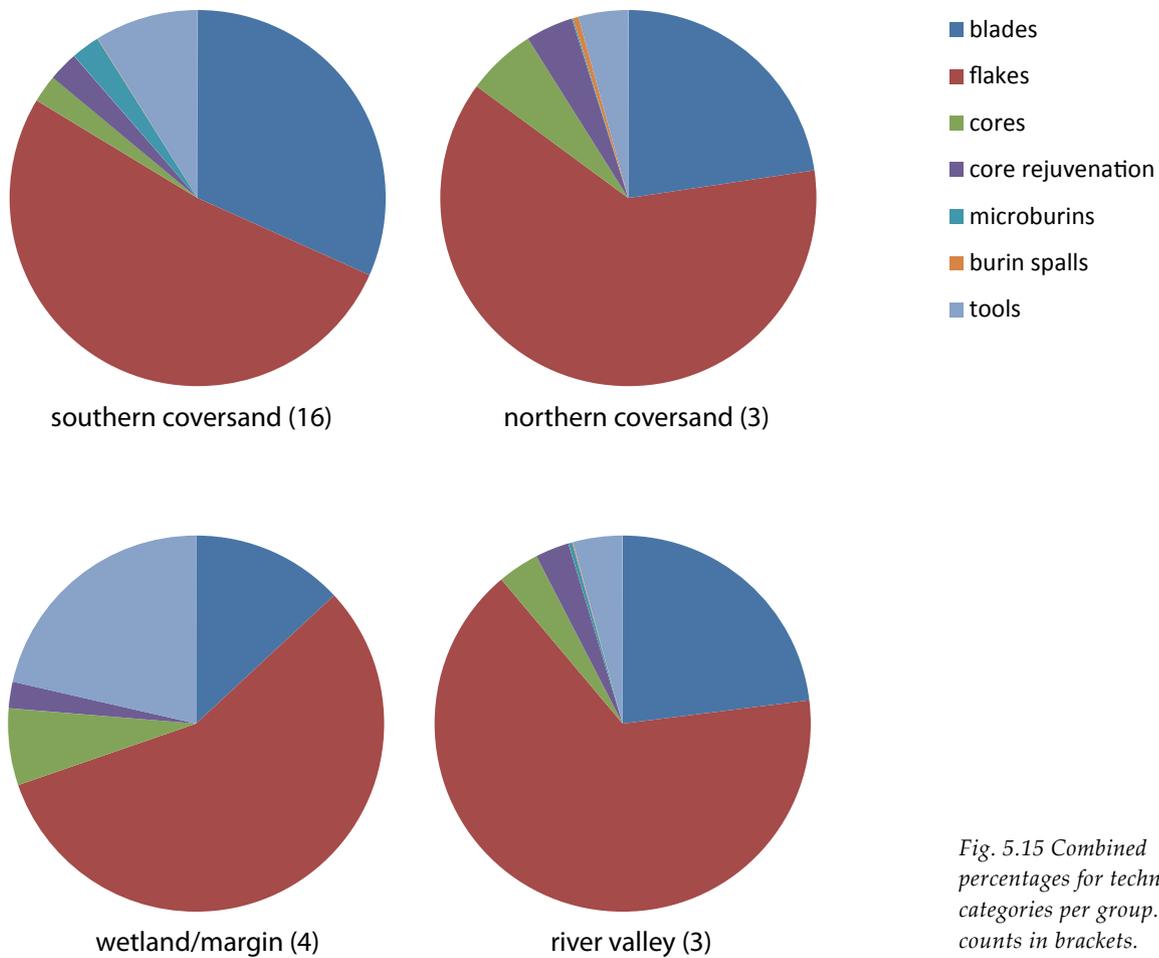


Fig. 5.15 Combined percentages for technological categories per group. Total site counts in brackets.

the case both at sites with completely excavated assemblages as well as locations (Brecht-Overbroek I and II and Helmond Stiphoutsbroek) where (part of) the assemblage is surface-related. The group of river valley sites also demonstrates a considerable contribution of blades. Within the group of wetland sites there is a distinct difference between both Hardinxveld sites where the contribution of blades, in particular at Polderweg, is limited and Swifterbant-S22 and S23 where the composition is more balanced.

When the scores of the individual sites are combined into group scores, regional differences become even more apparent (see fig. 5.17). Evidence for the relative importance of blade production on the southern coversand is evident. The contribution of blades at the river valley sites might, if the Ardennes sites are exemplary for the Meuse valley, perhaps reflect a system in close contact with sites similar to those on the southern coversand. For the wetland group it is clear that both Hardinxveld sites are characterised by a flake-based industry, which clearly contrasts with sites in the other groups, while blades play a more important role at Swifterbant-S22 and S23.

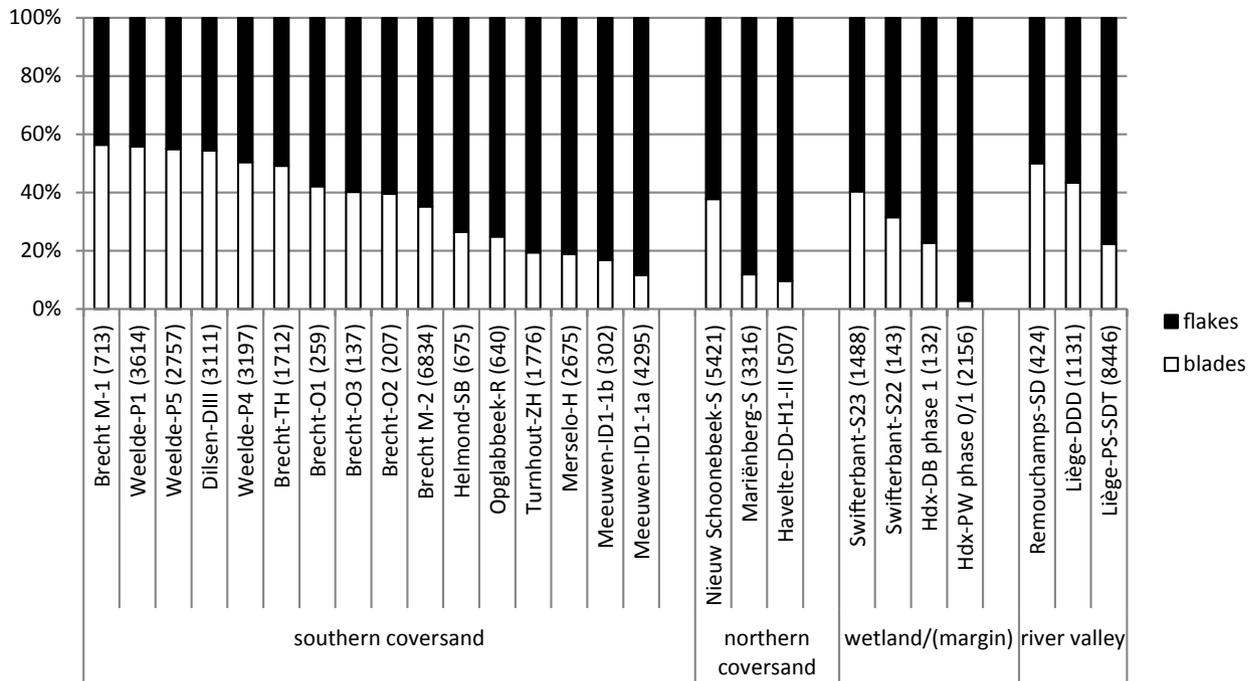


Fig. 5.16 Percentages for blades and flakes per site. Counts in brackets.

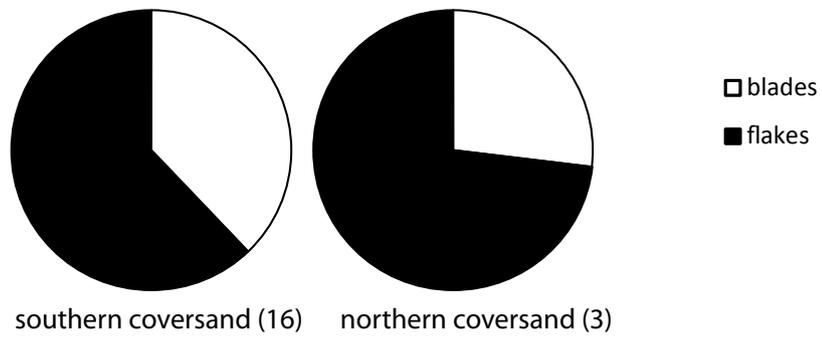
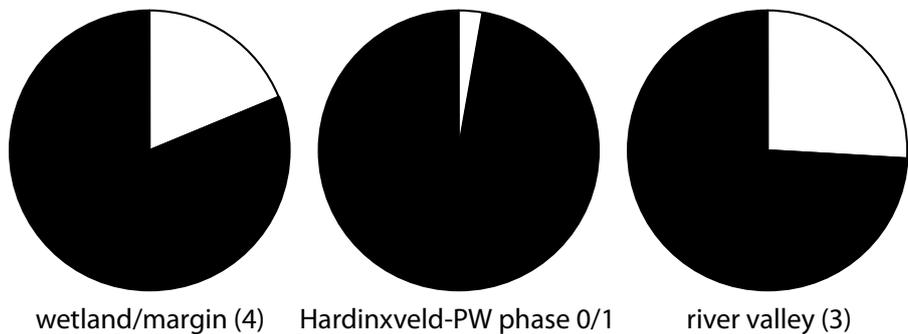


Fig. 5.17 Combined percentages for flakes and blades per group. Number of sites in brackets.



The available information on core type confirms the importance of blade production on the southern coversand (see fig. 5.18). This contrasts most distinctly with the wetland Hardinxveld sites.³⁵ The wetland margin locations of Swifterbant also stand out and quite oppositely indicate that blade cores were also of importance there, although this is somewhat qualified when compared to the contribution of flakes and blades (see fig. 5.16).

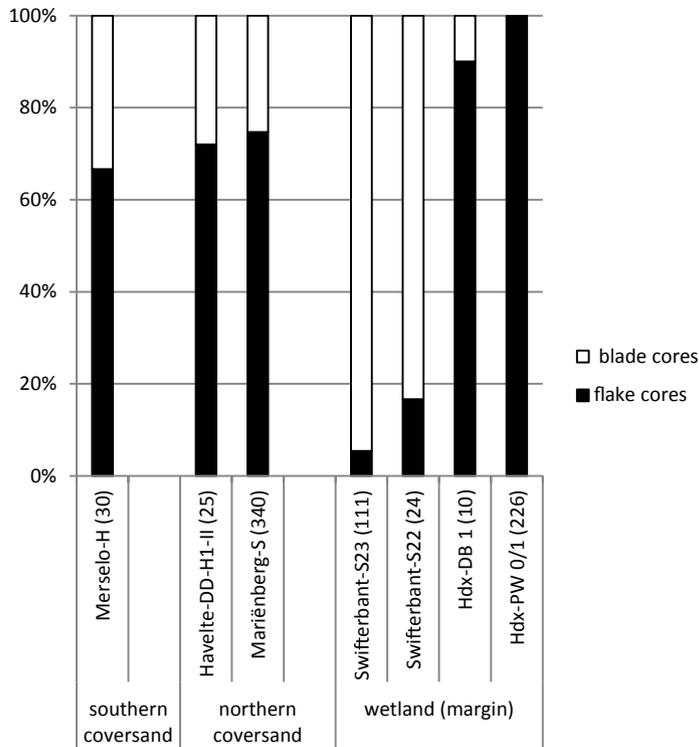


Fig. 5.18 Relative composition of flake and blade cores for informative sites. Number of cores in brackets.

	N sites	area excavated m ²	N cores/rejuvenation flakes	mean contribution cores to assemblage
southern coversand	16	7278	932/1007	2.37
northern coversand	3	5440	643/443	5.95
wetland/(margin)	4	3139	371/127	6.60
river valley	3	478	401/329	3.56

Table 5.12 Mean number of cores per group in relation to excavated area. (Based on assemblage counts excluding chips and debris and including tools.)

5.5.3.2 Cores and core rejuvenation flakes

In relation to the flake and blade emphases in the assemblages described above it is informative to put the occurrence of cores into perspective as well. These are presented in fig. 5.19. What is most apparent is the relatively low number of cores for a number of sites on the southern coversand. Only in two cases do they exceed 100 in number.

This particular perspective regarding sites on the southern coversand becomes even more apparent when the mean number of cores per group is combined with the overall area excavated.

It appears that especially for the southern coversand area in view of the area excavated the overall number of cores is low for the group and the individual sites. This may be emphasized by the fact that excavation at sites on the southern coversand was often aimed at artefact clusters, hypothetically increasing the expected number of cores. This is confirmed by their lower contribution to the assemblage. The river valley group is most comparable to this situation.

Combining the information from cores and core rejuvenation flakes it appears that the latter only match and exceed the contribution of cores for a group of sites on the southern coversand (see fig. 5.20). This supports the general characteristic described above regarding the more limited importance of cores at sites on the southern coversand.

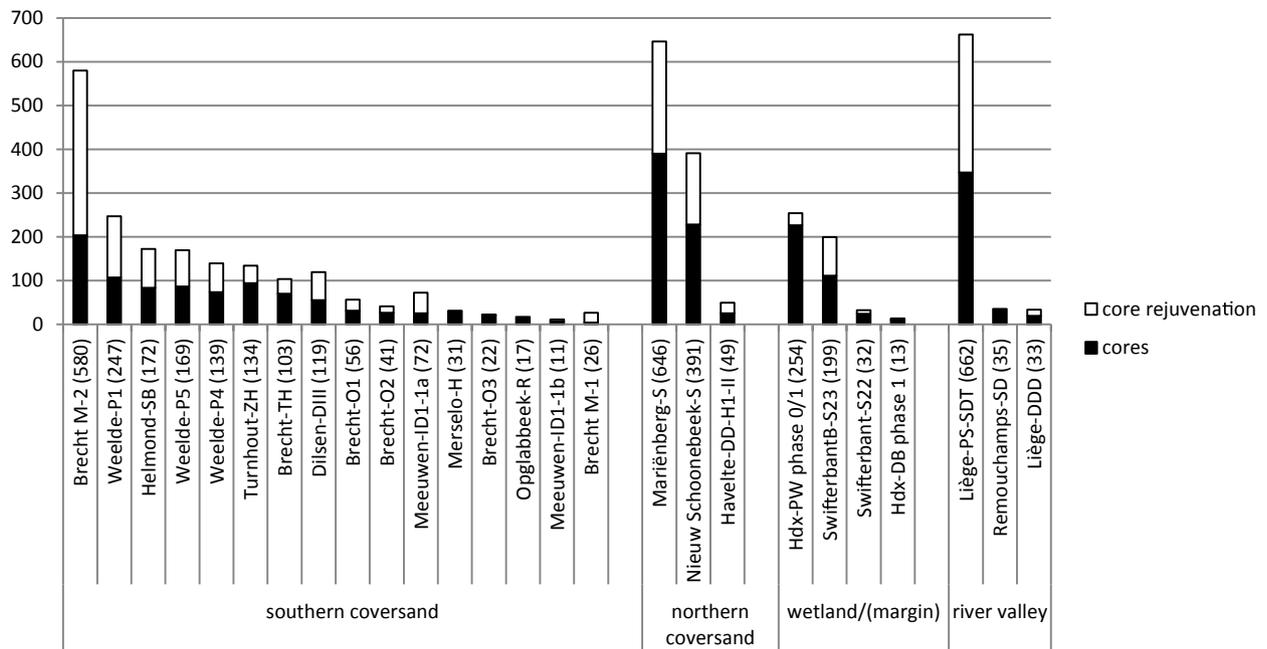


Fig. 5.19 Counts for cores and core rejuvenation flakes per site and group. See also Appendix IIA.

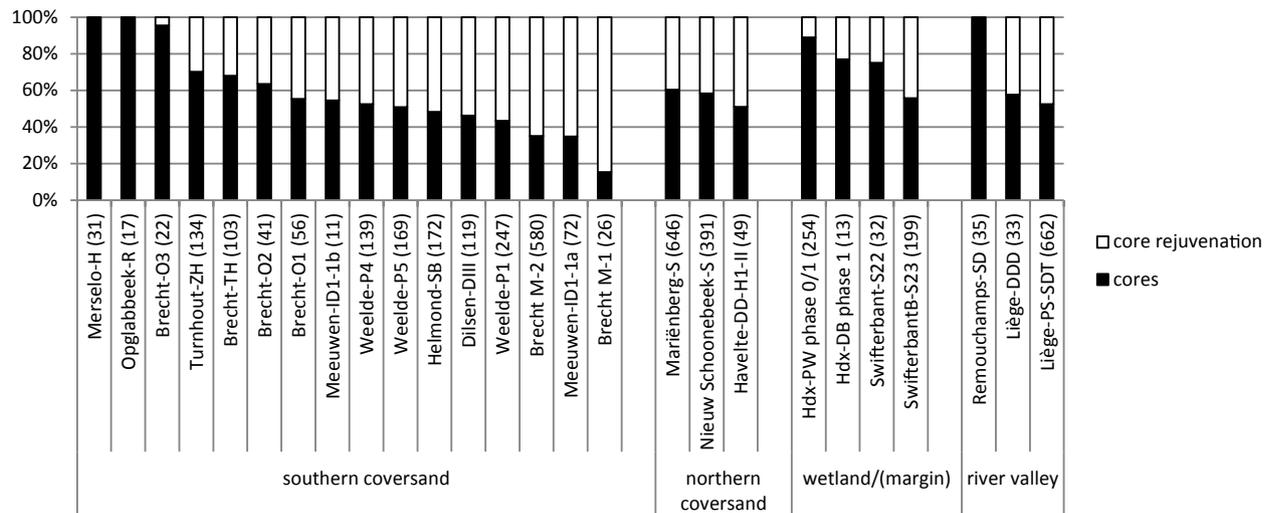


Fig. 5.20 Percentages of cores and core rejuvenation flakes per site. Number of artefacts in brackets.

5.5.3.3 Technological characteristics and potential implications

The characteristics recorded for debitage technique and cores described above form indicators for specific types of technological behaviour, connected to aspects of mobility and the settlement system. As argued above emphases in flake- or blade-based industries may reflect the type of mobility system in use in relation to the tasks employed, although certain intrinsic limitations should be taken into account (*cf. supra*). With respect to the sites studied here, those on the southern coversand are characterised by a more important contribution of blades overall.

In particular the Hardinxveld sites contrast with this with a mainly flake-based industry. Blades are hardly of importance there and the bipolar core technology was mainly geared towards producing workable edges on flakes (see Van Gijn *et al.* 2001^a, 133, 159; see also Andrefsky 2005, 241). This would argue for a higher degree of mobility for sites in the first group in comparison to distinct wetland locations as Hardinxveld with a lower residential mobility.

Blades are often used for the production of a variety of formal tools such as trapezes and Montbani blades. It is important to note that the contribution perspective here is based on five sites where blades are more important than flakes and four additional sites that demonstrated small differences. Further, intermediate evidence is provided by the importance of blade cores for sites in the southern coversand landscape and the contribution of microburins to the overall assemblage (see fig. 5.15). Flakes are evidently more important at most other sites, but unfortunately site numbers apart from those in the southern coversand group are too low to argue for more distinct regional characteristics. Microburins are typical waste products of the blade-based fabrication of trapezes. As argued above, the river valley sites are somewhat comparable in composition to the sites on the southern coversand.

When the contribution of cores and core rejuvenation flakes is included, the lower contribution of cores at sites on the southern coversand appears to be significant. This would potentially be in line with a higher mobility if it is argued that cores are part of the mobile toolkit (*cf. supra*) and were therefore regularly transported away from site to site and discarded upon exhaustion on the way to or at another site. The ratio between cores and rejuvenation flakes potentially supports this. The larger contribution of the latter to sites in the southern coversand landscape may indicate a higher level of core exhaustion and transport of cores at these locations. Especially the wetland site of Polderweg yields opposite, contrasting evidence. Cores were regularly discarded there while rejuvenation seems to have been less important, which also supports an expedient character.

Alternatively it should be realized that the number of cores and the ratio between cores and rejuvenation flakes may be influenced by a number of other primary factors, such as the size and quality of the raw material (mostly rolled nodules, terrace flint or flint from moraine deposits) and the influence of testing upon procurement, specific tasks and tradition. As such it may only form an indication of secondary importance.

From a technological perspective there are thus several identifiable differences. The main contrast exists between the group of sites on the southern coversand and wetland sites, especially the site of Polderweg. The former group is characterised by relatively low numbers of cores, a considerable contribution of blades to the assemblage and evidence for a curated technology, while Polderweg can be characterised as the opposite end of the spectrum with a high contribution of cores (*c.* 7% of the assemblage), a dominance of flakes and an overall expedient technology. The other sites are more difficult to characterise and can be placed on a continuum between these two, indicating a certain degree of variability, mainly of sites on the northern coversand and in the wetland group. The distinction in technology can be regarded as indicative for different patterns of mobility, suggesting an overall higher level of residential mobility at sites on the southern

coversand. This contrasts most distinctly with the results obtained for Polderweg and a comparison should be understood against the specialist wetland background of the latter site.³⁶

5.5.4 *Typological characteristics*

The typological characteristics of the artefact spectrum provide insight into the range of activities performed at a site and the emphases therein within and between regions. This is also informative as to aspects of mobility and the settlement system. In this respect, tool morphology is not directly informative on tool function or performed activity as argued above (scrapers, retouched blades and flakes and even points have been used for a variety of tasks and use-wear analysis has only been performed for a limited number of site assemblages. This limits the identification of activities and the functional characterization of a site. On a more general level differences and similarities observed between the typological composition of assemblages of (groups of) sites may point to different typological choices and preferences. Such shifts in accent detected within the typological spectrum may indicate different emphases in activities performed, and offer a perspective on the (regional) nature of the settlement system in general.

An overview of the typological characteristics of the different groups of sites is presented in fig. 5.21 (A-D), see also Appendix IIB. Sites with an overall small sample size (less than 25 tools), overall low numbers of artefacts (less than 400 artefacts), or difficulties in attribution have been excluded from further analysis to avoid biases caused by site-specific research intensity.³⁷

The typological characteristics and their composition per site for the most important artefact categories have been presented in fig. 5.22.

The composition of the most important artefact categories gives a first impression of the characteristics of the different sites individually and per region. For the southern coversand landscape the overall importance of points (*c.* 40%) is striking. For the northern coversand and river valley sites points are also of importance, yet some display a less significant contribution in favour of other tools. Only in the wetland (margin) group do points play a significantly smaller role. Another feature is the importance of retouched blades, both in the assemblages of the southern coversand group and those of the river valley sites, as well as at the wetland margin sites Swifterbant-S22 and S23.

Combining the evidence from the different sites per defined region or group enables the elucidation of group percentages. It should be taken into account though that the combined evidence only has a broad base for the southern coversand group. These results are presented in fig. 5.23.

The group compositions reflect some of the characteristics mentioned above. Apparent is the importance of points in the southern coversand group and to a somewhat lesser extent the northern coversand group and river valley group. The composition of both of these latter groups, however, is characterised by more diversity regarding other types of tools, while the overall composition of the river valley group somewhat resembles that of the southern coversand sites. The wetland (margin) groups deviates most from this with an emphasis on non-formal tools and a smaller role for points. In the following, several typological elements will be discussed in more detail.

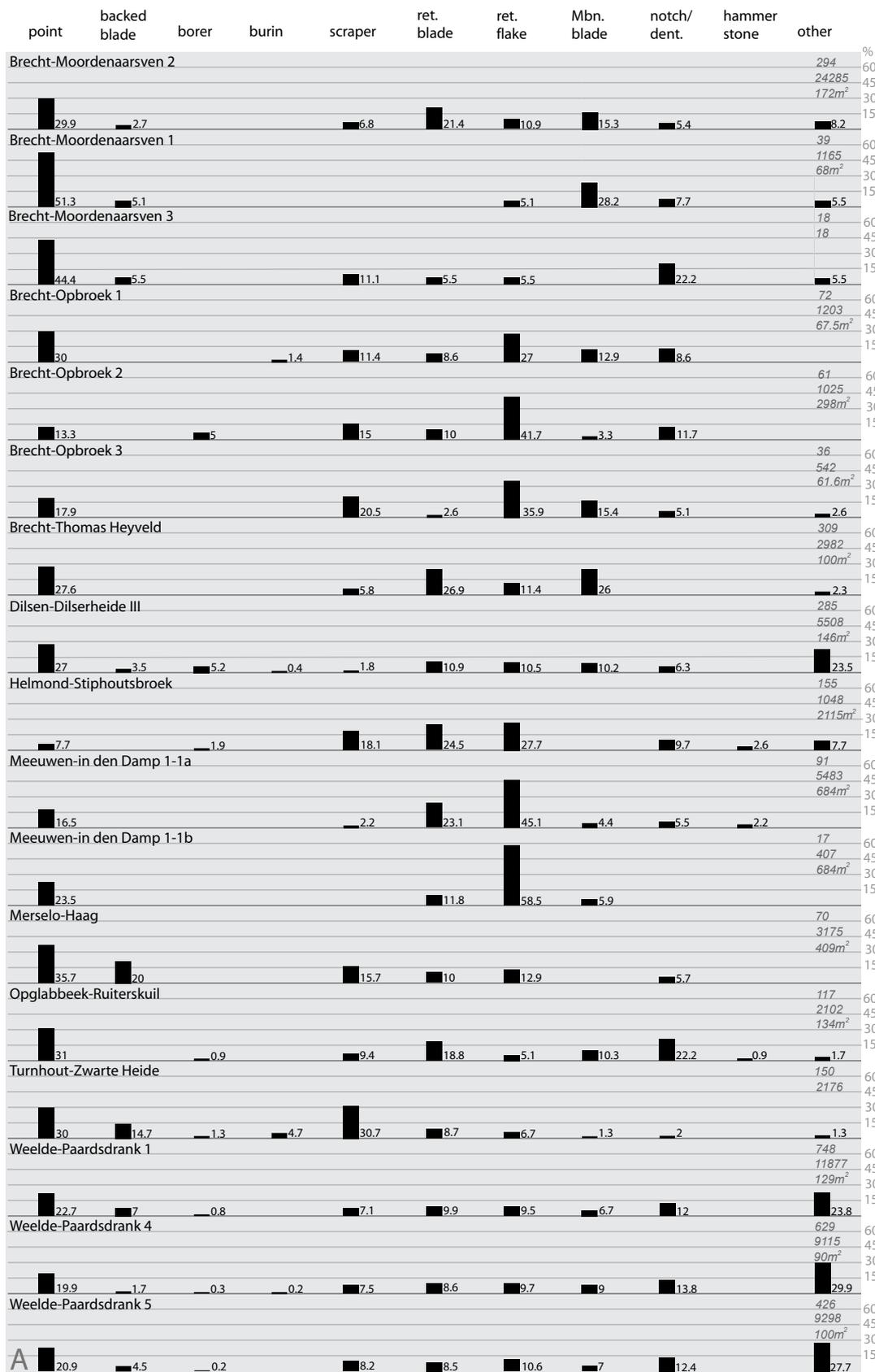
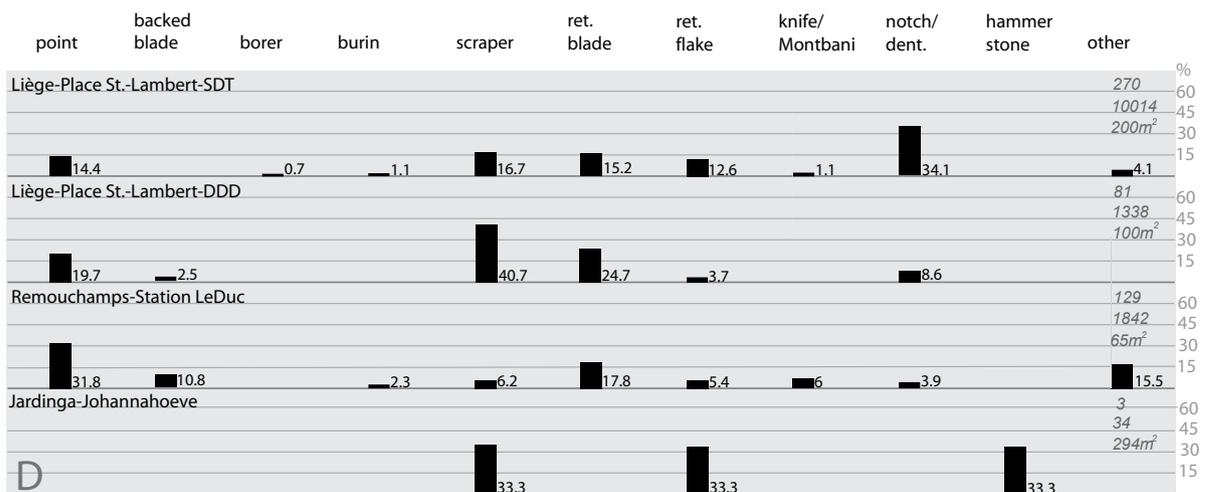
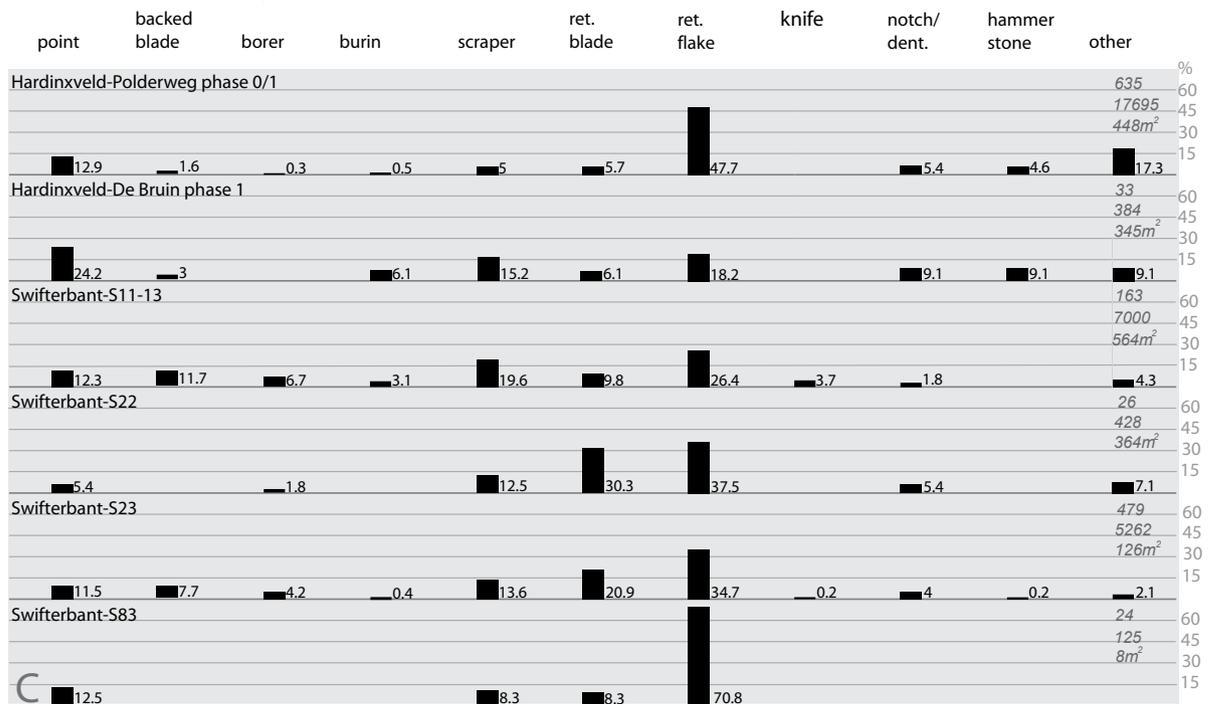
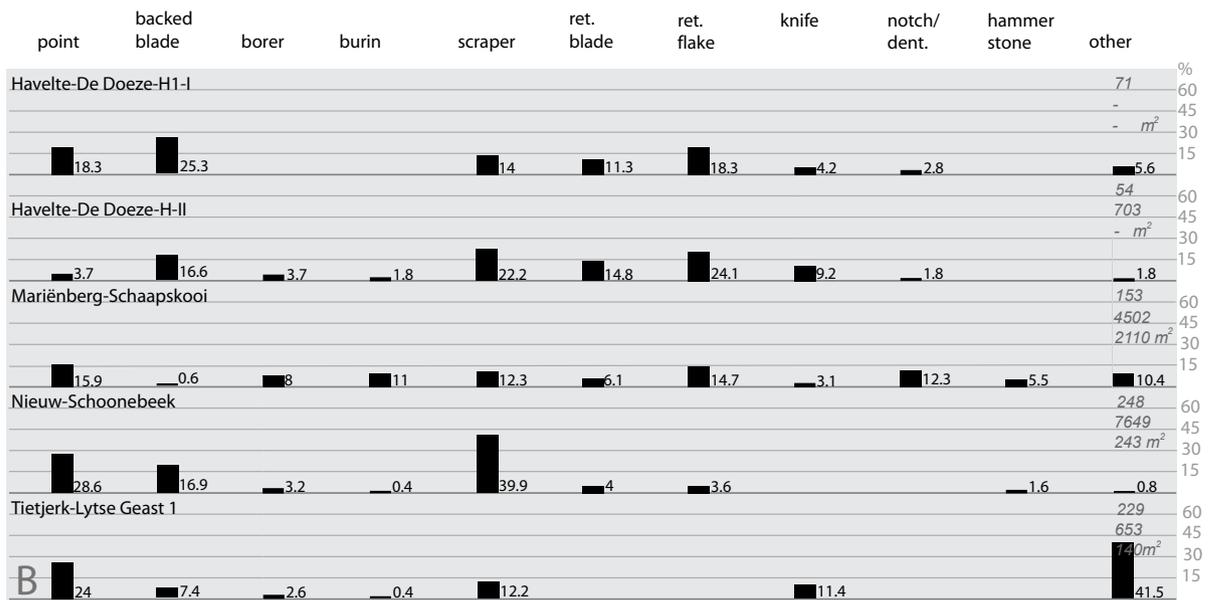


Fig. 5.21 Typological percentages per site arranged according to the groups defined, respectively southern coversand landscape (A), northern coversand landscape (B), wetland/wetland margin (C) and river valley/valley floor (D). Outlined on the right are number of tools, total number of artefacts and area excavated.



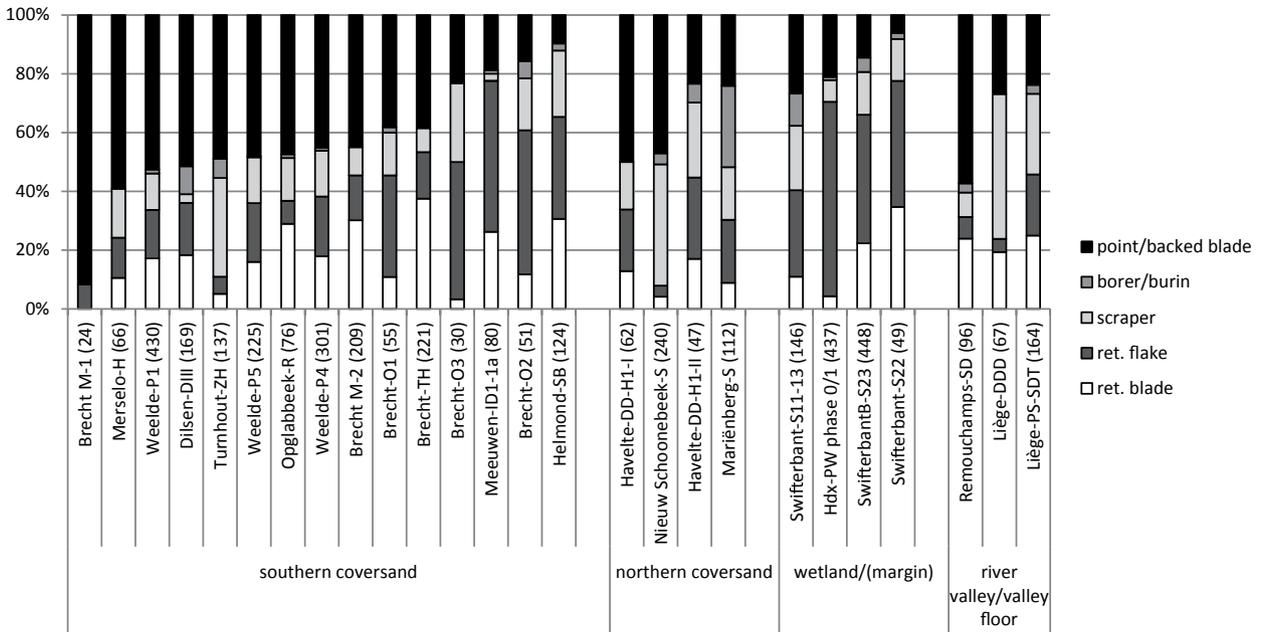


Fig. 5.22 Typological percentage composition per site for the major categories of tool types.

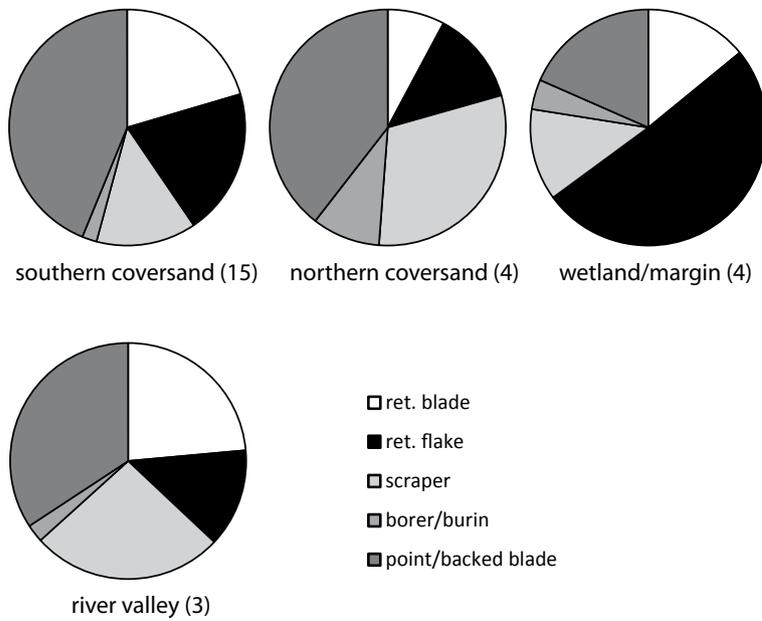


Fig. 5.23 Typological percentage composition per group for the major categories of tool types.

5.5.4.1 Points and backed blades

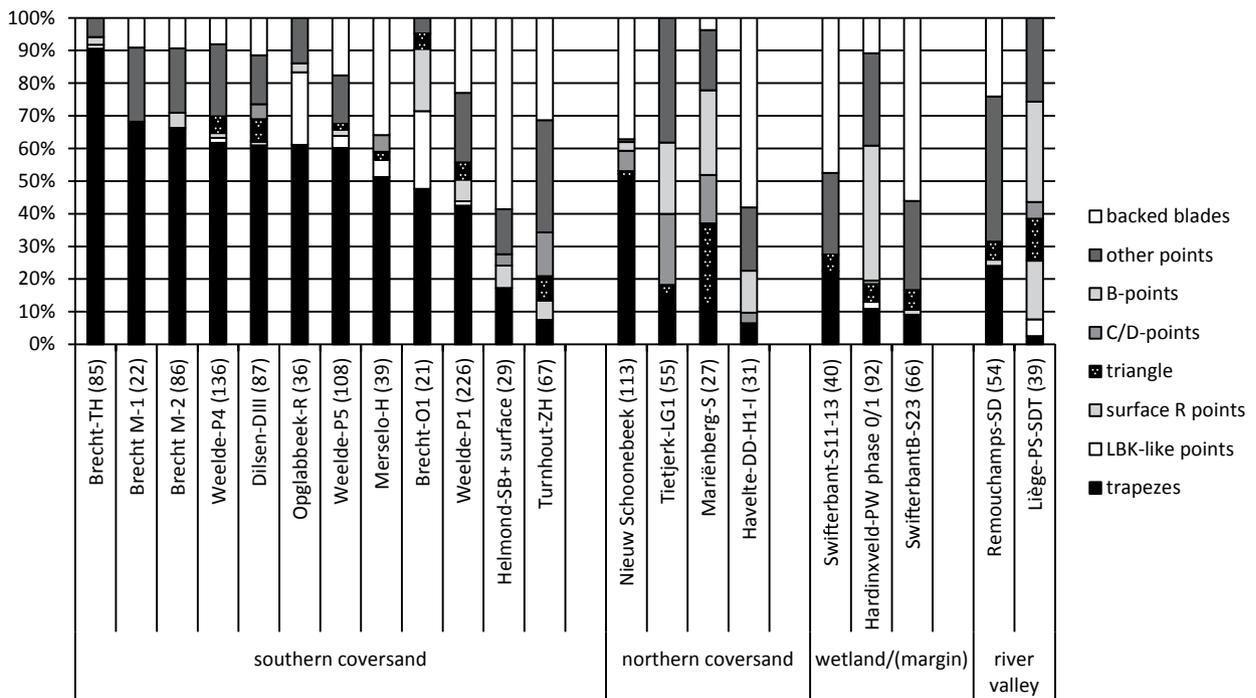
Points most likely represent curation (retooling) and discard of arrows and arrowheads. Therefore sites with many points are often interpreted as (temporary) hunting camps. While this terminology is too restrictive for the range of activities performed, the presence of many points stresses the importance of hunting (see Binford 1987^b; 1980, 8-12; Boaz 1998, 308).

A first observation concerns the importance of points at sites in the southern and the northern coversand landscape and at the river valley sites, as mentioned above (see fig. 5.22 and 5.23; see also Appendix IIB). This differs from the relative paucity in points at sites in the wetlands and wetland margin group. The counts for the northern coversand landscape are somewhat influenced by the high number of points and backed blades at Nieuw Schoonebeek. Since backed blades are probably parts of composite tools, this may skew the perspective. In any case the divergent contribution at the wetland sites and in particular at Hardinxveld-Polderweg is significant. In line with its distinct wetland location this may, for example, point to a greater importance of fishing as opposed to terrestrial hunting (see also the contribution of points at Liège in fig. 5.21).

Further information may be obtained from point type diversity, which is presented in fig. 5.24 (see also Appendix IIC). Of the sites with quantitative typological information mentioned above, those with point counts below twenty have been excluded. It should be noted once more that certain point types remained in use for a long time, but all may in fact be part of Late Mesolithic assemblages (*cf. supra*; Arts 1989, fig 8; Crombé 1998).

Trapezes and trapeze production are most common at sites on the southern coversand. The contrasts between the groups may be explained from a regional perspective, identifying the dominance of trapeze production as a characteristic southern feature. Alternatively, but less likely, it may be related to specific functional properties making them especially useful for hunting in the (southern) coversand landscape (see also Fischer 1989). LBK-like points are clearly a southern feature as are points with surface retouch such as *feuilles de gui* (see Verhart/Arts 2005, 249). Triangles, points with retouched bases and D-points signal continuity, especially in the north (*ibid.*). The importance of points with unretouched base (B-points) at Hardinxveld-Polderweg is remarkable. Since the site is firmly dated to the later part of the Late Mesolithic and is situated in a central to southern

Fig. 5.24 Percentages for point types per site. Total counts for points in brackets.



site/group	N points and backed blades	N tools	percentage
southern coversand (15)	963	3482	27.7
northern coversand (4)	182	526	34.6
wetland/(margin) (4)	199	1303	15.3
Hardinxveld-PW-phase 0/1 (1)	92	635	14.5
river valley/valley floor (3)	112	480	23.3

Table 5.13 Percentages for tools and backed blades for the different groups and Hardinxveld-Polderweg. Number of sites in brackets.

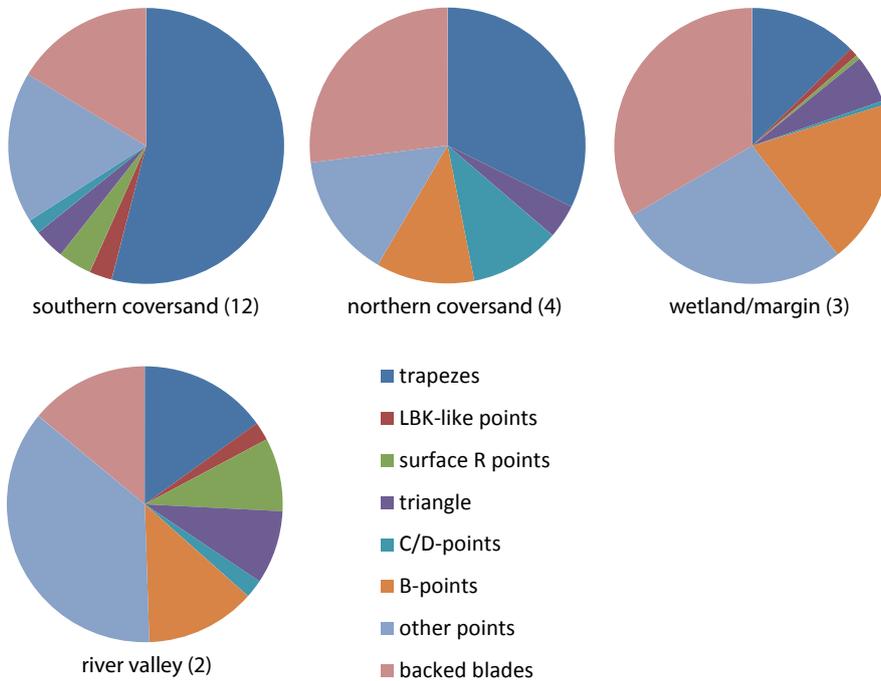


Fig. 5.25 Group percentage composition for point types. Number of sites in brackets.

location within the LRA, one would have expected a predominance of trapezes. Instead the B-points indicate a distinctly different accent which may point to different functional requirements. This might either be a functional adjustment to specific wetland conditions or be related to the quality of the material and the expedient technology characteristics for the Polderweg assemblage. Without both Hardinxveld sites, values for this point type at wetland sites would concur with the other groups. Finally, backed blades seem of more importance in the north and at river dune sites, especially at Swifterbant.

If the counts are combined per group (see fig. 5.25), the compositions once more accentuate the dominance of trapezes at sites on the southern coversand, the greater diversity elsewhere and the importance of B-points and backed blades for the group of wetland sites.

5.5.4.2 Other tools

Of the other artefacts (see figs. 5.21 and 5.22), scrapers show some variability in their contribution. Since these artefacts are easily recognized, it is likely that differences point to different emphases in the activity spectrum and are not research biased. These tools are used for a wide variety of tasks (Andrefksy 2005; Odell

1981), hence a broader spectrum of activities at sites in the northern coversand and river valley group (in particular at Liège) may be proposed, although the small number of sites involved limit such a conclusion. The low numbers recorded for Polderweg may be attributed to the effects of a largely expedient technology where retouched flakes may have replaced scrapers for certain activities (see Van Gijn *et al.* 2001^a, table 6.14).

Borers and burins form a minor contribution to most sites. They may be indicative of a broader emphasis in task spectrum at sites in the wetlands and wetland margin or on the northern coversand when compared to sites in the southern coversand landscape. Especially the contribution of burins at Mariënberg is striking. Although difficult to compare, Bergumermeer-S64B yielded similar high counts. The low numbers for Polderweg might again relate to the effects of an expedient technology.

Montbani blades (see Robinson 2010, 141) are mainly found on the southern coversand and have been compared and combined with the group of knives, mainly found on the northern coversand and on the northern river dunes in the wetland group.³⁸ The Montbani blade is characteristic for the southern coversand landscape and in combination with points forms an important, formal contribution to the artefact spectrum. Notched and denticulated artefacts appear of more importance at river valley sites, especially at Liège.

At some sites the 'other tools' category is relatively large (see fig. 5.18). The majority of these at for instance Weelde, Liège or Remouchamps is formed by indeterminable microliths and artefacts that may either be waste or tools, such as, for instance, truncated blades (see Huyge/Vermeersch 1982, 167; Van Gijn 1989, table 22 and 23). Other lithic artefacts were incorporated as well.³⁹

5.5.4.3 Retouched flakes and blades

Another typological component of the lithic assemblages of the sites studied is formed by retouched flakes and blades. They are presented in fig. 5.26.⁴⁰ Sites with counts below 10 have been excluded.

The distribution between retouched flakes and blades per site in general resembles the distribution between flakes and blades as demonstrated in fig. 5.16. This indicates that a representative part of the respective flake- and blade-based debitage techniques distinguished for the individual sites and groups results in non-formal tools. Especially the increased contribution of retouched blades (in comparison to unmodified blades) indicates that a considerable part of the unmodified blades may perhaps be interpreted as blanks. This supports the distinction made earlier between more curated industries, as distinguished most convincingly for the southern coversand area and river valley sites, versus a more balanced spectrum for sites in the other groups. The importance of curated elements within the technological and typological aspects of sites in the southern coversand landscape is further substantiated by the contribution of Montbani blades.

Noteworthy is the importance of retouched blades at river valley sites, which is consistent at all three locations. The similarities in composition compared to sites on the southern coversand potentially supports the idea of correlating these types of sites (typologically and technologically) in a complementary settlement system (*cf. supra*).

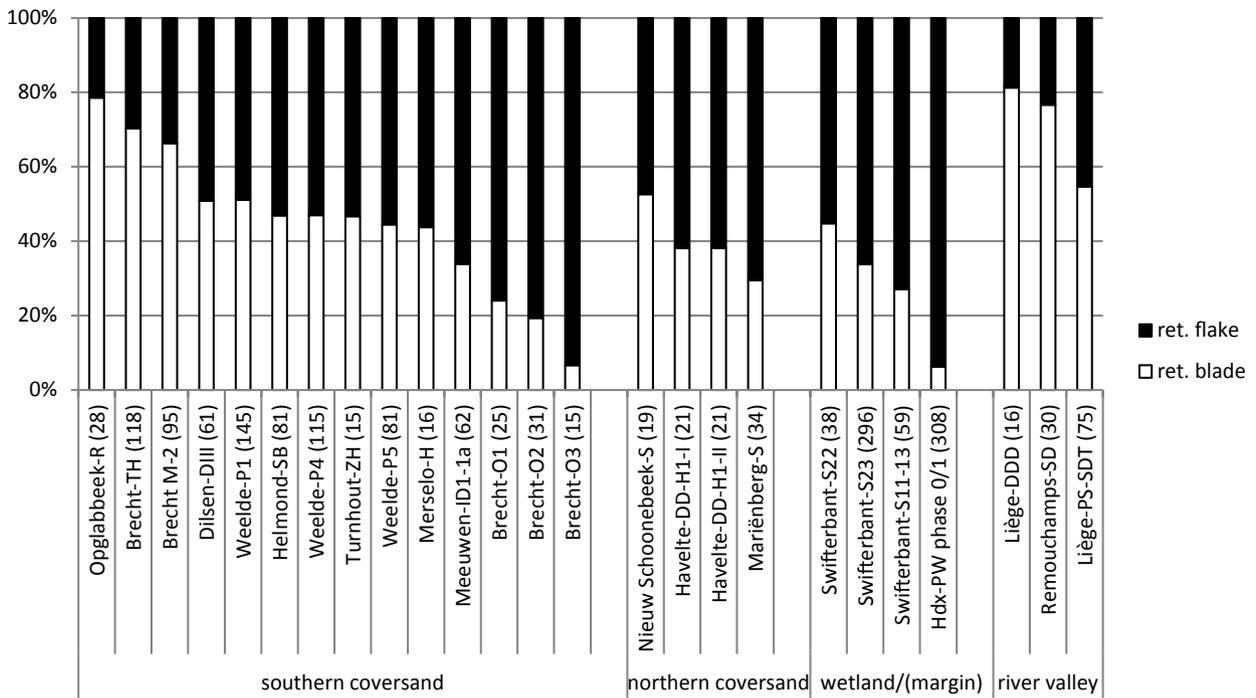


Fig. 5.26 Percentages for retouched flakes and blades per site. Total counts in brackets.

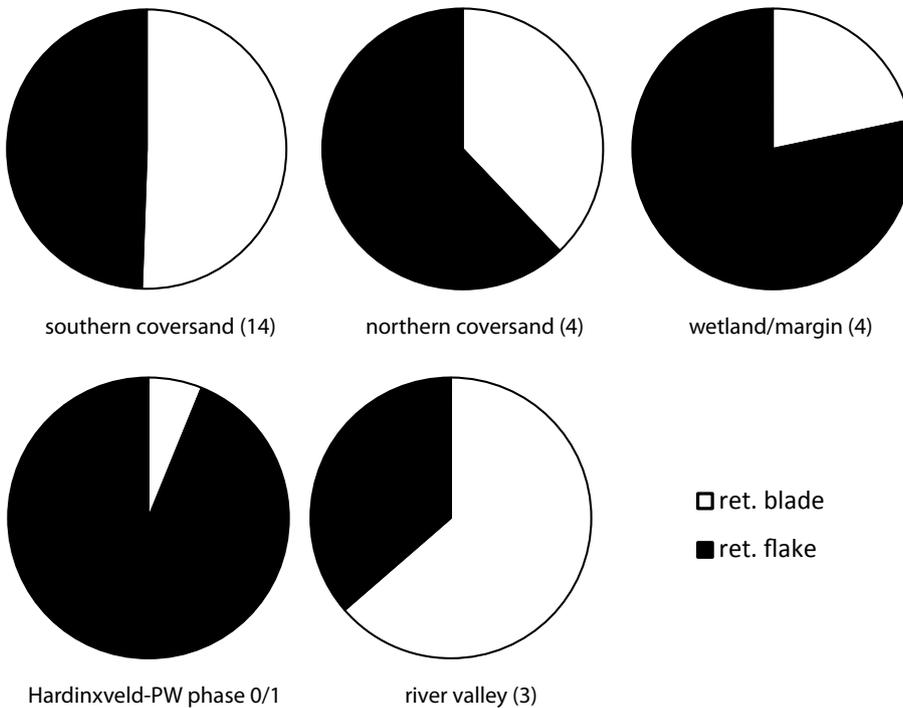


Fig. 5.27 Group percentages for retouched flakes and blades. Number of sites in brackets.

The contribution of retouched flakes is largest for the wetland site of Hardinxveld-Polderweg. The nearby site of De Bruin only yielded six retouched flakes and two retouched blades, yet despite its low numbers seems to confirm this composition.

When the results from the individual sites are combined per group (fig. 5.27), the general distribution mirrors that of flakes versus blades (see fig. 5.17). The most distinct feature remains the contrasting importance of retouched blades for the southern coversand group in comparison to wetland sites, in particular Hardinxveld-Polderweg. The distinctive position of Swifterbant-S22 should be noted in this, however.

5.5.4.4 Percentage distribution and box plot analysis

Based on a number of the analyses presented above, the percentage counts may be grouped (see fig. 5.28). Hardinxveld-Giessendam-Polderweg has been plotted both as an individual site as well as within the group of wetlands or wetland margin sites. Exclusion of Polderweg from this group did not seriously alter the composition. Due to the low number of sites in three of the four groups, the statistical significance of the distributions with respect to each other was tested as well (see Appendix IID).

The compositions point out some of the characteristics mentioned above. This involves the similarities between the southern coversand and river valley group (regarding points, Montbani blades and retouched blades). The 'typological investment' within the southern coversand group in points indicates production and therewith terrestrial hunting. This differs from somewhat more diverse spectrum of sites on the northern coversand and the more limited importance of points and dominance of retouched flakes at the wetland (margin) sites, Hardinxveld-Polderweg in particular.

In order to understand these different emphases in the typological composition of the assemblages from a functional perspective, a set of boxplot analyses based on the percentage distribution is introduced (fig. 5.29). The boxplot graphs present both the individual tool types as well as functional categories. Points and backed blades have been grouped within a hypothetical 'hunting toolkit'.⁴¹ Similarly, tools related to processing and production tasks, including borers, burins, scrapers and notched or denticulated artefacts have been grouped under 'processing toolkit'. Retouched flakes and blades make up a general third group, while the formal Montbani blades and knives form the last group.

Points are relatively important at sites on the southern coversand. More than half of the sites yielded values of *c.* 25% or more. Backed blades are less common. On the northern coversand these are often of high importance, although the distribution is strongly influenced by the sites of Havelte (25%) and Nieuw Schoonebeek (17%). Points are also of relative importance at sites in the river valley group. In the combined graph for the 'hunting toolkit' the distribution of points and backed blades and their median for the group of southern and northern coversand sites stand out, especially with respect to the wetland group.⁴²

If points form the strongest indication for hunting activities then a 'hunting toolkit' seems to have been of distinct importance for sites in the southern coversand landscape, especially when combined with the group percentages (fig. 5.28) and offset against the quantitatively broad dataset. The importance of backed blades should be noted as a potentially important feature of sites in the northern coversand landscape, in relation to hunting activities.

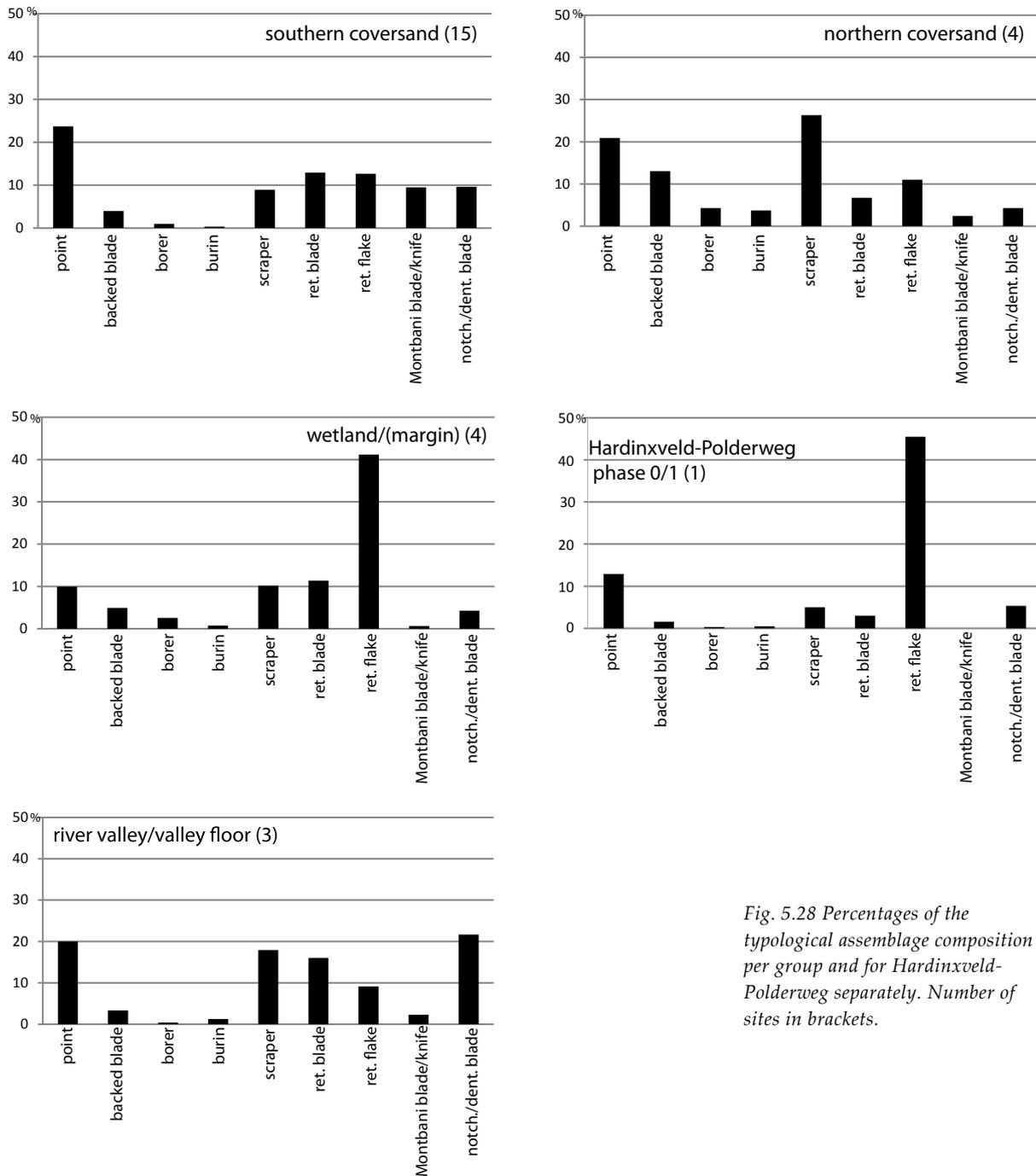


Fig. 5.28 Percentages of the typological assemblage composition per group and for Hardinxveld-Polderweg separately. Number of sites in brackets.

Borers yield relatively low values for sites in the southern coversand landscape and seem of less importance at the valley floor sites. This contrasts with the upper values, but not necessarily the distribution in both other groups. Burins yield low values in general, although this appears most consistent for sites on the southern coversand. The high contribution of burins at Mariënberg (11%) may point to specific task focuses at this site, or it is an artefact of identification. The distribution of scrapers is less outspoken. It can only be noted that the upper extremes within the northern and river valley group exceed the contribution of scrapers to assemblages

in the southern coversand landscape. Notched and denticulated artefacts provide a relatively low contribution in all groups when outliers are excluded. When grouped within a 'processing toolkit' the most characteristic feature is formed by the extremes in the group of sites on the northern coversand and those in river valley situations. On the basis of the studied sites, (formal) processing artefacts form a relatively smaller contribution to assemblages in the southern coversand landscape and in the wetlands.

The distribution of retouched flakes and blades mirrors the percentage counts above. In the group of wetland (margin) sites, the importance of retouched flakes is distinct, while retouched blades are significantly influenced by both Swifterbant outliers. Assuming retouched flakes and blades fulfilled similar functions, the overall counts in the 'general toolkit' indicate that all groups are comparable in their contribution of these tools to the assemblage, except for the group of wetland (/margin) sites. There the contribution of retouched blades and flakes stands out markedly.

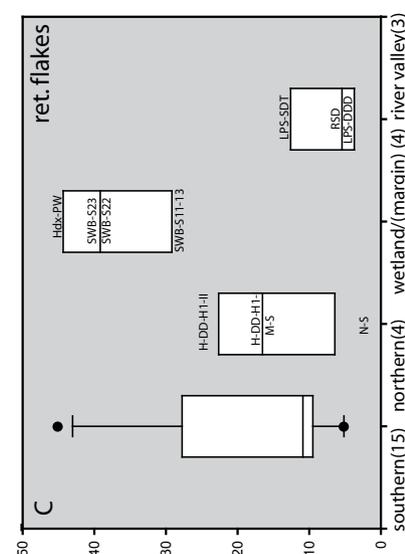
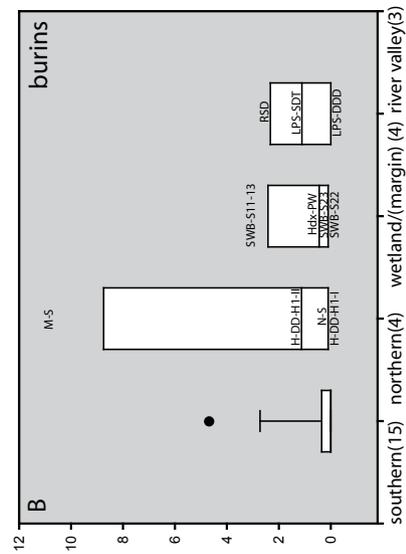
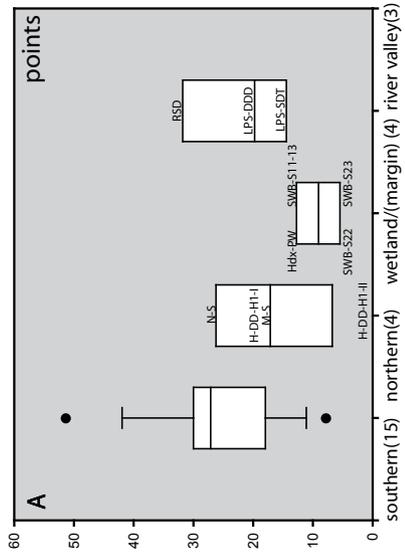
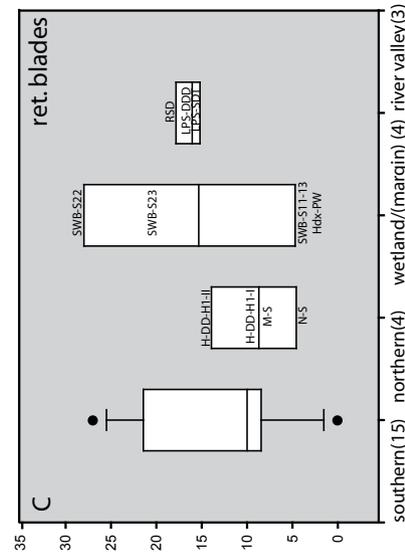
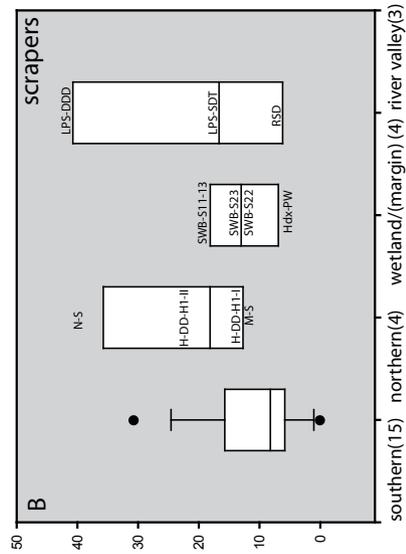
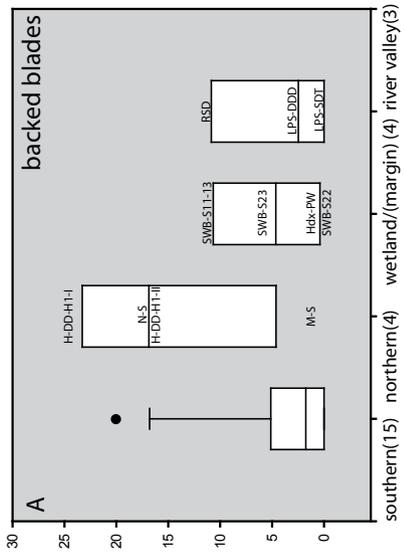
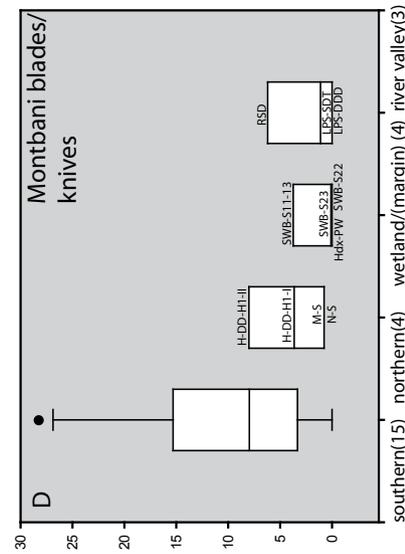
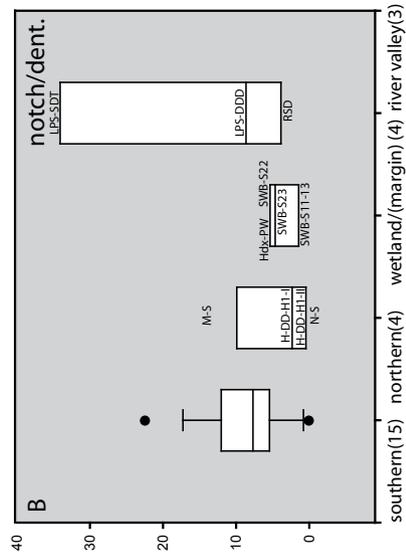
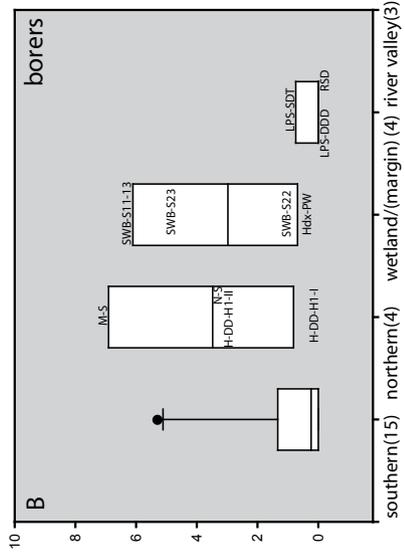
Finally, the distribution of Montbani blades (mainly documented for the southern coversand landscape and river valley sites) and knives (mainly documented for the northern coversand landscape and at the wetland (margin) sites) point to a low contribution for these elements at the wetland or wetland margin sites. This may relate to the compensating function of retouched flakes and blades. On the southern coversand Montbani blades clearly form a relatively important contribution to the toolkit, suggesting that they may be interpreted as specifically (reliable) and multi-functional tools related to hunting activities.⁴³

Interpreting differences

The boxplot distributions do not allow the identification of assemblage types, but point out differences in emphases. In the southern coversand landscape the assemblages, dominated by points and Montbani blades, fit hunting activities, including the primary butchering of carcasses and the processing of meat. While these activities are also of importance in the other groups their overall typological basis is somewhat broader and perhaps indicative of a more diverse set of activities. The wetland (margin) sites demonstrate a relatively smaller contribution of hunting tools and a greater importance of general tools such as retouched flakes. It should further be remarked that the various artefact distributions for sites in the southern coversand landscape, with the exception of Montbani blades, show a relatively limited spread, indicating the existence of homogeneity and consistency within these assemblages. The higher number of sites for the southern coversand landscape further confirms this distribution.

5.5.4.5 Visual cluster analysis

A complementary approach to the analysis above is offered by cluster analysis. This statistical analysis has proven useful for detecting (latent) patterns within archaeological data. However, both the array of methods available and the nature of the data often complicate an objective application and detection of inherent structure (see Shennan 1997, 253-254). An alternative approach is provided by arranging data into star plots (Chambers *et al.*, 1983). This is a visual method for displaying multivariate observations. The length of the individual rays corresponds with the size of the variable. The overall configuration of properties



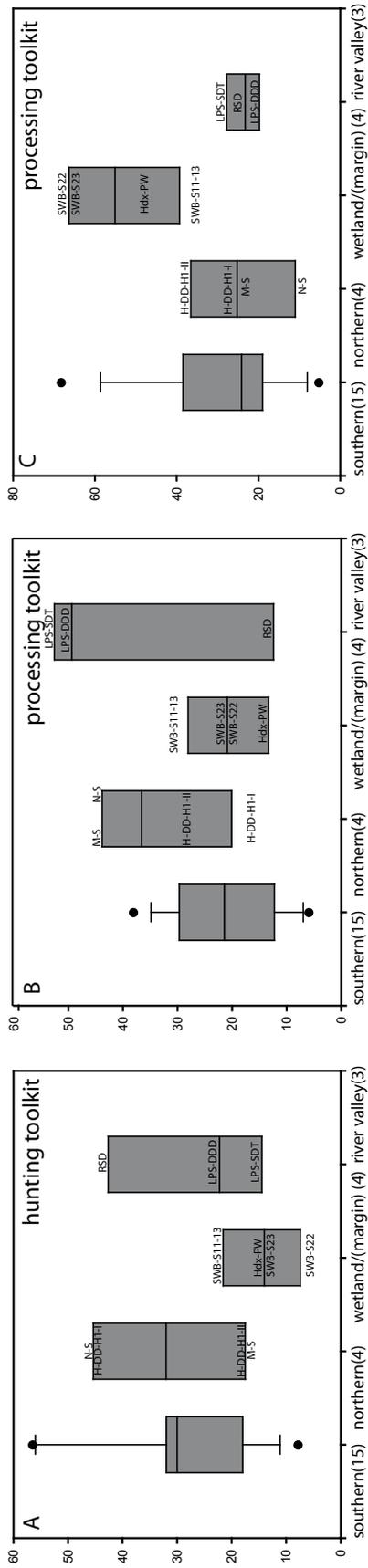


Fig. 5.29 Boxplot graphs for tools and combined functional categories. For the small groups individual sites have been plotted within the distribution graphs in order to pinpoint the nature of the specific distribution (see table 5.1 for abbreviations). (A) Boxplot graphs for percentages of 'points', 'backed blades' and combined 'hunting toolkit'. (B) Boxplot graphs for percentages of 'borers', 'burns', 'scrapers' and notched and denticulated artefacts as well as for the combined 'processing toolkit'. (C) Boxplot graphs for percentages of 'retouched flakes', 'retouched blades', and combined 'general toolkit'. (D) Boxplot graphs for percentages of Montbani blades and knives.

per observation (site or group) and their ordering allow for the detection of similarities or differences. This approach offers a visual alternative for what has been discussed earlier.

The data have been plotted per group for the entire tool assemblage (see fig. 5.30) and for the assemblage excluding retouched flakes, blades, hammerstones and 'other tools'.

In general the composition of the star plots accentuates the importance of points and Montbani blades at sites in the southern coversand landscape and, to a lesser extent, backed blades and points in the northern coversand landscape. The different shape of the star plots for the wetland group relates to the role of retouched flakes and blades, once more indicating their important contribution to these assemblages. Within the river valley group points clearly dominate and a somewhat more balanced image appears, along the lines of the southern coversand group. The star plots that exclude the general category of retouched flakes and blades clearly demonstrate the distinct focus on point manufacture, curation and therewith hunting for sites on the southern coversand.

In the analysis the individual sites were plotted as well and, in particular for the southern coversand, wetland (margin) and river valley sites, yield largely similar perspectives, comparable to the group composition. The relevance of assemblage diversity is based on the premise that there might be sites with a more general function and those with a more specialist function (Andrefsky 2005, 214). While the time-averaged nature of most of the sites prevents an appropriate analysis of site types, different but consistent emphases in assemblage composition may be informative on the absence or presence of activities.⁴⁴ One statistical approach, used by Chatters (1987, 363-366), to assess the degree of diversity and therewith specialization within studied assemblages is the evenness index (see also Andrefsky 2005; Rhode 1988). The results of this test for the different sites and groups statistically confirmed the lower values and hence greater homogeneity for sites in the group on the southern coversand and to a lesser extent the southern river valley sites, especially when retouched flakes and blades are removed from the counts (see Appendix IIE).

5.5.4.6 Typological characteristics and potential implications

From a typological perspective the site assemblages for the southern coversand stress the importance of hunting as a primary activity, which is substantiated by the number of sites that yielded information. The similarities between the river valley sites and those of the southern coversand hint at the presence of similar communities from a material perspective: formal tools such as points and Montbani blades characterise the assemblages, while retouched blades form an important contribution as well.⁴⁵ The emphasis in the assemblage spectra of the different sites in this area is relatively uniform and points to the importance of hunting (see also Crombé *et al.* 2011^b, 468). The assemblages of sites on the northern coversand are largely comparable, but have a less outspoken character. The contribution of scrapers, burins, backed blades and borers point to a more varied toolkit, although these types are not absent elsewhere. The contribution of retouched blades is less distinct when compared to the south. The wetland and wetland margin sites yield a different picture. Points are less important there. Retouched flakes dominate the spectrum at Polderweg, while S22 and S23 show a more important contribution

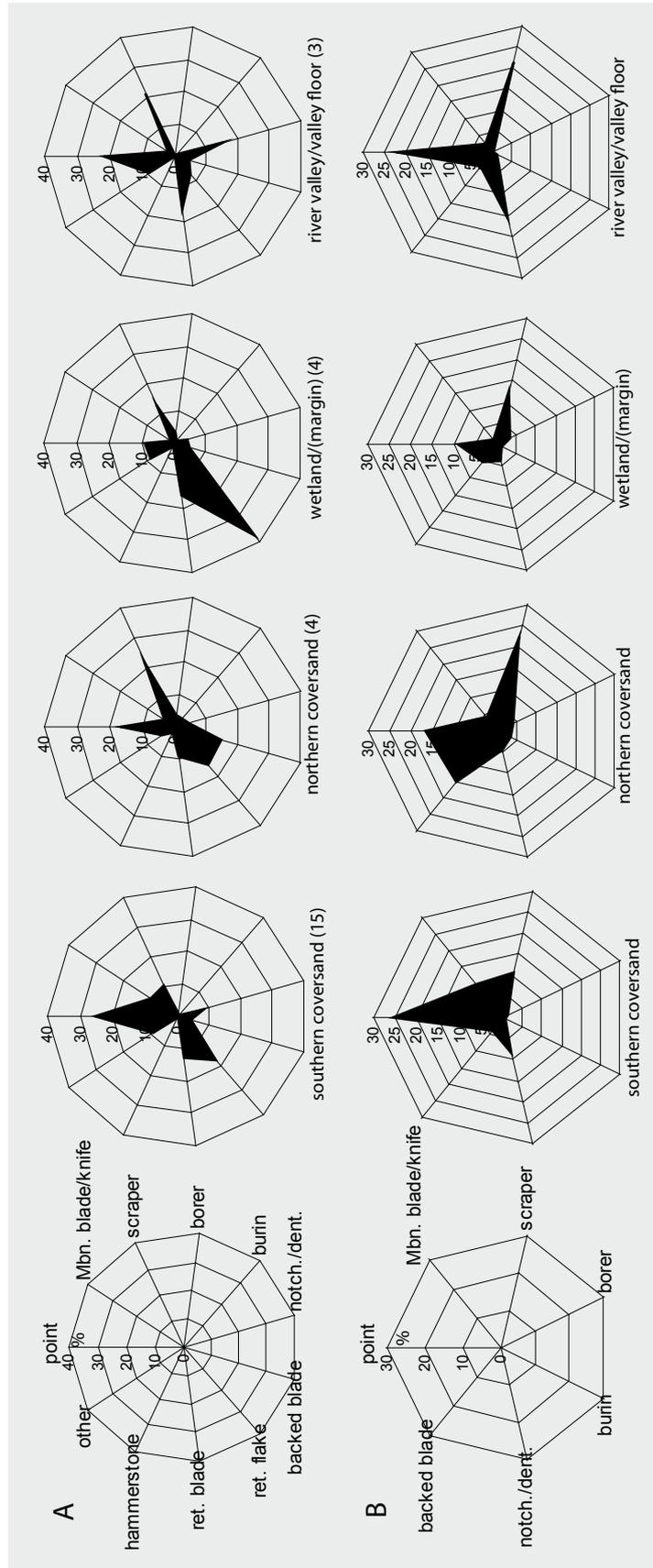


Fig. 5.30 Visual cluster analysis (star plots) of tool assemblage percentages per group (A) and for a selection of artefacts, excluding retouched flakes and blades, hammerstones and 'other tools' (B). Number of sites in brackets.

of retouched blades, in line with their technological component. At these wetland (margin) sites the tool spectrum differs most from that of sites on the southern coversand, mainly in terms of a more limited contribution of points and an important role for retouched flakes.

Based on the assemblage compositions the main distinction between a group of southern coversand sites characterised by curated elements, both in technology and typology, and sites with a more expedient character such as those in the wetland group and in particular Hardinxveld-Polderweg remains. The assemblages of many of the other sites should be understood as representing differences of degree rather than kind.

5.5.5 *Wommersom quartzite*

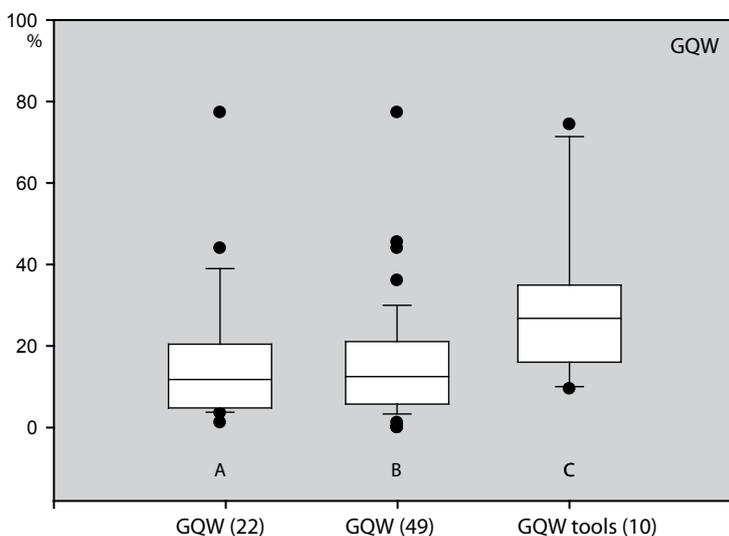
The technological and typological analysis above did not incorporate the role of raw material. The raw material composition and its information regarding resource procurement, mobility and the settlement system will be discussed below (see section 5.5.6). There is however one aspect that offers a complementary perspective on the typological and technological information presented earlier. This involves the role of Wommersom quartzite in assemblages on the southern coversand.

5.5.5.1 Wommersom quartzite contribution

Of both quantitative and qualitative significance is the contribution of Wommersom quartzite (*Grès Quartzite de Wommersom*, or GQW), to the assemblages on the southern coversand. The grey to dark grey mottled quartz is not too fine-grained and is ideally suited for the production of blades and microliths (Gendel 1984, 144). Since the only outcrop is located near Tienen in the Hageland (Gendel 1982), this type of raw material is predominantly found at sites in the southern coversand group.⁴⁶ Other southern locations include the river dune site of Melsele which yielded *c.* 5% of GQW (Van Berg *et al.* 1992), while sector DDD at the valley floor site of Liège yielded *c.* 8% (Van der Sloot *in prep.*). Further north GQW is only encountered sporadically.⁴⁷ Noteworthy is the relative importance of GQW for sites on the southern coversand. On average between 5% and 20% of the assemblages there was made of Wommersom quartzite. The specifics of this distribution have been plotted below (see fig. 5.31, see also Appendix IIG and IIH).

The contribution of GQW to the assemblages of these sites is significant. There are outliers, such as Brecht-Moordenaarsven 1, where a knapping place may have been excavated (see Appendix I) and for the sites documented by Vermeersch (1976) it should be taken into account that these are mostly surface samples, yet the importance of GQW is distinct.⁴⁸ Within the group of sites on the southern coversand (and occasionally outside this group), the procurement and use of Wommersom quartzite should therefore be interpreted as a meaningful characteristic. One explanation for its importance may be found in its qualities as a very workable, 'forgiving' raw material, excellently suited for the production of blades and microliths (see Gendel 1984). Below, a number of aspects are studied in more detail, based on those sites that yielded informative raw material counts.

Fig. 5.31 Boxplot distribution of the percentage of Wommersom quartzite for sites on the southern coversand. (A) sites used in this study. (B) sites used in this study combined with the Hageland sites documented by Vermeersch (1976). (C) sites informative on the Wommersom component in the tool spectrum (N tools > 15). Dots signify outliers. Number of sites in brackets.



5.5.5.2 Technological preference and Wommersom quartzite

Several technological categories of artefacts are informative on the importance of Wommersom quartzite. In fig. 5.32 the contribution of Wommersom and flint is compared for cores and core rejuvenation flakes.

As argued earlier the importance of core rejuvenation flakes in relation to cores may point to the fact that cores may have belonged to the transported part of the toolkit (*cf. supra*; Robinson *et al.* 2008, 65). Fig. 5.32 further demonstrates that at several sites Wommersom cores form an important component and that Wommersom rejuvenation flakes at some sites are quantitatively even more important. This may support the idea of the role of cores and in particular those of Wommersom quartzite as parts of a transported mobile toolkit in a curated technological system, although the overall number of sites is limited.

When reviewing the information on debitage (see fig. 5.33), Wommersom quartzite also forms a relatively distinct component, especially in relation to blades where it was often worked in Montbani style (*e.g.* Huyge/Vermeersch 1982, 159; Lauwers/Vermeersch 1982, 6; Maes/Vermeersch 1984, 71; Robinson 2010, 138-140; Vermeersch *et al.* 2005, 69).

Fig. 5.34 demonstrates the contribution of GQW to the microburins found. In view of the relation between Montbani-style debitage and the microburin technique in point production (see Robinson 2010, 140-142), Wommersom quartzite, from a technological perspective, may have been favoured for the manufacturing of arrowheads at some sites. Although there are also many microburins of flint, the importance of GQW for point production (see below) may be indicative of a preferential use.

Not only did Wommersom quartzite function in a different procurement and exchange system, but technologically was relatively often worked with blade debitage. It may have mainly served the purpose of producing microliths for hunting equipment.⁴⁹

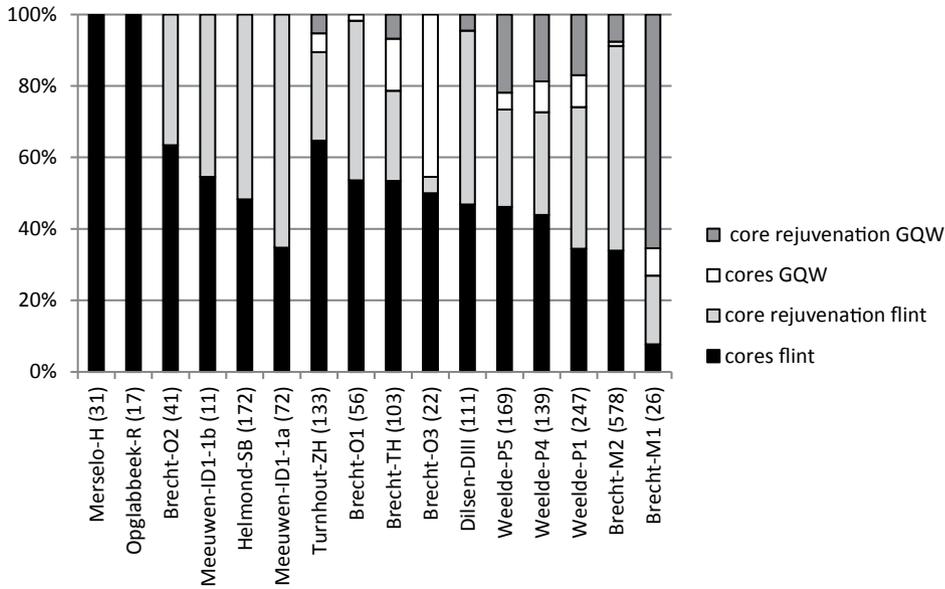


Fig. 5.32 Percentages of flint and GQW cores and core rejuvenation flakes at sites on the southern coversand (counts in brackets).

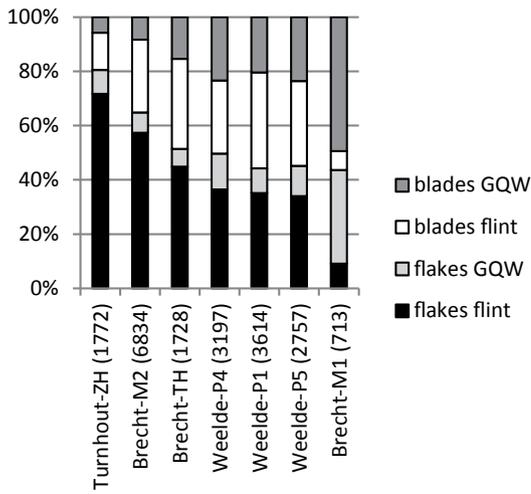


Fig. 5.33 Percentages of flint and GQW flakes and blades at sites on the southern coversand (counts in brackets).

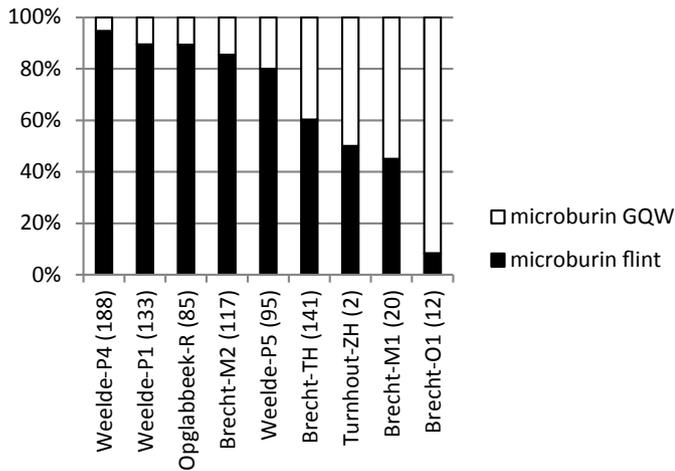


Fig. 5.34 Percentages of flint and GQW microburins at sites on the southern coversand (counts in brackets).

5.5.5.3 Typological characteristics and Wommersom quartzite

The technological characteristics described above are reflected in some of the typological aspects of the assemblages documented for sites with qualitative information on raw material use. GQW forms a frequently used raw material for the production of points, as already visible for the microburins. A contribution of 15-20% appears to be the norm (see fig. 5.35). For backed blades Wommersom quartzite appears to have been of less importance.

The production of typical formal tools such as scrapers, notched or denticulated artefacts and in particular Montbani blades supports the importance of GQW in blade production and the subsequent fabrication of formal tools. For scrapers 10-20% appears to be the norm and for notched or denticulated and Montbani blades even 20-40% (see fig. 5.36).

The contribution of GQW to the categories of retouched flakes and blades follows that of the technological categories of flakes and blades discussed above. Again GQW is of increased importance in the production of blades (see fig. 5.37).

Fig. 5.35 Percentages of flint and GQW points and backed blades at sites on the southern coversand (counts in brackets).

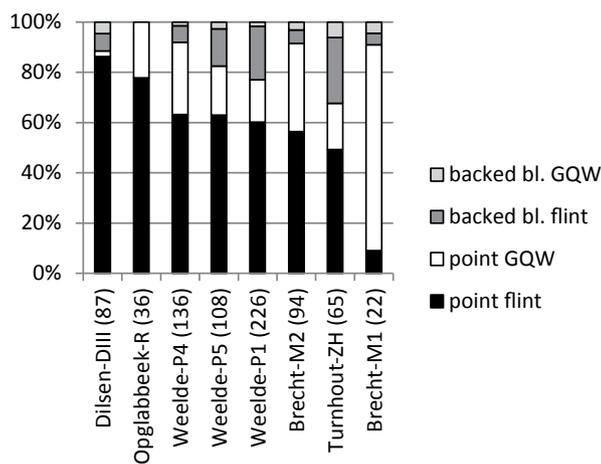
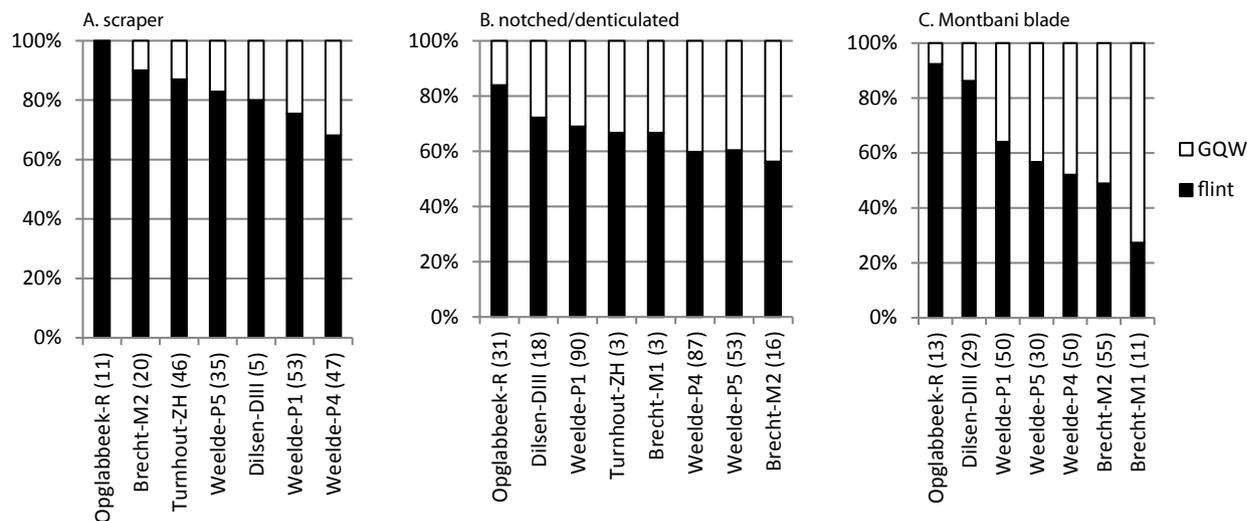


Fig. 5.36 Percentages of flint and GQW for (A) scrapers, (B) notched and denticulated artefacts and (C) Montbani blades at sites on the southern coversand (counts in brackets).



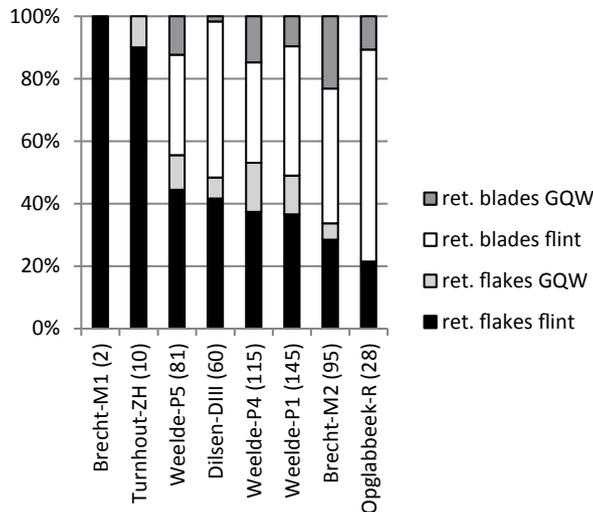


Fig. 5.37 Percentages of flint and GQW retouched flakes and blades at sites on the southern coversand (counts in brackets).

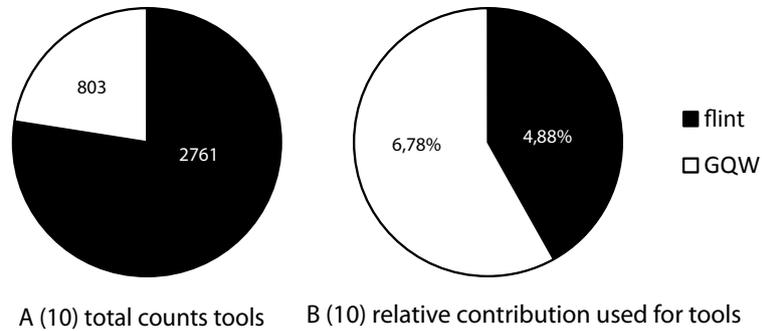
5.5.5.4 Interpreting the contribution of Wommersom quartzite

The technological and typological comparisons above point to the importance of Wommersom quartzite as a consistent raw material component at sites on the southern coversand. Its function in the production of blades and formal tools is apparent when the raw material composition of tools is compared for Wommersom quartzite and flint. This could be done for those sites that provided raw material information both in general as well as in relation to individual tool types. These are Brecht-Moordenaarsven 1-3, Thomas-Heyveld, Dilsen-DIII, Opglabbeek-Ruiterskuil, Turnhout-Zwarte Heide and Weelde 1,4 and 5 (see fig. 5.38).

Although only a number of sites yielded enough comparative information, it is evident that GQW forms an important contribution to the tool spectrum and that it is relatively often used for tool production. This is further supported by a recent detailed lithic study for the Belgian Mesolithic. This indicated that for the Campine area in particular there was a clear preference for Wommersom quartzite in armature production (Robinson 2010, 180, 199).⁵⁰ The superior qualities of Wommersom quartzite made it a functionally reliable material that may also have had certain social connotations (*e.g.* Wiessner 1983; see also Crombé 2002, 104; Ruibal *et al.* 2011) as well as a role in exchange networks, or as territorial marker (Gendel 1984; 1989; Heinen 2006; Terberger 2006).⁵¹

Based on these considerations the role of Wommersom quartzite supports the idea of a more curated technology and toolkit for sites on the southern coversand. This might relate to the need for qualitatively robust and trustworthy tools. As argued earlier tool shape, size and design form important factors, especially for mobile groups having to deal with transport costs (see Kuhn 1994, 438). The care taken in, for example, trapeze or Montbani blade production points to good craftsmanship and perhaps even overdesigned components. These are characteristic for so-called reliable systems that are counted on to work when needed (Bleed 1986, table 1). In this sense the use of GQW in particular might be seen as functioning within a curated technology (*sensu* Binford 1983, 283 (1979)), where tools are used, maintained and recycled intensively. The implications of a higher mobility and a typological emphasis on point production and possibly hunting may have required reliable qualities. In that respect Wommersom quartzite

Fig. 5.38 (A) Total counts for tools of flint and Wommersom quartzite in 10 informative assemblages. (B) Relative contribution of Wommersom quartzite (6.78%) and flint (4.88%) use for tools. Number of sites in brackets.



might have served as the ideal ‘travel toolkit’. Another crucial factor in this is the availability of raw material (see also Randolph Daniel Jr. 2001), whereby curation can be linked to overall regional scarcity in raw material (Bamforth 1986, 40). Although there appears not to have been an absolute shortage in the availability of Wommersom quartzite, its single outcrop, distance and possible social constraints on procurement, stress the particular role GQW played in toolkits on the southern coversand. Especially in view of the rather regular supply to sites at a distance of up to 90 km from the source (see below).

Phtanite chert

Several sites on the southern coversand also yielded evidence for additional raw materials (see Appendix I; Verhart 2000, 83). Of limited yet recurrent importance is the role of phtanite or lydite of Ceroux-Mousty. This is a fine-grained radiolarian chert that can be found in the valley of the Ry-Angon near the village of Ottignies. It is characterised by a homogeneous texture and black colour, which stresses the singularity of this type of raw material. Huyge and Vermeersch (1982, 153) argue that some material might have originated from river gravels, yet the size and quantity of artefacts at some sites (for example Brecht-Overbroek I and Brecht-Thomas Heyveld) do not point to the use of small rolled nodules. Its limited but recurrent presence in assemblages up to 140 km from the source indicate its sought-after (symbolic?) value. Although the number of sites and artefacts (see Appendix IIG) is rather low, the contribution of phtanite appears to decrease as sites are situated further from the potential Ottignies source area. The (surveyed) sites of Vermeersch (1976) demonstrate a contribution of 10-40 artefacts at distances up to 40 km. Further away the contribution drops, yet outliers are formed by Weelde-Paardsdrank (16 artefacts at 85 km) and Brecht-Overbroek I even yielded 90 artefacts at 82 km away (Huyge/Vermeersch 1982; Vermeersch *et al.* 2005, 69). The occurrence of 83 debitage products at the latter site, including eleven unworked pieces and a core rejuvenation fragment indicate the local processing of one or more phtanite cores and the occurrence of five microburins and several trapezes point to the production of arrowheads. Other artefacts at Overbroek I are several Montbani blades. The remaining sites yielded far lower quantities of phtanite, comprising blades or Montbani blades, a crested blade, a backed blade, microburins, a trapeze, an endscraper and some debris. Although Overbroek I demonstrates that phtanite was also worked locally, the predominance of tools and the scarcity of waste suggest that this raw material type was predominantly transported in the form of blanks or finished products. It

therefore appears that phtanite may have taken on a role or function comparable to Wommersom quartzite, although the limited numbers appear to indicate less frequent local production.

5.5.6 Raw material procurement

Apart from the technological and typological composition of the studied lithic assemblages, the role of raw material and resource procurement strategies forms an additional perspective on aspects of mobility and the settlement system (*e.g.* Kelly 1992, 55). The distance to the original geological source or outcrop forms just one aspect (see Pasda 2006, 196) as ethnographic and archaeological accounts point out the variability present in procurement strategies, including residential, logistical and large-scale mobility, down-the-line exchange, trade and raids (*e.g.* Dennell 1985; Kind 2006; Lovis *et al.* 2006^{a,b}; Mauss 1990 (1950); Randolp Daniel Jr. 2001; Whallon 2006; Zvelebil 2006).

This makes us aware of the problems involved in interpreting evidence of raw material procurement strategies, but it does not necessarily hinder a comparative analysis of this evidence. Similarities and contrasts may be informative on actual differences in procurement strategies, although often these cannot be pinpointed more precisely.

5.5.6.1 Raw material composition

Not all sites yielded information regarding the composition of raw material. For the southern coversand landscape some 22 sites or parts of sites yielded information regarding the composition of the lithic raw material spectrum, while a further 27 sites, most of which are surface collections from the Hageland area (see Vermeersch 1976), provided additional information (see Appendix IIF and IIG). Information for the other groups is limited to single sites. The available information is presented in fig. 5.39.

The majority of artefacts is made on regionally available rolled nodules (see Appendix I). These can be of fluvial origin, often found within older terraces, or derive from a moraine context (in the north) and are usually of mediocre to inferior quality (*e.g.* Price *et al.* 1974, 35; Verhart 2000, 83). The river pebbles in the south have even been described as heavily rolled and weathered nodules of frost cracked flint, recovered from river beds (Crombé 1998; Robinson 2010, 132). This demonstrates that most of the time the majority of tools could be fabricated locally and need not have been of high quality. Of course this type of raw material is not always inferior (when properly selected). Probably the availability of these resources formed a factor in choices pertaining to mobility and site location. The other groups of raw materials are more informative on procurement and mobility strategies. While information is limited to a few sites, most descriptive accounts of raw material composition at other sites, such as Hoge Vaart-A27, Mariënberg, Urk-E4 and the Swifterbant sites, confirm the predominance of locally available flint of modest quality.

Combining this information, it can generally be stated that sites located outside of the southern coversand landscape relied heavily on locally available flint. Other elements usually comprise up to 5% of the assemblage.⁵² This category for most sites comprises artefacts of sandstone, chert, quartz, quartzite and phtanite, and limited other types of flint.⁵³

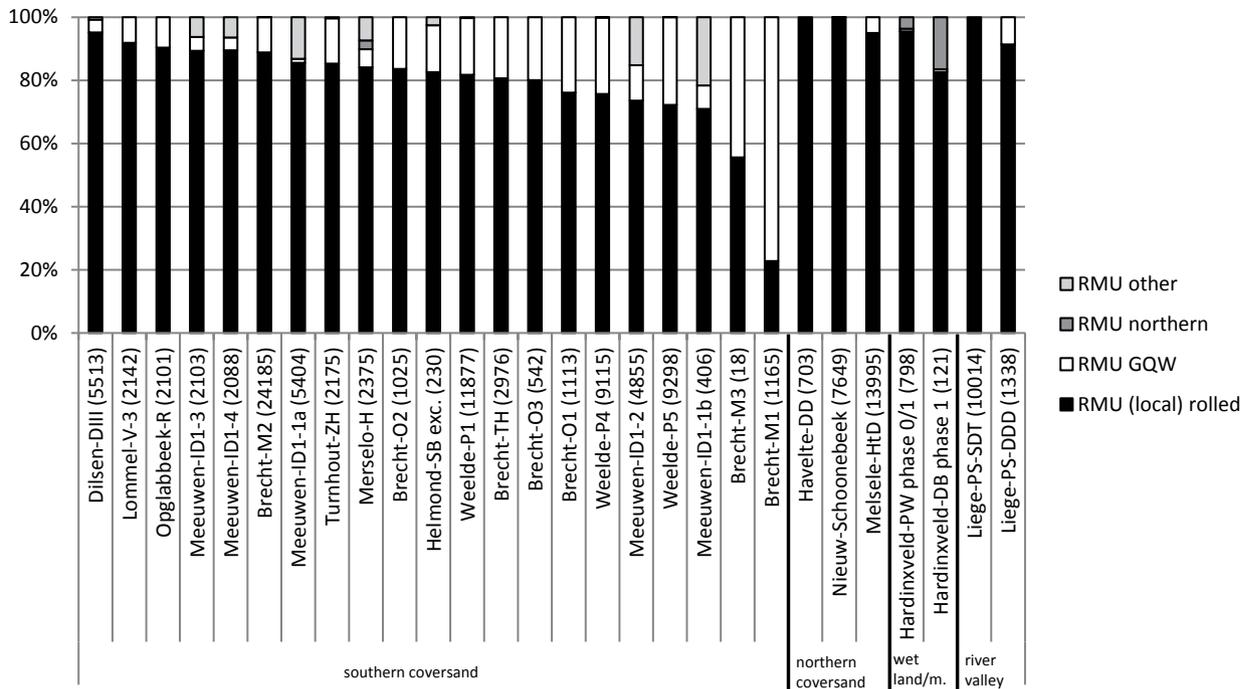


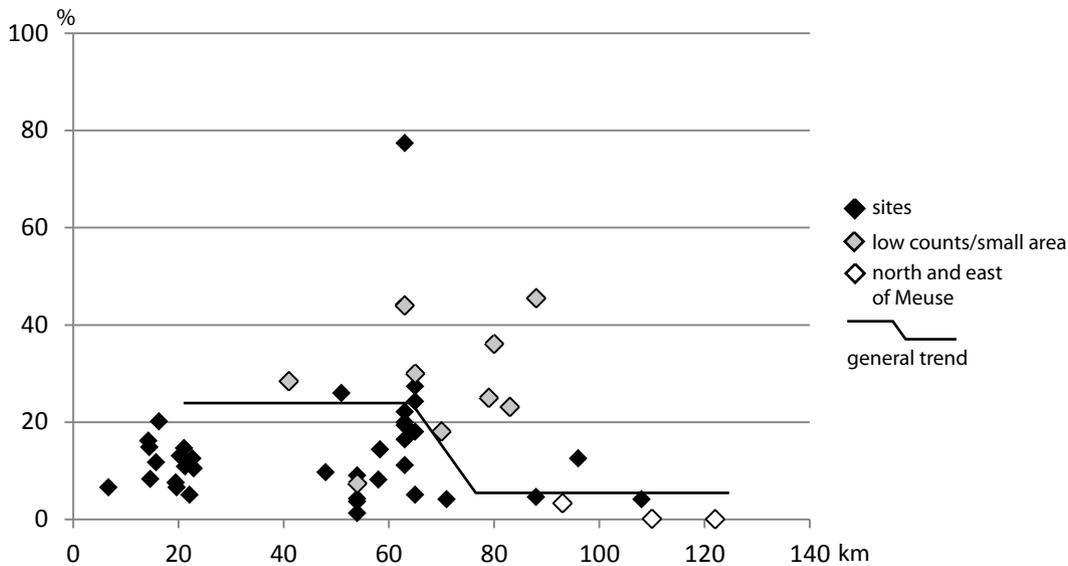
Fig. 5.39 Percentages for raw materials in lithic assemblages per site. Total counts in brackets.

5.5.6.2 Practices of procurement: Wommersom quartzite

More information may be obtained by focusing on the systems of procurement. This may be based on the percentage distribution in relation to the source area. Most information in that respect is available for the southern coversand and the role of GQW as discussed above.

The geographical distribution of GQW seems to be roughly delimited by the Meuse, the Scheldt and the Rhine, covering an area of *c.* 40.000 km² (Gendel 1984; Van Oorsouw 1993) with occasional finds in the German Rhineland (Arora 1979). This distribution – in combination with certain point types – has been interpreted as the territory of a dialectic tribe (Verhart/Arts 2005, 242; see also Gendel 1989; Robinson 2010, 134). All sites fall within this territory. In fig. 5.40 the known percentage frequencies of the studied sites with Wommersom quartzite have been plotted against their direct distance to the outcrop. The sites previously studied by Gendel (1984, 139-143) have also been incorporated in the plot. Additionally several substantial surface collections from the Hageland studied by Vermeersch (1976, 237) and at the time attributed to a Late Mesolithic ‘in contact with farmers’ have been included.⁵⁴ Since the latter study was confined to the Hageland, the clustering of artefacts within 25 km from the source area and their absence between 25 and 50 km, is research related. In general the plot as generated by Gendel (1984, fig. 7.5) is confirmed, but more sites have become available.

If sites with low artefact counts are left out an even more distinct distribution appears: up to 70 km from Wommersom rather substantial quantities of Wommersom quartzite are found in the assemblages, varying roughly between 5% and 30%, with an overall mean of 14.5%. Several concentrations at Meeuwen yielded counts up to 10%, while Brecht-Moordenaarsven 1 is responsible for an outlier of 77.3% for Wommersom quartzite and potentially represents the single event of a GQW knapping episode.



The pattern beyond *c.* 70-90 km distance is characterised by a decrease in sites and a sharp drop in the GQW percentages (see also Crombé/Cauwe 2001, 56).⁵⁵ Currently this drop in percentage seems less related to the barrier function of the Meuse than previously suggested (Gendel 1984, 142), since sites, both east and west of the Meuse yielded low counts. The Atlantic Meuse probably consisted of multiple channels with a lower energetic discharge and was probably easier to cross than its current successor. In addition, the Meuse may have been an important source of raw material and a conductor for transport and interaction.

Unfortunately, the overall pattern is still strongly influenced by the uneven distribution of qualitatively informative sites.⁵⁶ If the supposed drop at around 70-90 km is a reflection of past behaviour then both intrinsic (annual) mobility and down-the-line exchange do not completely explain this phenomenon. Crombé and Cauwe (2001, 56) in this respect mention the transportation of substantial (30-77%) amounts of GQW to the sandy area between the Meuse and Scheldt and a rapid drop beyond to *c.* 5%. They argue for the existence of local groups (microbands) exploiting small (*c.* 100 x 100 km) territories. The existing distribution patterns would be related to the seasonal movements of these individual groups exploiting the outcrop (see also Crombé *et al.* 2011^b, 468). Although much is still unknown regarding the procurement of lithic raw material in this area and Wommersom quartzite in particular (Robinson 2010, 135), a plausible scenario would be the combination of exploitation systems. Up to 70-90 km from the source, the relatively high contribution of GQW to the assemblages may be explained by an important contribution of intrinsic mobility in combination with intensive exchange. Procurement in this zone may have been direct and embedded within the cycle of mobility (see Binford 1983(1979); Crombé 1998, 61). Outside this zone less intensive or less frequent contacts between groups of hunter-gatherers resulted in a more restricted exchange of this type of raw material.

Additional evidence is provided by the technological qualities of the form in which GQW may be procured. Wommersom quartzite occurs as tabular blocks and is easily workable without intensive preparation (Gendel 1982; Van Oorsouw 1993). This might explain the absence of intensive quarrying, testing

Fig. 5.40 Percentages of Wommersom quartzite plotted against the direct line distance from Wommersom. Grey squares: sites with low artefact counts ($N < 500$), or small excavation areas. White squares: sites north and east of the Meuse. (For point information see Appendix IIG, Gendel 1984 and Vermeersch 1976).

and preparatory debris at the location of the Steensberg (see Gendel 1984, 132). Cores of Wommersom quartzite do occur in some numbers at sites such as Brecht, Meeuwen and Weelde, closer to the source, but are scarce to absent at for example Dilsen-Dilserheide III, Nijnsel III, Merselo-Haag and (probably) also at Helmond-Stiphoutsbroek outside this zone (*e.g.* Gendel 1984, 146; Luyppaert *et al.* 1993, 14; Verhart 2000, 79-83, 105; Vermeersch *et al.* 1992, 17). It is plausible that cores could have played a more prominent role within the exchange system with direct access, while finished artefacts or blanks may have travelled further into the periphery (see also Van Oorsouw 1993, 47). This forms a further argument indicative of the relative scarcity of GQW, its associated curated use and its interpretation as a very mobile component of the toolkit in that area (*cf. supra*; Crombé/Cauwe 2001, 56).

Summing up, the information on GQW in combination with the technological and typological characteristics sketched above indicate that the use and procurement of this raw material hold a special position at sites in the southern coversand area and the southern river valley sites. GQW may be characterized as a favoured material, especially in the production of formal tools such as trapezes, that was used alongside local rolled flint nodules and distributed through a different mechanism, most likely incorporating embedded procurement in relation to exchange. It therefore points to a distinct degree of mobility.

5.5.6.3 Practices of procurement: long distance supply

Where Wommersom quartzite points to a system combining intrinsic annual mobility and exchange, a different accent is provided by the raw material procurement at both Hardinxveld sites in the wetlands of the Alblasserwaard area. Procurement there contrasts with the Wommersom and local rolled nodule system described above. Since both Hardinxveld sites are located in the extensive wetland environment of the Dutch delta, the nearest outcrops of terrace flint (forming the majority of the lithic toolkit) were located at a distance of *c.* 70-100 km, while natural stone could be found at the ice-pushed ridges near Utrecht at a distance of 45 km (Louwe Kooijmans 2001^a; Van Gijn *et al.* 2001^b).

As is demonstrated in table 5.14 the sites of Polderweg and De Bruin potentially would yield 258 kg of flint and 277 kg of natural stone, if the entire site was excavated (x5). Since all lithic resources had to be procured and transported over distances ranging from minimally 45 km up to 250 km, this represents an energetically costly undertaking.⁵⁷ It should be noted though that with respect to the occupation span, this means that less than 1 kg of lithic raw material was discarded at the sites on a yearly basis. Furthermore it is not known to what extent raw material was procured through interaction and down-the-line exchange, although Louwe Kooijmans and Verhart (2007) argue in favour of at least partial intrinsic mobility, perhaps aided by canoes in the form of expeditions.

It should be realized that the sites were not occupied continuously or for the same purpose during the millennium that they were used. Polderweg phase 1 and De Bruin phase 2 yield most material. Additionally a seasonal occupation, as was attested most evidently for Polderweg phase 1, is most likely (see Louwe Kooijmans 2003). These considerations, in combination with the fact that we are dealing with what was eventually left or abandoned at the site, again add value to the (yearly) effort invested in providing the sites with a sufficient lithic supply.

	occupation period	N flint	N stone	W flint (g)	W stone (g)	W flint (g) overall (x5)	W stone (g) overall (x5)	W flint (g) per year	W stone (g) per year
Polderweg all phases	c. 500	18938	c. 63 (large)	25547	31648	127735	158240	51 (255)	63.3 (316.5)
De Bruin all phases	c. 1000	12263	unknown	26226	2385	131130	119250	26 (130)	23.8 (119)
total	(c. 1000)	31201	unknown	51773	55498	258865	277490	78 (390)	87.1 (435.5)

Raw material	rolled nodules	terrace flint	Rijckholt	northern flint	GQW	Belgian Lightgr.	natural stone	pyrite
Distance to source in km	70-100	70-100	c. 150	70-100	90	c. 150	45-150	150-250

The presence of an unused pre-core of *bergfrische* Rijckholt flint and other large pieces (see Van Gijn *et al.* 2001^a, 128-129), point to the nature of procurement as inclusive of considerable bulk material and indicative of canoe transport (see also Ames 2002), perhaps rather than down-the-line exchange. In general, the nature of the resource procurement at Hardinxveld and its isolated position with respect to resources contrasts somewhat paradoxically with the expedient nature of its industry. This supports the interpretation as a relative stable long-term residential location.

5.5.6.4 Comparing systems of procurement

Based on the information regarding local lithic resources and Wommersom quartzite at sites in the southern coversand area and the raw material procurement at Hardinxveld a number of procurement system models may be sketched that are characterized both by common aspects but also distinctly different emphases. Evidently these types of systems are static generalizations of past dynamic procurement systems. These are of course influenced distinctly by the geographical and environmental setting of the sites, the actual distance to the sources of raw material and the socio-economic aspects of the communities involved. The systems have been visualized in fig. 5.41.

Based on the information available, the first model (A) is characteristic for most sites located in the northern coversand landscape, but also applies to wetland margin sites such as Hoge Vaart and the Swifterbant sites. The sites are situated in the vicinity of local sources of lithic raw material. In most cases these are outcrops of erratically transported nodules of mediocre to inferior quality located at a distance of 1 or 2 km up to *c.* 10 km (*e.g.* Beuker 1989; Deckers 1982; Peeters 2007). The flint is procured, used and discarded locally, while a small number of artefacts might have been taken along to the next location (solid grey line) or exchanged (dashed grey line). Additionally other lithics might complement the assemblage (white lines). These can be obtained through direct mobility, or indirectly through exchange. An exceptional example is provided by an artefact of Wommersom quartzite found at the site of Hoge Vaart-A27. Most of the time, however, it will be difficult to distinguish between those lithics that are part of regular procurement practices and those that should be considered 'additional' or 'exotic'.

The second model (B) represents lithic resource procurement in the southern coversand landscape and at the southern river valley sites. The basic properties of the first system also apply here. This is visualized by the dashed square in the upper left representing a situation similar to the first model (A). It should

Table 5.14 Quantitative information on the number and weight of flint and other stone artefacts transported to Hardinxveld-Giessendam Polderweg and De Bruin, in combination with an estimation of the distances to the raw material sources. Numbers in brackets are estimations for the entire site (multiplied by a factor of 5).

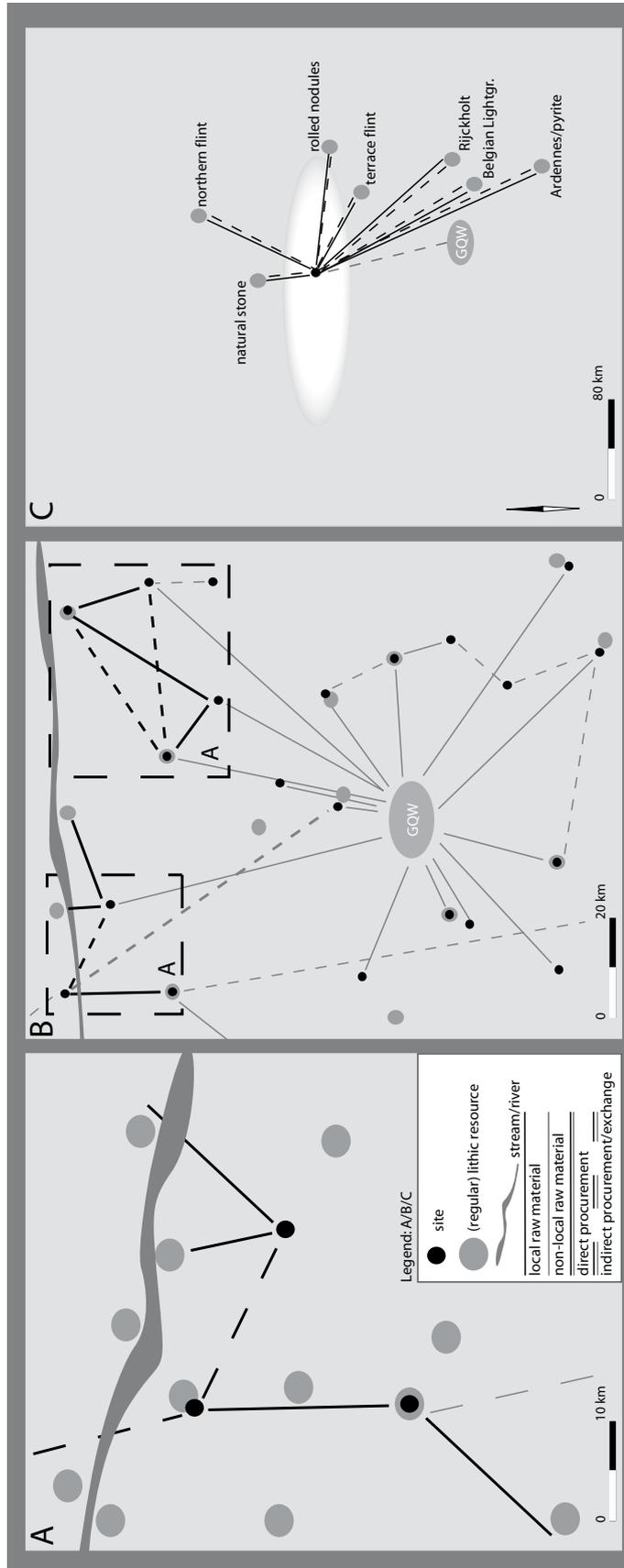


Fig. 5.41 Schematic representation of hypothetical resource procurement systems in the LRA. Type A marks a system focusing on residential moves to resources in combination with exchange. Type B incorporates the characteristics of A but emphasizes the distribution of Wommersom quartzite. Type C is based upon the wetland sites of Hardinxveld-Giessendam Polderweg and De Bruin. Note the differences in scale.

be noted though that outcropping sources of fluvially rolled nodules were less homogeneously distributed, compared to the erratic flint in the north. Furthermore procurement of Wommersom quartzite through direct mobility (either focused or embedded), or indirectly through exchange is an important feature of this system. The relatively high contribution of GQW to the assemblages up to 70-90 km from the source suggests that the Wommersom outcrop was regularly visited from sites in mobility cycles situated in that zone. The low numbers of cores and the specific qualities of GQW described above, also demonstrate that it was regularly transported between sites or exchanged (*e.g.* Crombé/Cauwe 2001, 56; Verhart 2000, table 2.14; Vermeersch *et al.* 1992, 17). These options have been depicted in the dashed square in the upper right corner and elsewhere. There are also some sites without Wommersom quartzite. For phtanite it may be suggested that exchange mechanisms, focusing on blanks and finished products were probably more important (*cf. supra*).

The third model (C) has been documented for the wetland sites of Hardinxveld-Polderweg and De Bruin. Their isolated position away from lithic resources required a procurement strategy where raw material was transported to the sites over considerable distances (45-250 km). There is little information on the relation between procurement through intrinsic mobility or exchange. The presence of canoes and raw material of considerable volume and weight (*e.g.* the Rijckholt precore) might point to the importance of organized expeditions (Ames 2002; Louwe Kooijmans/Verhart 2007), perhaps aimed at procuring larger nodules. It is also possible that raw materials were brought to the site at the start of each occupation. This would be more in line with Binford's argument of embedded procurement (1979 (1983), 273-275) and residential mobility. Axes made of bones of aurochs (see Louwe Kooijmans 2003; Appendix I) at least indicate direct mobility to the southern upland coversand area.

5.5.6.5 From raw material patterns to mobility processes

The systems that have been sketched above have in common that they represent lines of contact rather than the mechanisms of mobility underlying them. Based on ethnographical and archaeological parallels (*e.g.* Dennell 1985; Kind 2006; Kelly 1995; Lovis *et al.* 2006; Whallon 2006; Zvelebil 2006) and excluding trade and raids, three general systems of procurement may be outlined. The first involves intrinsic mobility in which those resources are used that, as it were, are found 'along the way'. This involves local outcrops of raw materials that are incorporated in the yearly round as well as adjustments of residential mobility patterns to include them. The second involves what may be termed expeditions. These are often logistical moves towards particular raw material resources with the distinct purpose of extracting them for use elsewhere. One may envisage that there is a zone of overlap between an expedition and a logistical foray (*sensu* Binford 1980) from a residential base in the relative vicinity of a raw material source. A third mechanism is formed by exchange, either in a down-the-line pattern, or of a more targeted nature.

Binford (1983(1979), 273-275) argues that raw material procurement was usually embedded within the scale of mobility related to subsistence activities (see also Crombé 1998, 61; Rensink 1995, 91), a detailed study by Gould and Saggers of the Western Desert Aborigines indicates the existence of 'Special-Purpose'

procurement (see Gould/Saggers 1985, 120). The study argues in favour of the existence of ritual and social mechanics governing raw material procurement: ‘... *there is ample evidence that Western Desert Aborigines made special efforts to visit lithic sources, usually as part of a visit to an adjacent sacred site, but sometimes, too, in order to obtain raw material that was known to have superior technical qualities*’ (*ibid.*). This ‘exotic stone hypothesis’ presupposes the existence of long-distance social relationships or networks enabling long-distance movement and exchange of lithic materials (*ibid.* 122). Furthermore it is argued that the utilitarian properties of the raw material, next to its accessibility, form an important factor in procurement strategies. This is demonstrated by a case-study of James Range in Australia, where despite the local availability of raw materials, usually within one kilometre of semi-permanent water supplies, a considerable amount of exotic lithic material was used. The latter has superior technological qualities and was procured for this very reason (Gould/Saggers 1985, 124-134; Andrefsky 2005, 239-243).

It is difficult to indicate which mobility processes best apply to the patterns sketched above. The archaeological resolution does not allow for detecting shifts in strategies, combinations between strategies or a clear-cut distinction between intrinsic procurement and exchange. In general it appears that residential mobility and expeditions may have contributed greatly to obtain raw material from sources with a general open access, while (down-the-line) exchange should be considered as well, perhaps for specific items.

With respect to the models discussed above it is plausible that the regular lithic procurement at sites on the southern and northern coversand is characterized by a system of intrinsic mobility. Local sources of flint were exploited by sites situated in their vicinity and these outcrops may have formed a distinct pull factor in settlement location choice. Similarly, for the southern coversand, Wommersom quartzite will have been exploited by intrinsic mobility, especially because of its considerable contribution to almost all assemblages. However, since not all of the sites where Wommersom is present are likely to form part of mobility cycles that included the Wommersom outcrop, it is likely that specific expeditions in combination with exchange form a distinct aspect of this system. Further research into the quantitative and qualitative contribution of GQW at (Late) Mesolithic sites may shed light on the specific mechanisms that apply. For the Hardinxveld wetland sites a different principal mechanism appears to be in place. These sites were not situated next to lithic resources, but in the vicinity of water, transport routes and faunal and botanical sources. Subsequently they acted as ‘magnets’ attracting and accumulating the necessary raw material for habitation in this area. Procurement strategies probably included material that was brought to the site from the previous residential base, but must also have included (long distance) expeditions as well as exchange. In contrast to the other sites emphasis here is directed more towards supplying sites with sufficient raw material from elsewhere, instead of residential moves towards resources.

Through this distinction we are afforded several glimpses of the character of Late Mesolithic settlement systems and mobility. The main contrast appears to be that between sites where consumers ‘map onto’ the majority of lithic resources in their mobility rounds and those locations where (lithic) raw material is brought in from considerable distances (see also Binford 1980, 10). The contribution of Wommersom quartzite for sites on the southern coversand represents an intermediary position in this respect as it will partially have been the result of

intrinsic mobility or expeditions in combination with exchange. It might be argued that the consistency of the contribution of GQW at many sites may result from intrinsic mobility or expeditions in relation to shorter duration of occupation and frequent visits, characterised by a regular introduction of Wommersom quartzite to locations (see also Andrefsky 2005, 234).

5.5.7 Conclusions regarding lithic assemblage spectrum and raw material

The available information on the technological and typological composition of the studied assemblages and the raw material component is limited. Evidently the 'signal' of more specific or salient toolkits and systems of procurement has to an important extent been lost within the 'noise' of repeated occupations, activities and combinations of strategies (*e.g.* Smit 2010; Sommer 1991; see also Chapter 4). Furthermore the quantitative distribution of sites, as argued earlier, is biased towards the southern coversand area, implying that similarities and differences are mainly coloured with respect to this dataset.⁵⁸ Taking these aspects into account a number of general conclusions may be given.

- The group of sites on the southern and northern coversand and the river valley sites are mainly characterized by the importance of points in the tool spectrum. For most sites on the southern coversand points distinctly form a consistent dominant category. This underscores the importance of hunting activities. In most cases the typological differences between sites on the northern and southern coversand appear to be more gradual than fundamental. The limited number of sites on the northern coversand do demonstrate a more varied typological spectrum, while points and Montbani blades are typical for sites on the southern coversand. Next to this, both the technological and typological characteristics point to similarities between the southern river valley sites and those on the southern coversand. This is further supported by the contribution of Wommersom quartzite. This could indicate that sites in both areas were part of comparable systems of mobility.
- The wetland sites, in particular both Hardinxveld sites, demonstrate a distinctly different character in the tool spectrum of their assemblages. Non-formal tools, in particular retouched flakes, form an important component and point to an expedient technology. This is substantiated by the technological component which is convincingly flake-based. This contrasts most with the (importance of the) curated blade-based component and importance of hunting implements in assemblages on the southern coversand. These differences may suggest different technological systems, where expedient systems as at Hardinxveld may indicate a lower residential mobility (*cf. supra*). This divergent composition should, however, be understood against the wetland background of the Hardinxveld sites, their particular environmental context and related specific activity spectrum (see also Louwe Kooijmans 2003). Some of the wetland margin sites are adjacent to the northern coversand uplands and may be more related to sites there.
- In relation to both the technological and typological characteristics of the studied assemblages, the role of Wommersom quartzite in the spectra of sites on the southern coversand may be understood in particular in relation to the

production of formal tools such as points (trapezia) and Montbani blades. It therefore functioned as a raw material with a distinct purpose, intent and probably value.

- Regarding raw material procurement the main component in the systems of sites on the southern coversand, northern coversand and of river valley sites is formed by local sources of flint (of erratic or fluvial origin) that were mostly part of the intrinsic mobility round. The role of Wommersom quartzite in assemblages on the southern coversand should additionally be understood within a similar system of procurement, most likely in combination with targeted expeditions and exchange. Of a different nature is the type of resource procurement demonstrated at Hardinxveld. There a logistical system was in place which supplied this wetland location with raw material over considerable distances, most likely through expeditions in combination with exchange.
- The limited indications provided by the studied tool assemblages, as well as the problems involved in characterising them, form a further indication for the fact that the study of Late Mesolithic mobility and the character of its settlement system should be studied within the wider context of the sites and take into account aspects such as ecological context, site location choice, site structure, investment, raw material choice etc. (see Kelly 1992; Kent 1992, 635). Only a combined approach offers the opportunity to complementarily compare sites and evidence.

5.6 Discussion

The comparison of information from various categories in the preceding paragraphs will now be placed in an interpretative framework. The main emphasis will be placed on the degree to which the information may be understood with available models and information from ethnography. As has become evident, most information is available for the sites of the southern coversand group that are relatively intercomparable, and these contrast most with the the distinct wetland locations Hardinxveld-Giessendam Polderweg and De Bruin with their qualitatively different characteristics. The interpretative potential of the other sites and groups studied is quantitatively limited. The following section will introduce models for mobility and settlement systems and discuss the available evidence and diversity.

5.6.1 *Data criticism and interpretative approach*

The classificatory systems for a distinction in settlement types dating to the Mesolithic in the LRA have been discussed and criticized above, most notably those of Newell (1973) and Price (1978; see also Mellars 1976^a). Criticism mainly centred on the fact that the sites used in the analysis dated to different phases of the Mesolithic and were not found within one regional context. Environmental variables or site location choice were not incorporated in the analysis either. Moreover, the models did not account for possible reuse of the same locations (*cf. supra*; see also Lanting/Van der Plicht 1997/1998; Niekus 2006; Raemaekers 1999; Verhart 2003; Verhart/Groenendijk 2005). Meanwhile, other studies have demonstrated that these locations often consist of diachronically inhabited,

spatially overlapping units (*e.g.* Crombé *et al.* 2006; Peeters 2007; Rensink 1995; Séara 2006; Van Gils/De Bie 2008). Only sites that have been ‘sealed’ in a pristine state of a settlement system could potentially be classified in such a system (see also Binford’s (1981^b) ‘Pompeii-Premise’). For the Mesolithic these situations have only rarely been documented and are not representative (*e.g.* Bokelmann 1986).

This evokes the question of what evidence for (Late) Mesolithic site function and settlement system we are left with. On the basis of the sites reviewed above it can only be concluded that almost all should be interpreted as time-averaged palimpsests of multiple visits to the same location and that there is often no closed association between artefacts, features and radiocarbon dates (*e.g.* Crombé *et al.* 2012). Due to reuse, spatial overlap, site formative processes, and absence of organic remains (see also Conkey 1987), resolution at most sites will remain coarse. Even the most informative episode of occupation at the wetland site of Hardinxveld-Polderweg (phase 1) is the result of 100-200 years of visits and activities.

This does not mean that most of the sites we study are uninformative, but it *does* mean that we should adjust our questions to the resolution at hand and ‘tune in’ to the type of signal that *is* present (see Chapter 4). Since most Late Mesolithic sites that are detected in the LRA can be seen as multi-component palimpsests of repetitive visits to the same location, questions should thus focus on their nature (see Jochim 1991, 315). Why did these locations develop into frequently visited sites, or ‘persistent places’ (*sensu* Schlanger 1992)? What is the rationale behind settlement location choice? Is there evidence for consistent structuring of space or investment in locations and activities? Which emphases are to be found in the overall artefact assemblage (see for example Bamforth 1991)? How do these relate to the environment and how does this differ from other persistent places?

While these questions will not lead to the identification of a site typology or reveal specific chronological developments, they are informative on (part of) the Late Mesolithic settlement system. In the following, results of the comparative analysis of Late Mesolithic sites presented above will be interpreted in the light of aspects of mobility and the settlement system. The distinction between logistic and residential mobility as proposed by Binford (1980) will be used as a starting point.

5.6.2 Theory on mobility

Before interpreting the archaeological patterning regarding Late Mesolithic mobility a number of theoretical aspects are presented. These form a framework for understanding the characteristics of and differences between the studied sites and their implications with respect to settlement systems and mobility.

5.6.2.1 Beyond foraging and collecting

A considerable number of ethnographic and archaeological publications have addressed, interpreted and categorized (hunter-gatherer) mobility (*e.g.* Bettinger 1999; Binford 1990; Habu/Fitzhugh 2002; Zvelebil 2006).⁵⁹ They present a wide and variable range of present and past hunter-gatherer settlement systems and form a good indication of the heterogeneity present (see Lovis *et al.* 2006^a, 175). Furthermore they present useful approaches for studying past mobility. Binford’s 1980 paper, *Willow Smoke and Dogs’ Tails: Hunter-Gatherer Settlement Systems*

and Archaeological Site Formation is one of the most influential contributions to the understanding of hunter-gatherer mobility (Fitzhugh/Habu (eds) 2002). In this article Binford distinguishes between two resource strategies with distinct patterns of mobility related to the exploitation of the natural environment. The first strategy, termed 'residential mobility', is characterised by frequent residential moves whereby camps are located or 'mapped' onto resource patches. Consumers are thus moved to goods. Binford termed these groups 'foragers' (1980, 5-7).⁶⁰ The other resource strategy is labeled 'logistical mobility' and is practised by what Binford terms 'collectors'. Base camps are located next to one critical resource or 'magnet location' which is exploited for an extended period of time. Other resources (food and non-food, see Binford/Johnson 2002, *viii*) are procured through logistical mobility, involving specialized 'task groups'. These might operate at a great distance from the base camp, moving goods to consumers. Technological investment in storage and facilities is common (Binford 1980, 10).

While foraging systems are most common for areas with (regular) resource patches or undifferentiated areas (*e.g.* the tropical rainforest), collector strategies are '*accommodations to [spatially and/or temporally] incongruent distributions of critical resources or conditions*' (Binford 1980, 5-10). These are often groups living in arctic or sub-arctic environments (see Kelly 1995, 120). Using Effective Temperature (ET) as a measure, Binford demonstrated the importance of the link between mobility and the environment.

The model stresses the strategies behind the patterns we observe and specifies the material consequences of hunter-gatherer behaviour in intersite variability in tool assemblages and site types (Habu/Fitzhugh 2002, 2). This latter aspect gave archaeologists potential tools for the interpretation of observed site patterning within a framework of 'Middle-Range' theory. Rensink (1995, 86) adds that the concepts not only reflect upon resource exploitation strategies, but also refer to other aspects of hunter-gatherer life, such as technological organization, social structure, anticipation and planning depth. While this adds to the value of this model, several points of criticism need to be raised.

5.6.2.2 Criticism of the forager-collector model

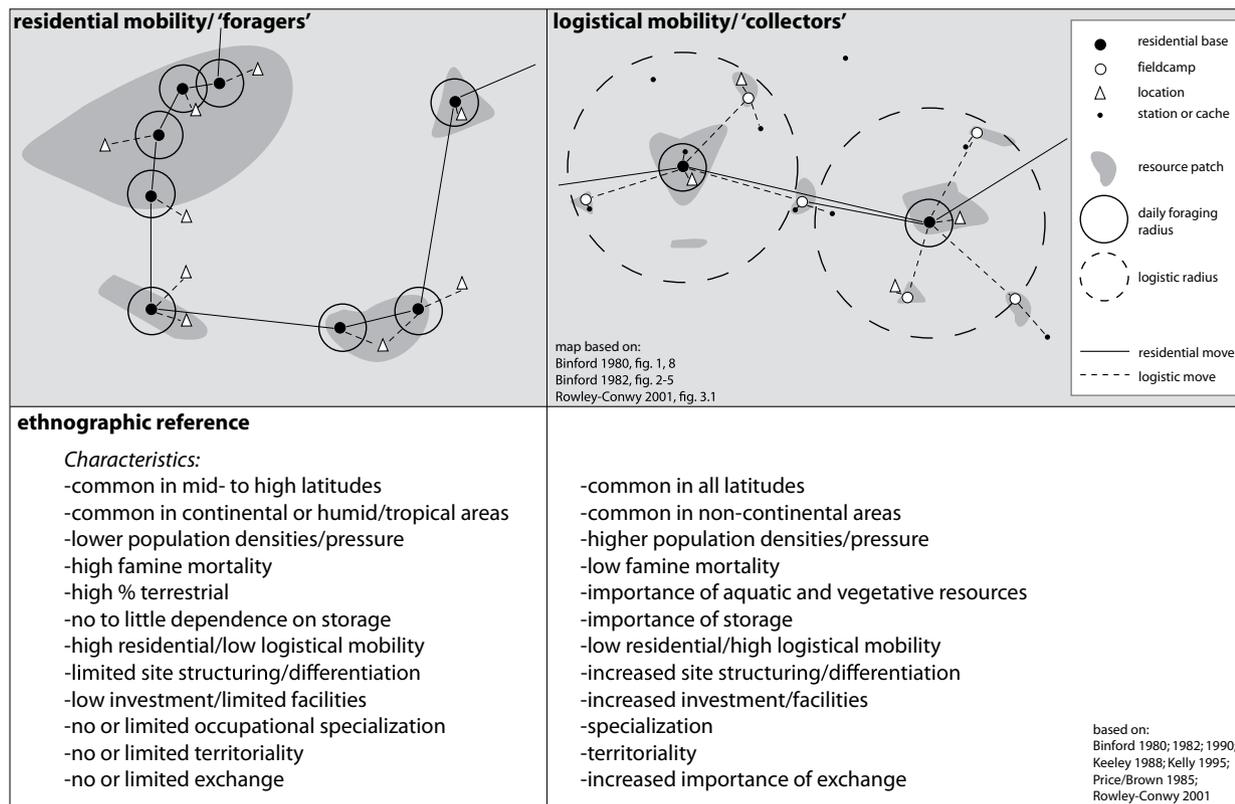
While the forager-collector model provides a valuable tool for studying hunter-gatherer mobility and settlement systems, certain aspects of it and similar models (*e.g.* Bettinger 1999; Hayden 1981; Woodburn 1980) should be pointed out. The forager-collector model has been used to dichotomously categorize archaeological sites as belonging to one of either category (for criticism and examples see Binford/Johnson 2002, *xi*; Chatters 1987, 337-338; Kelly 1992, 45; 1995, 117; Raemaekers 1999, 118, but also 192; Rensink 1995, 99; and recently Crombé *et al.* 2011^b). However, the concepts were not intended as '*polar types of subsistence-settlement systems*', but '*as a graded series from simple to complex*' (Binford 1980, 12). Foragers and collectors form broad generalizations on a continuum of resource strategies, with many intermediate and combined strategies in between (see Chatters 1987, 337). The central message therefore is that most of the actual mobility, as it was experienced by past groups of hunter-gatherers, involved a multitude of decisions at the agency-level of groups and individuals for a variety of predominantly economic, but also social, political and ritual reasons.⁶¹ Mobility is also distinctly related to issues of age, gender and skill (*e.g.* Kelly 1992, 57), frequently leading to

both group fissioning as well as aggregation (Chatters 1987, 348). It should thus be realized that mobility consists of a very complex, interrelated set of motivations, most of which are beyond our archaeological scope. Bearing these arguments in mind, one can only agree with Kelly (1992, 60; see also Chatters 1987, 337) that in order to arrive at a better understanding of mobility and sedentism, we need to understand that mobility is not just variable, but multi-dimensional.

While this places the forager-collector model in perspective it does not argue against its use. Many of the nuances introduced above lack characteristic material visibility. This makes them important as cautionary tales, but of less use to archaeology. The strength of the forager-collector model lies in its identification and contrasting of two very different resource strategies, each with a distinctive type of mobility, organization of movement, settlement pattern, material consequence and potential archaeological output. While the latter aspect is confounded by many of the factors mentioned above, most importantly redundancy in site use, the model offers two well-defined extremes for interpreting archaeological evidence for mobility systems, without denying that there is in fact much variability that should be accounted for (*cf.* Kelly 1995, 34).

From this perspective it is appropriate to use the forager-collector model as a heuristic framework for identifying and analyzing this variability, also with respect to archaeological evidence of mobility strategies and settlement patterns. A schematic representation of this framework has been depicted in fig. 5.42.

Fig. 5.42 Model of residential versus logistical mobility and ethnographic characteristics.



5.6.2.3 Site location, settlement structure and persistency

Site location and site structure are related to the possibilities provided and constraints imposed by the natural environment. The choice for a certain site location is often based upon the availability of crucial resources in the environment. These in turn influence the character of settlement as for example expressed in refuse areas, spatial structuring or features. It also constrains the spectrum of activities performed at a location and hence the specialized or broad nature of the toolkit and the technological choices made therein. Within the forager-collector model (Binford 1980) this ‘targeting of resources’ plays a crucial role. Within collector strategies, sites are located near a crucial resource and other resources are harvested in a logistic manner. Forager strategies exploit resources until the diminishing returns drop below a certain threshold (depending on the specific situation; see Kelly 1995) and subsequently move to a new location. As a result, base camps in a logistically mobile system are inhabited longer than base camps in a residentially mobile system. Based upon one of Schiffer’s general principles (1995, 37), there is an inverse relationship between increased intensity of occupation and spatial correspondence between use and discard locations. While this does not preclude the factor of ‘anticipated mobility’ (see Kent 1992; Kent/Vierich 1989), it means that the degree of spatial structuring at sites that are inhabited for extended periods of time will be greater compared to sites that are not.⁶² Additionally, within stable systems it can also be expected that, given the (seasonal) regeneration of resources, the frequency of reoccupation will be greater in residential systems. From this it follows that there might be an archaeologically detectable distinction between regularly occupied sites of some ‘duration’ with a certain degree of spatial structuring and investment and more frequently occupied sites with a more erratic character. While the degree of ‘permanency’ of base camps in both systems thus might be the same, there is a considerable difference in the frequency and duration of visits.

A note on persistency

In relation to the discussion on permanency outlined above, an alternative and complementary perspective is offered by the perspective of persistent places. Almost all Late Mesolithic sites analysed here can to some extent be characterised as persistent places. This generally means that sites have been used for extensive periods of time, but there are two important additional considerations. Firstly, different and non-exclusive time-scales might be active. For example, the temporally unrelated killing and butchering of aurochs at Jardinga on two separate occasions forms one end of the spectrum, while the extensive and consistent use of Mariënberg, or the seasonally repetitive occupation of Polderweg form another. Secondly, different motives may result in the long-term use of a specific location. In this vein, Schlanger argues that persistent places are locations that are repeatedly used during the long-term occupation of a region (1992, 97) and defines three main categories.

1. Persistent places that have unique qualities with respect to activities performed, such as the proximity of water, resources or good hunting grounds.

2. Persistent places that are marked by features that serve as a focus for reoccupation. This particularly relates to built environment, such as huts, houses, (storage) facilities etc. This category thus relates to what was defined above as ‘investment’.
3. Persistent places as locations that through their long history of occupation harbour considerable quantities of cultural materials. These accumulations of material might become important structuring components of the cultural landscape and provide an exploitable resource of expedient or cached tools. Here sites are thus more or less defined as quarries, where necessary raw materials can be obtained by ‘scavenging’.

While Schlanger’s subdivision covers important motives for the development of persistent places, it is mechanistic in that only economic or material incentives are defined (see also Barton *et al.* 1995, 81). Various ethnographic accounts provide evidence for the fact that the ‘fixedness’ of mobility rounds to certain places is to a significant extent culturally motivated (*e.g.* Kelly 1992, 48; Kent 1992; Vickers 1989). Religious and political motives, marriage opportunities, trade and exchange might all have formed additional incentives for visiting the same locations over and over again. In this respect Barton *et al.* (1995, 110) particularly point out the range of meanings attached to features in the natural landscape and their meaning as boundary or reference point, means of transport and communication and for defining social and group identities. It is thus important to note that while economic or material considerations might have formed the initial reason to visit a certain place, other motives will, in time, have contributed to the persistency of these locations, or even have become the main reason for visiting.

The contrast sketched above indicates that from a general perspective there is a difference between persistent places in relation to the combination of a specific set of consistent conditions and persistent places that combine a multitude of motives, including considerations of distinct socio-cultural character. At the latter sites there may be a more consistent use of space over time, involving distinct place-bound structuring and investment. Specific places were sought out and physically altered, through structures and facilities, to cater to the (seasonally) recurrent needs of their inhabitants. The presence of huts, canoes, facilities such as fish weirs and considerable quantities of raw material point to a certain degree of inalienable ‘ownership’; specific places seemed to have belonged to specific groups. A claim that might have been substantiated by the presence of burial grounds and depositions and that might have involved increased territoriality and appropriation of place (Kelly 1995; Littleton/Allen 2007, 295; Nicholas 2007^{a,b}; Price/Brown 1985, 11; Rowley-Conwy 2001, 44; Zvelebil 2003^b).

5.6.3 Implementation: site location choice and settlement structure

The section above presented a theoretical background and approach for dealing with (Late Mesolithic) hunter-gatherer settlement systems and mobility. This also highlighted the difficulties involved in relation to both the ethnographical variability and the (remaining) archaeological patterning of mobility. In the following the characteristics of Late Mesolithic occupation for the sites and regions studied will be discussed against this background.

5.6.3.1 Southern coversand area: consistent conditions

Most locations on the southern coversand lack internal structuring. In some cases (e.g. Weelde-Paardsdrank sector 5) flint knapping debris, remains of hearths, hazelnutshells and bones have been found together. While it can be argued that the absence of temporal resolution prevents a proper analysis of the contemporaneity of these activities and events of refuse disposal, the same argument can be used to indicate the absence of any consistency in the spatial structure of these locations. More important arguments are, however, found on another level. Most of the sites in the southern coversand landscape show similar characteristics in site location choice, mainly focusing on (sun-exposed) slopes of coversand dunes and ridges bordering on little streams or fens. Site location choice seems to have been less governed by a return to a specific place, than by a return to a specific set of conditions existing within a known patch or rich area with respect to resources, water and perhaps wildlife diversity (Amkreutz 2009; Van Gils *et al.* 2009; Vanmontfort *et al.* in press). This led to the development of extensive site complexes of chronologically mostly unrelated, yet spatially contiguous and overlapping clusters and concentrations (see also Vanmontfort *et al.* 2010^b, 48). At Lommel-Molse Nete and Opglabbeek-Ruiterskuil recent prospecting research was able to indicate the large extent of these scatters of finds. At Opglabbeek the 1971 excavation measuring 145 m² could for example be correlated with an area of 20000 m² yielding Mesolithic finds (see Van Gils/De Bie 2006). Despite the taphonomically limited resolution this points to a high degree of redundancy, correlation between activity and refuse areas and a generally limited investment in features other than occasional hearths. Thus, many aspects of these sites point to a considerable level of residential mobility.

5.6.3.2 Wetlands and wetland margin: from space to place

The consistency in site location choice and settlement structure as exemplified by Hardinxveld-Polderweg and De Bruin contrasts with the characteristics outlined for the southern coversand area above. Analogous to the ‘positioning strategy’ employed by collectors (see Binford 1980, 14-15) these sites are evidently located near, or within an area of (critical) resources. The elaborate wetlands provided water, shelter and an abundance of wildlife and vegetable sources. Next to terrestrial species, aquatic resources such as fish, beavers and many species of birds could be procured. Furthermore many species of wood and other botanical resources such as waternut (*Trapa natans*), yellow waterlily (*Nuphar lutea*) and waterlily (*Nymphaea alba*) were available (Bakels/Van Beurden 2001). Although it is evident that the fens and small streams of the southern coversand also provided ‘rich’ elements within the landscape, the scale and character of the wetlands of the (Dutch) delta form a difference of kind rather than degree. As demonstrated, for instance, by the seasonal information available for Polderweg and De Bruin (see Louwe Kooijmans 2003; *cf. infra*) these extensive wetlands provided a highly sustainable landscape enabling an occupation duration of up to several months. There is evidence that the sites were used on multiple occasions during the year (see Louwe Kooijmans 2001^{a,b}). From this it follows that residential locations in this area are liable to be characterised by an increased level of spatial structuring and investment. This is confirmed by the archaeological evidence of both Polderweg and De Bruin. Both sites were located at a considerable distance from dry land, which over time only

increased (see Louwe Kooijmans 2001^a, fig. 15.3a). Furthermore, out of the many available locations, the rather small donk of Polderweg and, later on, the donk of De Bruin were specifically selected for establishing residential bases (see also Louwe Kooijmans 2001^a, 449). This implies investment in transport over water in order to reach these locations and this may have been preferred above a site location in the wetland margin.⁶³ It also implies that specific places were targeted, although there was in fact more or less an ‘archipelago’ of locations with similar qualities (e.g. Verbruggen 1992^b). The entire array of motivations for revisiting these locations is not within the scope of archaeological resolution, although it is likely that economic reasons, next to physical site location arguments, were only part of the story (see Barton *et al.* 1995; Schlanger 1992). The effects can be documented in the continuity represented in radiocarbon dates, the consistency in seasonality and the amount of material that was brought to the site. From a spatial perspective, the continuous and recurrent structuring of the site forms a further argument for a consistent use of space. This involves the existence of a living area on the top and on the slopes of the dune, activity areas on the slope and at the foot and refuse disposal areas in the bordering marsh. It represents a consistent, graded use of space practised over a considerable length of time. The degree of spatial structuring, the level of redundancy and the ‘fixedness’ of these locations point towards a logistical, collector-type mobility strategy.

5.6.3.3 Northern coversand area and river valley sites: within the continuum

Unfortunately most other sites are less informative. Hearthpit sites such as Mariënberg or Hoge Vaart are located at the convergence of ecozones, which may have provided possibilities for an extended stay. The resolution of the ¹⁴C data and the absence of clearly associated faunal remains prevent an indication of the actual length of stay. The hearthpit sites found on the river dunes at Swifterbant suffer from the same problems. Hypothetically, the duration of occupation at hearthpit sites might be anywhere between the average site occupation on the southern coversand and the seasonal occupation of for example Polderweg. Investment in specific facilities such as hearthpits (see Perry 1999; Verlinde/Newell 2006) and the (questionable) spatial structuring with respect to flint knapping argue for more integrated spatial structuring. Similar conclusions may be reached for other sites. Bergumermeer-S64B for example was located on the margin of an extensive lake, providing rich resources. This might be correlated with the presence of indications for spatial structuring as demonstrated by features, hearths, postholes and manuports (see Newell 1980). More evidence for an extended stay and increased spatial structuring is provided by the southern river valley sites. Liège-Place St.-Lambert, Remouchamps-Station LeDuc and to a lesser extent Namur-Grognon are all located in the margins of rich floodplain environments of middle-sized to large rivers. While all sites show evidence of considerable investment, most emblematically demonstrated by the stone-based structures (Gob/Jacques 1985; Van der Sloot *et al.* 2003), both Liège and Remouchamps also provided evidence for spatial structuring.

5.6.4 Features and 'investment'

Next to site location choice and internal settlement structure, 'investment' in structures, facilities and places in general has also been mentioned as an important factor for determining the degree of mobility (*e.g.* Binford 1980; 1990; Chatters 1987; Kelly 1992; 1995; Kelly *et al.* 2005; Kent 1992; Rafferty 1985). This factor is also correlated to a significant extent to the environment. Basically the availability of resources at a certain location determines the sustainability of its occupation (see Rafferty 1985, 119). In forager systems resource deficiencies are solved by residential mobility. Diminishing returns, especially with respect to subsistence, form a major incentive to move (Sahlins 1972; Kelly 1992; 1995, 132-141). In collector systems the problem of diminishing returns is tackled by logistical mobility. Task groups move out to procure specific resources which are brought back to the residential camp (Binford 1980, 10). These may be bulk resources and storage may be necessary (Binford 1980, 15; Chatters 1987, 337). From this it follows that the residential base thus functions as a 'hub' or central node within the logistical system (see fig. 5.42). Since residence is changed less frequently it becomes worthwhile to invest in more solid structures, dwellings, facilities, storage capacity etc., all the more since these locations would be used frequently over time. Special notice should be made of so-called 'anticipated mobility' (Kent 1991; 1992; Kent/Vierich 1989), related to Binford's 'planning depth' (1976; 1979 (1983)). This is the hypothesis that the length of time people *plan* to occupy a camp is an important determinant of factors such as site size, number and size of dwellings, structures and facilities.⁶⁴

Late Mesolithic features and investment in relation to mobility and settlement system

Based on a review of the variety and quantity of features and artefacts present at sites, the southern coversand locations studied are characterised by short-term occupations with a limited degree of investment. The opposite could be concluded for the wetland locations of Hardinxveld-Polderweg and De Bruin and the southern river valley sites. Information regarding hearthpit sites and other locations is more difficult to interpret. Hearthpits may have formed a specific facility as well as the investment in stone pavements at the sites in the Meuse valley near Liège.

In the following a number of characteristic aspects of 'investment' will be discussed in more detail. These are subsequently followed by a (brief) discussion in relation to the evidence provided by the studied sites and its repercussions for Late Mesolithic mobility and the settlement system.

5.6.4.1 Dwelling structures

Cross-cultural studies demonstrate that investing labour in dwelling structures is often related to reduced residential mobility (Gillman 1987; Kelly 1992).⁶⁵ Kent (1992) provided links between population size, anticipated mobility and number and size of houses, while Rafferty (1985) acknowledges a certain connection between sedentariness and housing, but also stresses the various nuances in it. Binford (1990) stresses the strong link between the type of housing and its environmental setting. He suggests that there is generally an inverse relationship between mobility and investment in housing (1990, 120) and further

distinguishes some broad patterns. A first concerns the fact that among modern hunter-gatherers shelters are almost always found at residential sites. However, since shelters are often expediently constructed they might leave no trace in the archaeological record, often leading to misinterpretations in site typology (*ibid.* 120). Binford (1990, 123-130) introduces several broad patterns observed in housing among almost 200 groups of historic and proto-historic hunter-gatherers, related to different systems of mobility. The most important trends have been summarized in table 5.15.

Several trends can be noted. Very mobile people tend to construct circular or semi-circular dwellings, while elliptic forms are characteristic of semi-nomadic groups. Rectangular forms seem associated with more sedentary communities (Binford 1990, 123). This could be related to the fact that more mobile dwellings such as tents and some huts tend not to be rectangular. Rafferty (1985, 130, based on Flannery 1972) adds that rectangular shapes increase flexibility in the use of walls and addition of new rooms. These are features that might be of importance when structures are inhabited for a longer time.

The investment in placement of the dwelling increases with sedentariness. Very mobile groups tend to place their structures on the ground surface, while less mobile groups increasingly invest in preparation of the house site. This also relates to the portability of dwelling structures (*e.g.* hides, posts etc.) and the availability of local materials around the site location. Low investment is related to the scale of mobility and transport costs, while high investment is related to the planned duration of stay or planned reuse (Binford 1990, 124; see also Janes 1983, cited in David/Kramer 2001, 288).⁶⁶ Other evidence is provided by the similarity in wall and roof material in primary and alternative housing, which is related to either a very homogeneous type of mobility or almost no residential mobility at all. Seasonal contrasts in mobility and social and activity-related variability tend to yield greater numbers of alternative housing (*ibid.* 127). Wall and roof material in mobile groups are often the same (*e.g.* hide tents or ephemeral structures of branches), while roofing material is either transportable (*e.g.* hides), or locally accumulated (*e.g.* vegetation or bark). With less mobile groups there is more

Table 5.15 Major correlations between housing and mobility. Based on Binford (1990).

mobility					
housing aspects	fully nomadic	semi-nomadic	semi-sedent.	fully sedentary	comments
ground plan	(semi)-circular	semi-circular/elliptical	rectangular	rectangular	
structure placement	ground surface	ground surface/semi-subterranean	semi-subterranean/ground surface	semi-subterranean	
investment	low, related to mobility/transport costs	intermediate	intermediate	high, related to planned duration and re-use	
wall and roof material in primary houses	same	same	different	different	
wall and roof material in alternative houses	same	same	same	different	
roofing material	hides/grass/bark	grass/earth/mats	wood/earth/ grass or bark	wood/bark/grass	related to transportability and environmental productivity
interpretation primary roofing material	transportable	locally accumulated	increased investment	increased investment	
alternative housing	mainly absent	present	present	mainly absent	characteristic of semi-nomadic and semi-sedentary hunter-gatherers
roofing material alternative housing	grass/bark/earth	increase in hides	bark/mats	increase vegetative material	related to productivity environment

difference between wall and roofing material and the latter might require more investment. Alternative housing is most common in semi-nomadic groups and it is here most differences are noted between primary and alternative houses. In very mobile groups the same type of housing is used in all seasons, while in sedentary groups there might be a difference in roofing of summer and winter houses (*ibid.* 129-130).

One important trend emerging from the hunter-gatherer dataset used by Binford (1990) is the unmistakable relationship between a dependence on hunting and the portability of primary housing (*cf. supra*; see Binford (1990, table 11)). Binford (1990, 137) argues that since prey animals move and are differentially responsive to shifting productivity in plant communities, as well as more difficult to kill, this ensures that hunters of these animals exploit larger ranges and will be quite mobile. In short, terrestrial hunters make many more residential moves per year, travel much greater distances over an annual round, and in turn exploit vastly larger areas than do aquatic resource exploiters (see also Kelly 1995, 130-131). This would potentially lead to (archaeologically) traceable differences in housing.

Implementation: dwellings and mobility in the LRA Late Mesolithic

The ethnographic framework presented above only provides general trends in correlation between housing and mobility, but the information is of some value for the sites studied here. First of all, for the LRA and to a certain extent Northwestern Europe in general, there is little evidence for (Late) Mesolithic dwelling structures with a rectangular shape (*e.g.* Grøn 1995; 2003; Hamburg/Louwe Kooijmans 2001; Karsten/Knarrström 2003).⁶⁷ On the other hand rectangular shapes do occur in the slightly later Swifterbant culture as for example demonstrated at Swifterbant-S3 and perhaps at Hüde I (see Appendix I) and the subsequent Hazendonk group (see Houkes/Bruning 2008; Kampffmeyer 1991; De Roever 2004; Raemaekers *et al.* 1997; Stapel 1991). They are therefore potentially related to changes in social structure and mobility patterns, possibly related to the incipient stages of agriculture.

Based on this data it is more likely that the evidence for dwelling structures in the Late Mesolithic should be attributed to fully mobile or semi-nomadic groups (see table 5.15). Within the Late Mesolithic some differentiation is visible. The absent or vague indications for dwelling structures provided by sites in the southern coversand landscape (see 5.4.4.5) may point to the existence of ephemeral dwelling structures, which were either transportable (tents) or made expediently of locally available resources (see Binford 1990, 122-124). Sites such as Meeuwen and Weelde provide limited evidence for this (Pilati 2001; 2009). Potentially increased investment in dwelling structures is provided by sites located in rich environments allowing for longer site duration and thus investment. The sunken dwellings of Hardinxveld-Polderweg and De Bruin and the energetic investment in stone pavements and dwelling structures at Liège and Remouchamps provide the best example for this.

It is not possible to directly associate the general absence of structural dwellings on the southern coversand with a fully mobile settlement system, or for that matter the more structural evidence for dwellings, including the semi-subterranean dwellings, with semi-nomadic groups. It can, however, be assumed that the absence of structural dwelling structures is related to a higher residential

mobility, including factors such as portability and expedient use of materials. This would be in line with the character of occupation established so far for sites in the southern coversand landscape as well as several other locations. Conversely it is likely that structural investment 'pays off' in a situation where an increased sustainable occupation is possible. Extensive wetlands and larger floodplains are the most likely settings for this scenario.

5.6.4.2 Burials

Burials may form a further indication of investment in distinct places and reduced residential mobility. Binford (2004) was able to distinguish several universal trends between beliefs about death, mortuary practices and the character and mobility of hunter-gatherers.⁶⁸ One of the clearest important trends is the relationship between disposal area, group size and mobility. Binford (2004, 7) suggests that burial, or mortuary practice for that matter, might occur at any given moment and is thus not necessarily related to archaeologically detectable places such as settlements. Disposal of the deceased is thus not geographically and temporally bound, or not very much so. According to Binford (*ibid.*, 10) this observation is most consistent for hunter-gatherers with a high degree of mobility, *i.e.* foragers. On the other hand, the use of small cemeteries for disposal of the dead, often associated with traditional family space, is most common among groups of hunter-gatherers where extended families form the core unit of the group (Binford 2004, 7). These groups are associated with a lower degree of residential mobility and generally comprise collectors (*ibid.*, 10-11). Choice of burial location is therefore related to both the degree of residential mobility and population density (*ibid.*, 8, 9). There is thus a correlation between settlement pattern and disposal practices, whereby the use of small cemeteries or specific locations is inversely related to residential mobility.

In addition Littleton and Allen (2007, 294) argue that cemeteries might have been less planned than is often assumed and their development and maintenance is interwoven with the perception of certain locations as 'persistent places'. The existence of burials at these sites might have structured subsequent actions, creating a meaningful landscape (Littleton/Allen 2007, 295). Burial areas therefore are created by '*a process of accumulation over time, and may in turn, by becoming mortuary landscapes, structure human activity and contribute to the landscape of meaning.*' (*ibid.*, 295). There might thus be a difference of degree between isolated burials and cemeteries. Which locations developed into 'persistent places' and were seen as suitable for burial of course remains unanswered. Nevertheless, there are ethnographic as well archaeological indications for a correlation between ritual activities such as deposition and burial and specifically wet locations, or wet margins (Koch 1999; Larsson 1990^{a,b}; 2004; 2007^{a,b}; Littleton/Allen 2007; Nicholas 1998^{a,b}; Nicholas 2007^b; Peeters 2007; Zvelebil 2003^b). In this respect it need not only be down to taphonomy that the best indications for Late Mesolithic burials have until now been found in wetlands.

Implementation: burials and mobility in the LRA Late Mesolithic

The overall evidence for Late Mesolithic burial and cremation, let alone cemeteries, is not unambiguous and restricted to only a few sites (see section 5.4.4.6; see also Louwe Kooijmans 2007^b). The evidence is restricted to calcined but undated

remains at Hoge Vaart-A27 (Peeters/Hogestijn 2001), disputed (see Louwe Kooijmans 2007^b; 2012^b) sitting graves at Mariënberg (Verlinde/Newell 2006; *cf. supra*), loose and undated bone material at several other sites, including Swifterbant locations (Constandse-Westermann/Meiklejohn 1979) and inhumations as well as stray bone material at Hardinxveld-Polderweg and De Bruin (Louwe Kooijmans 2003; 2007^a). The latter two sites provided most evidence for structured and continued mortuary practices of both humans and dogs (see Appendix I; Louwe Kooijmans 2007^b).⁶⁹

Overall, burial practices only form a limited indication for investment and restricted residential mobility. There is no evidence to suggest that burial locations were only maintained in places with increased duration of occupation, or that the deceased were specifically brought to these sites. If evidence from the preceding Middle Mesolithic is included then cremation graves are for example known from typical upland locations such as Dalfsen-Welsum and Oirschot V (Verlinde 1974; Arts/Hoogland 1987). Recently another Middle Mesolithic cremation grave has come to light at the river dune site of Rotterdam-Beverwaard (see Appendix I; Zijl *et al.* 2011).

Both ethnographic and archaeological studies indicate that many motivations underlie the eventual outcome of mortuary practices (*e.g.* Binford 2004; Hertz 1907; Nilsson Stutz 2003; Parker Pearson 1999). In spite of this variability in origins it can be suggested that there is a possible reason for the development of small cemeteries within the Early Neolithic Swifterbant communities (see Louwe Kooijmans 2007^b). The Swifterbant cemeteries are characterised by a distinct uniformity in layout, orientation and tradition, also involving practices of reburial and manipulation of bones. This suggests a certain 'fixedness' of these locations resulting from repeated visits and a possible lower residential mobility. It can be argued that Late Mesolithic burials such as those of Polderweg and De Bruin, under less intense but comparable conditions, were also specifically located at these sites. They may form early examples of mortuary practices that perhaps did not take place in relation to small fixed cemeteries, but represented more than a coincidental burial ground.

Finally it should be stressed that while the limited evidence for mortuary practice in the form of burial may hint at relationships between people and (persistent) places, many of the other disposal practices and forms of body treatment go unnoticed. Their limited visibility and less structured archaeological nature however do not suggest a less intensive potential relation to place.

5.6.4.3 Storage

A further issue that should be addressed with respect to investment and reduced mobility is storage. This is generally perceived as an important mechanism accommodating a lower residential mobility as well as a larger group size and to deal with issues such as scarcity and seasonality (*e.g.* Anderson 2006; Binford 1980; Chatters 1987; Cribb 1991; Jochim 1991; Kelly 1992; 1995; Kent 1992; Smith 2003). Others have additionally interpreted storing as an important feature of emerging complexity (Price/Brown 1985; Keeley 1988; Testart 1982), especially since it might conflict with the basic rule of sharing among foragers (*e.g.* Bird-David 1990; 1992^a). In this perspective storing is thought to develop in 'rich' environments, where the accumulated resources might lead to the development

of social hierarchies. According to Binford (1980, 15) storage enables hunter-gatherers to solve the problem of temporal incongruity of resources beyond their period of availability in the habitat, but it develops mainly as a response to specific environmental conditions. It is thus much more a tactic to insure against consumption shortfalls during the non-growing (winter)season (1990, 140). Binford does agree that storage is mainly (but not absolutely) a feature of logistic strategies (1990, 133, 144-146). These strategies, often characteristic for higher latitudes, cope with the temporal incongruity and increased amount of time spent searching for resources. Storage in this respect can be advantageous since it might prevent high-risk residential moves in the lean season. Storage can thus be seen as indicative of a decreased residential mobility and an increased investment in certain locations and facilities.

Implementation: storage in the Late Mesolithic LRA?

There is no positive evidence for storage at Late Mesolithic sites in the LRA. This may relate to the problems surrounding storage in a temperate climate, but is also importantly a taphonomic problem; cached organic resources will not have been preserved. Pits or other storage structures might not have been preserved or recognized as such either. Furthermore, despite its tough qualities, one of the most suitable staple foods, hazelnut (*Corylus avellana*), has only been found in limited quantities. If their high caloric value formed a substantial contribution to Late Mesolithic subsistence, then it is remarkable that, in view of the storage capacity needed for their use and the amount of waste that might have been produced (see Cappers/Ytsma 2002/2003), no substantial evidence for storage facilities have been found in the Late Mesolithic over large parts of Northern Europe. Only a few secondary indications exist for storage. On the southern coversand burnt hazelnut shells are sporadically found, sometimes in concentrations (see Huyge/Vermeersch 1982). The site of Havelte H1 yielded several small elliptical and circular features which on the basis of their differing fill were interpreted as possible storage facilities (Price *et al.* 1974, 23). Pits were found at Mariënberg, Hoge Vaart-A27 and Bergumermeer-S64B and it is possible that the function of hearthpits, as found at many sites in the north or on river dunes, includes the preparation of food, such as the roasting of hazelnuts. The stone structures of Liège-Place St.-Lambert-SDT could have served as storage platforms (see Cribb 1991), although an interpretation as facilities for smoking fish is more likely (see Marchand *et al.* 2007). The wetland sites of De Bruin and Polderweg also yielded pits and postholes that might point to (storage) facilities. Botanical remains such as hazelnuts, acorns (*Quercus*) and apples (*Malus* sp.) were present there as well. No features or finds, however, yielded positive evidence for storage. Based on the considerations above it is most likely that evidence for storage can be found in locations where increased duration of occupation is to be expected.

5.6.4.4 Boats and canoes

Another element of investment is less obvious, but may involve those aspects of technology that require a distinct investment in time, energy and resources. Of particular importance in this respect is the example of boats or canoes. The importance of wetlands and aquatic resources for a logistical type of mobility and even socio-economic complexity is recognized by Ames (2002). Elaborating on

Binford's (1990) arguments, Ames focuses on the consequences of the development of aquatic technology, more specifically on the impact of boats and transport technology (Ames 2002, 20). Using ethnographic examples of hide and logboats (canoes), three important aspects are discussed. The first involves the increased distance that might be covered by boats. Based on weather circumstances, location (sea, river, lake), current and crew, accounts on average distance per hour diverge, but range between *c.* 3 and 7 km/h. The daily distance covered might amount to as much as 40 or even 90 miles (Ames 2002, 30). Another important aspect involves transport capacity, both of people and freight. Large canoes, exceeding 10 m in length, might carry 10-15 people or up to 5 tons of cargo (Ames 2002, 29). Although the Late Mesolithic canoes found in the LRA are much smaller (*c.* 5 m; see Louwe Kooijmans/Verhart 2007), this does indicate the increased capacity in 'moving goods' compared to pedestrian transport. This not only impacts on weight, but also on 'bulk'. Sizeable goods, such as large quantities of nuts, or complete carcasses, might be transported to the residential base (see also Hodder/Orton 1976, fig. 5.13). This also affects the amount of preparation and processing that needs to take place in the field, rather favouring processing activities at the residential site or destination (*ibid.*, 39). Instead of distance to homebase, the crucial decision in transport might have become the distance to the boat. Another, more typical, example involves the use of canoes in harvesting waterplants. Ames (2002, 29) describes the way in which North American Chinookan women used canoes as 'floating baskets' to harvest corms of *Sagittaria latifolia* (broadleaf arrowhead).⁷⁰ Spearing and netting of fish might also have involved canoes (see Louwe Kooijmans 2005^c, 183; Louwe Kooijmans *et al.* 2005, plate 12).

A further aspect mentioned by Ames involves the implications of having and using boats. Canoes (and paddles) require a considerable initial investment as well as a high ongoing one (they might need to be wetted down (on sunny days), covered and repaired). This is costly with respect to time and energetic investment. Using and maintaining canoes is therefore most worthwhile in mobility systems that are fairly stable and rely on fixed points of consistent duration in the yearly cycle. Canoes therefore enlarge the (logistical) foraging radius and transport capacity of hunter-gatherers. This influences their net nutritional gain, and from this perspective also the duration of occupation as well as group size. Furthermore boats, while requiring investment and maintenance, enable hunter-gatherers to reach inaccessible or remote places and facilitate intergroup contact. This of course has advantages for marriage networks, trade and exchange and specialization (Ames 2002, 44).

It might thus be concluded that the presence of boats or canoes most likely indicates a relatively stable settlement system, within a collector type mobility system (goods are brought to consumers), as well as investment in place, facilities and technology.

Implementation: canoes in the Late Mesolithic LRA

The actual evidence for Late Mesolithic canoes is limited. Apart from the rather small early Mesolithic vessel found at Pesse, most Late Mesolithic evidence in the LRA is provided by one complete canoe from Hardinxveld-De Bruin as well as several fragments. Furthermore there are paddles from Hardinxveld-Polderweg and Hoge Vaart-A27. Later evidence includes canoe fragments from Bergschenhoek, the Hazendonk and Wieringermeer, as well as paddle blades from Swifterbant,

the Hazendonk and Hekelingen (see Louwe Kooijmans/Verhart 2007). Most of the canoes and some paddle blades show distinct affinities with Scandinavian and western European examples (*ibid.*).

The presence of canoes in the LRA seems to be linked to sites that are located in extensive wetland settings such as those of the Dutch delta. Riverine and coastal transport might also have taken place. Exclusive exploitation of smaller bodies of water such as fens or streams might not have been profitable, keeping in mind the costs of making and maintaining these vessels. From this it follows that canoes, to a certain extent, form an indication for the stability in site location choice and the investment in these places and their facilities (the erratic character of many of the coversand sites do not seem to accord with this). This indicates that they also form a good secondary indication for the trophic richness of the environment. As such, they better fit collector-type mobility strategies.

Louwe Kooijmans and Verhart (2007) reflect on the possible use of these vessels for long distance transport of flint and other raw materials (the site of Polderweg for example yielded a precore of Rijckholt flint weighing 4 kg and other large stones), but they wonder whether the light canoes and slender paddle blades of Hardinxveld were suitable for long distance travel. Nevertheless, while the 150 km journey to the Rijckholt source location might not have been an option, these vessels were capable of navigating the extents of the 'widening' delta, reaching both coastal areas as well as the margin of the coversand and enabling riverine travel. This, in combination with the advantages in food procurement and personal mobility, argues in favour of perceiving canoes both as conductors for contact and exchange and accelerators for increased investment and stability. Because of their range and capacity they might increasingly tether mobility to fixed locations from which to exploit wetlands. Although the archaeological signal is limited, the effects of aquatic transport on communities compared to largely pedestrian hunter-gatherers should not be underestimated.

5.6.5 Toolkit and technology

Aspects of technological choice, toolkit composition and raw material use have been extensively discussed above. This yielded several important considerations with respect to mobility, that may be interpreted in relation to ethnographic models and systems of mobility as well.

5.6.5.1 Technological choices

Concerning technology a distinction was made between emphases in curated technologies as opposed to more expedient technologies. The increased use-life and reliability of the former type (Andrefsky 2005; Kelly 1992; Ugan *et al.* 2003) was mainly associated with (retouched) blade technology and formal tool production of for example trapezes and artefacts such as Montbani blades. This could be correlated to the character of the toolkit and the demands placed on the reliability of hunting equipment, especially on the southern coversand, forming an indication for increased mobility. The main contrasts to this system are again provided by the wetland locations of Polderweg and De Bruin. Curated technology and formal artefacts only formed a minimal contribution to the lithic assemblages of these sites, while expedient technology was favoured most. This could tentatively be coupled with a reduced residential mobility (see section 5.5.3.3).

Additionally, evidence for other technological investments was documented in the wetlands. Arguably this is primarily a taphonomic pattern, since the archaeological record on the coversand is biased towards lithics and will originally also have included an important organic component (of which some evidence remains; *e.g.* Arts 1994). The available wetland evidence includes investment in bone, antler and wooden artefacts such as axes, chisels, awls, hammers, sleeves, points and needles, hafts, shafts, bows, boards, spears, paddle blades, and canoes (see above) as well as rope and fish weirs (*e.g.* Louwe Kooijmans 2003; Louwe Kooijmans *et al.* 2001c; Out 2009). The technology required to produce these materials is costly in terms of time and energetic investment. It is difficult to quantify and correlate this, however, it appears that many of the artefacts mentioned above require time, investment and application that is not characteristic of the settlement structure and suggested mobility pattern for the upland coversand area. Moreover, several artefacts (spears, paddle blades, canoes, fish weirs) are typical for a wetland environment. Fish weirs furthermore indicate the existence of passive hunting tactics, involving investment in use and maintenance of untended (trapping) facilities. Other tools such as axes, hammers and chisels also point to activities directed at woodworking, which involve investment in place and a developed degree of environmental structuring and even management. It seems hard to imagine that this complete set of facilities and tools was also common to the base camp inventory of residentially more mobile groups on the coversand, where the available (lithic) evidence mainly stresses investment in (terrestrial) hunting equipment.⁷¹

5.6.5.2 Typology and resource procurement strategies

From a typological perspective one of the most distinct characteristics is the contribution of points to the assemblages of sites on the southern and northern coversand. A distinct difference of degree could be documented with respect to other sites. The degree of homogeneity documented for the larger set of assemblages on the southern coversand also indicates that over time the generic types of functions these sites had and thus the possible combinations of artefact sets were more limited (see Binford 1980, 12).

Resource procurement theory

According to Binford (1990) the changing variability in plant communities as one moves farther from the equatorial zone induces an increasing focus on animals in order to provide for the food needs of human communities. Furthermore, the presence of foods requiring a minimal search time decreases in a graded fashion. In areas without abundant aquatic resources this means an increased dependence on terrestrial animals, for which the search time and attendant mobility costs increase gradually with latitude (Binford 1990, 133-135). Despite richer locations such as the ecotones formed by peat fens (*meres*) and the margins of small stream valleys, no elaborate wetland resources are available on the coversand uplands, such as the Campine region. This substantiates the importance of terrestrial resources in these areas and a more homogeneous composition of the range of resources available (see also Brouwer-Burg 2012).

Bow-and-arrow hunting predominantly aims at procurement of terrestrial fauna in the form of larger ungulates such as red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), aurochs (*Bos primigenius*), and wild boar (*Sus scrofa*).⁷² A useful concept in this respect is predation mode. In general there is a distinction between 'pursuit modes' in which (a group of) specific prey items is hunted and other species are ignored, and 'search modes' in which any acceptable prey item is targeted in an opportunistic manner (see Chatters 1987, 350). The latter strategy is similar to Binford's 'encounter strategy' which is most typical for foragers (1980, 5). A more general distinction that can be made is between active and passive hunting strategies. The former refers to both forms of predation mode mentioned above, while passive strategies involve a time delay and placement of (costly) facilities such as nets, fish weirs and traps.

Shott (1990, cited in Kelly 1992, 55) argues that groups with a higher residential mobility, such as foragers, would produce assemblages with a more homogeneous spectrum (strong positive correlation). This limits site variability and enables a classification of these locations as base camps with, in this case, a distinct 'hunting character'. This raises the question what this means for issues such as mobility and investment.

Implementation: evidence for patterning?

Assuming that the composition of the mentioned assemblages is indeed equivalent to the relative importance of certain activities within the overall spectrum, then the consistent contribution of points (and artefacts such as Montbani blades) can only reflect the importance of terrestrial hunting for locations on the (southern) coversand (see Chatters 1987, 342). This is supported by the specific role of GQW in the fabrication of points and Montbani blades at sites on the southern coversand (see section 5.5.5.3). This contrasts with the broader, more general and expedient character of the assemblage spectrum at other places, most notably at both Hardinxveld sites where the toolkit is distinctly characterised by retouched flakes. The absence of informative faunal data for sites on the upland coversand prevents an adequate assessment of prey spectrum and predation mode being made. General inferences as to the most likely strategy, based on the site characteristics analysed above, may, however, be drawn. There is no evidence suggesting that only one or several species were hunted. This argues in favour of a more opportunistic search mode of predation. Supposing that comparable environmental conditions existed on the coversand a similar strategy might be expected for different locations, which would be in line with the level of homogeneity in site structure and artefact assemblage. In view of the indicated degree of residential mobility, it is unlikely that passive predation techniques formed an essential element of the subsistence strategy on the (southern) coversand. In the case of frequent residential moves and absence of elaborate aquatic resources, investment in the fabrication, use and maintenance of facilities and implements is a less viable option. From this it follows that the predation strategy most in line with the structural character of the sites and their assemblages within the environmental context, would be an active search or encounter strategy, predominantly focusing on the above-mentioned ungulates.

5.6.5.3 Raw material use

Within larger areas individual but associated bands use the available resources within the limits of their own territories, which may overlap (Kim 2006). The use of specific ‘exotic’ raw materials has regularly provided useful clues for both the range of these groups as well as the composition and extent of larger territories (see Lovis *et al.* 2006; Pasda 2006; Randolph Daniel Jr. 2001; Rensink 2005; Whallon 2006; Yven 2005; Zvelebil 2006). The range and character of mobility and territoriality is often interpreted, not only from an economic perspective, but also as a social ‘safety net’ (Whallon 2006, 260; see also Zvelebil 2006). This may be for biological reproduction or in case of resource shortage. Exotic materials such as Wommersom quartzite, phtanite, or, with the arrival of farming, *Breitkeile*, might serve as ‘currency’ within and between these systems (see Dennell 1985; Mauss 1950; Verhart 2000; 2012). With respect to raw material, implications for mobility are evident, both from the perspective of embedded procurement (Binford 1983(1979)) or specific expeditions for resources (Gould/Saggers 1985).

Implementation: different systems

There is a distinct difference between the character of the mobile procurement strategy underlying the assemblages on the southern coversand and the logistic strategy at the wetland sites of Polderweg and De Bruin. Raw material procurement on the southern coversand involved an important ‘exotic’ component, in the form of GQW, which implied a considerable and consistent intrinsic mobility, next to the practice of exchange. This contrasted with other sites where the contribution of ‘exotic’ raw material was limited as well. It distinctly contrasted with the wetland locations of Polderweg and De Bruin, which yielded clear evidence for logistical mobility in that raw material from various sources was continually transported to these locations.

Apart from differences in the degree of residential mobility this may also be associated with differences in territoriality. As is evidenced by the dispersal and use of Wommersom quartzite and its singular outcrop, the main area of distribution is often interpreted as belonging to a single dialectic tribe, within which the territories of bands and macrobands might be found (*e.g.* Gendel 1984; Verhart/Arts 2005). Other non-related indications for the existence of such areas are for example formed by the distribution of characteristic point types such as *feuilles de gui*, or traits such as lateralization of arrowheads (see Löhner 1994).

While ‘exotic’ materials have also been found at Polderweg and De Bruin, or even, in the case of GQW, at Hoge Vaart, their contribution to the assemblage is small compared to the southern coversand and especially the Campine area. This involves the increased distance to the source, but might additionally be explained by differences in mobility. This relates to the natural environment and interwoven with this, differences in demands of the existing social network, maintained by long(er) distance mobility and exchange. In the case of the trophically ‘rich’ wetland environment of the Dutch delta, the specific distribution of resources enabled a more extended stay, probably with a lower degree of risk. This enabled the development of a different (logistical) system of mobility, which provided for needs not entirely comparable to those of hunter-gatherers elsewhere. Both the necessity and the possibility to participate in a more mobile system such as the one characterised by the distribution of GQW might not have existed. This

hypothesis might be substantiated by (ethnographic) evidence existing for the general decrease in territorial size in wetland environments as a result of this decreasing mobility (see Ames 1991, 939; Nicholas 1998^a, 728; Nicholas 2007^a, 48; Nicholas 2007^b, 246, 250; Zvelebil 2003^b, 14). These smaller territories and the social changes involved with them may lead to increased territoriality and definition of boundaries (*e.g.* Kelly 1992, 58; 1995, 308-311; Price/Brown 1985, 11). There are thus broad correlations between the environment, mobility strategies, raw material procurement and territorial size. It is likely that along the forager-collector continuum there was a general decrease in annual territorial size, related to an increase in logistical mobility and a different participation in raw material networks.

5.6.6 *Interpreting mobility and settlement systems*

Little is known about the ecological character of the coversand environment in relation to the distribution of its resources, although there is evidently a considerable difference of degree between areas such as the northern or southern coversand landscape, the vast wetland area of the Dutch delta and, to a lesser extent, the floodplains of medium to large rivers. The structural aspects and lithic assemblages of sites on the southern coversand area argue in favour of the importance of terrestrial hunting. There is no evidence for any distinct structural investment, which mainly points to short-term stays. However, while Binford (1983(1979); 2001) makes an initial distinction between terrestrial and aquatic hunters, based on a general supraregional analysis, the actual situation need not have been that simple. Seasonally based combinations of strategies were possible as well, involving both terrestrial and aquatic components. This will be further discussed below.

Because of the potentially considerable differences between the environments available to hunter-gatherers we should suspect the existence of regionally specific settlement systems and mobility rounds, the characters of which will have differed under influence of the relative importance of aquatic and terrestrial resources. The band of hunter-gatherers occupying Polderweg might have been quite different from the hunter-gatherers that camped at Merselo.

The considerations above suffer from insufficient (organic) data and lack of spatio-temporal control. Clearly there is need for further research, yet the firm rooting of hunter-gatherer settlement systems in their natural environment strongly implies that differences in these environments will lead to differences in the settlement system. Based on this assumption a brief characterization of larger trends in Late Mesolithic mobility in the LRA might be given. This characterization can only be of a preliminary nature and it should be considered that the wetland perspective centres on the information produced by the Hardinxveld sites.

5.6.6.1 Wetland and upland environments: a continuum of possibilities with a wet advantage

The Late Mesolithic landscape provided a series of environmentally determined opportunities, whose composition, constraints and possibilities influenced mobility. Binford (1990) and others (*e.g.* Ames 2002; Keeley 1988; Nicholas 2007^{a,b}; Zvelebil 2003^b), have stressed the importance of aquatic resources in enabling a lower degree of residential mobility. Binford (1990, 147) sees the

expansion of diet breadth to include aquatic resources and the development of technology for their exploitation as important factors for reducing residential mobility. According to him this is the result of the increasing costs in procuring terrestrial resources in higher latitude environments. While the temperate Atlantic setting of the Late Mesolithic in Northwestern Europe might not have given rise to an irrevocable ‘aquatic shift’ in diet, full-time terrestrial hunter-gatherers will have been rare (see Binford 1990, 137; see also Binford 2001, table 5.1 and 212-222). Incorporation of aquatic resources seems to have been an often favoured addition to the diet (Binford 2001, 210). Binford (1990, 147) argues that the ‘access windows’ for ‘penetration of the aquatic biome’ are less ubiquitous and more reliable than those of terrestrial resources. Therefore strategic site locations, in combination with the productive capacity of aquatic species, led to a tethered system of mobility, corresponding with a high degree of repetition. This in turn might have led to an increase in investment, which in fact is more or less a reversal of the relationship between hunting and portability of primary housing stated above. Eventually the reliance on aquatic resources provides opportunities for many other changes in society, as for example permanence in settlement and increased group size (e.g. Binford 2001; Pálsson 1988; 1991).

The importance of aquatic environments

The importance of aquatic resources in creating opportunities for investment and spatial structuring, based on the increased static and reliable aspects of wetland resources, is evident. There are, however, differences in the definition of wetland or aquatic resources. Binford (1990), for example focuses on aquatic hunting and fishing, Kelly (1995) distinguishes between fishing and sea mammal hunting, while Ames (2002) argues water should be the main determining principle for food and resource procurement as well as transport. It is also possible to argue in favour of an even broader definition, extending primary wetland resources, such as fish and aquatic plants, to include for example otters (*Lutra lutra*) and beavers (*Castor fiber*), as well as including secondary resources. The latter involve plant and animal species which are typically attracted to wetlands and wetland margins and the biodiversity existing there. This for example includes several species of mammals, such as deer or wild boar, specific plant communities favouring wetland margins, bank or levee settings (see Bakels 1978) and, importantly, various species of (migratory) aquatic birds. Rather than the presence of typical wetland species it is the constellation of aquatic and terrestrial resources converging in these areas that made them attractive to prehistoric hunter-gatherers. As argued by Binford (1980; 1990; 2001) the incorporation of aquatic resources enables communities to become more sedentary and group size to increase. Apart from seasonality evidence, indications for a lower residential mobility have been provided by the site use and structuring and lithic characteristics of distinct wetland locations such as both Hardinxveld sites. Within such settings where resource distribution is diverse and heterogeneous a collector-type system of logistical mobility is most plausible.

Upland terrestrial characteristics and mobility

Although a whole range of intermediate environmental settings will have been present in the LRA, the aquatic biome and the distribution of resources in it contrasts most with what may be expected from the upland coversand landscape.

Characterised by a largely closed canopy forest, areas of diversification would mainly be formed by streams, lakes or peat fens (see section 5.3.2). Around these, natural diversity may have increased, but it may be argued that terrestrial resources and fauna formed an important component of the diet (see also Binford 2001, Chapter 6). Resources on the whole were probably less diverse in comparison to wetland locations and more homogeneously distributed at these locations. This would have required increased mobility and more residential moves (see Binford 1980; 1982), which fits the characteristics of site use and material assemblages in these environments. The smaller extent of the areas where resources diversify would become depleted much quicker in comparison with (the delta or large river valley) wetland environments, necessitating more frequent residential moves between such locations. Binford (1980, 5, 10) has argued that base camps are moved when resources get depleted. Depending on the extents of the available resource patches, the number and distance of residential moves and the size of the groups involved might differ (see also Kelly 1995). Furthermore the focus on terrestrial fauna species such as red deer, roe deer and aurochs involves dealing with the dispersed and unpredictable nature of the distribution of these types of animals, indeed necessitating frequent moves and a higher mobility (Crombé *et al.* 2011^b, 467). In this sense one could envisage the coversand areas as relatively homogeneous with resource clustering and diversification in specific areas that formed the most favoured locations for settlement.

5.6.6.2 Diversity and combined systems

While the contrasts between both settings are distinct it is not always useful to interpret them as a context for mutually exclusive types of hunter-gatherer mobility and resource procurement. Rather, instead of distinguishing between terrestrial and aquatic hunter-gatherers (*sensu* Binford 1990), or assuming an evolutionary or logical development from one to the other, it might be more profitable to qualitatively aim at establishing the contribution of a 'wet aspect' and aquatic resources in Late Mesolithic settlement systems.

Based on the evidence available, a description of the precise mobility regimes and settlement systems for the Late Mesolithic is not possible. However, based on the arguments advanced, an approximation of the diverse strategies existing and how these may have been combined is possible.

Implementation: diverging strategies

There are distinct differences between sites that might be hypothetically interpreted in terms of past settlement systems. As stated earlier, there is a considerable difference between sites in the southern coversand landscape and sites in wetland settings. The latter were probably inhabited for more extensive periods during the year, involving investment and structuring, and using a broad spectrum of, especially aquatic, resources. The former yielded evidence for repeated, but limited occupation with a focus on terrestrial hunting. While both systems are not necessarily exclusive it is evident that their relative importance to the yearly cycle largely structures the mobility of a group in a given area. Especially occupation of sites in extensive wetland settings often involves a certain degree of stability, arguing in favour of collector type strategies. This contrasts with the supposedly higher residential mobility of sites in the southern coversand landscape.

There are however also indications for a complementary function of sites within a settlement system with different regional and ecological components. Evidence for such a combination may be found in the similarities between some of the sites on the southern coversand and the technological (contribution of blades), typological (contribution of retouched flakes and blades) and raw material (*e.g.* Wommersom quartzite) characteristics of the three southern river valley locations near Liège. Although these may not themselves have been part of a settlement system incorporating the southern coversand area, they do perhaps represent a seasonal component that is typical for larger river valleys and floodplains, in this case the Meuse. Especially the latter element (GQW) might indicate comparable groups, or that members of the same wider community occupied sites in both settings.

The contrast between the investment and structuring characteristic for the river valley sites and its absence on the upland, may relate to resource procurement. Apart from the availability of stone, the river valley sites yield evidence for the exploitation of various resources in the rich floodplain settings, including aquatic resources such as fish. These especially might have formed an important contribution to the diet in winter (Binford 1990). This is potentially supported by the evidence for seasonality at the wetland site of Polderweg (see Louwe Kooijmans 2003), although the seasonality of fish in both environments need not have been the same.⁷³

Another example is formed by the Hardinxveld sites. Especially the seasonality evidence available for occupation at Polderweg during several months in the winter period (see Louwe Kooijmans 2003; Appendix I), indicates that these wetland sites formed stable longer-term base camps.⁷⁴ These may have been part of a system in which wetland margin sites played a complementary (summer?) role. The existence of such sites is suggested by locations in the wetland margin such as Maaspoort (see Louwe Kooijmans 2001^a). The presence of tools such as axes and worked pieces made of auroch bone and the relative absence of this species in the unworked bone assemblage as documented at Polderweg supports the idea of non-local hunting or procurement (Louwe Kooijmans *et al.* 2001^b).

A combined system?

The implications of the existence of diverse and potentially complementary strategies points to the possibility of combined mobility strategies, perhaps including different regions and a more or less distinct aquatic component. Such a system would be attuned to the spatio-temporal consistency and predictability of the environment. In other words when 'risk' and 'cost' of moving are high, it is likely that hunter-gatherers will opt to remain longer at locations with a more predictable level of resources and use logistical means to obtain additional food or resources (see Binford 1990, 132; Kelly 1992, 47). Binford (1990, 131-132) also relates the increased use of aquatic resources to the effective temperature and the patchiness and productivity of resources. From this expectation it follows that: '*aquatic resources are the target of exploitation for winter stores.*' Wetlands and to a lesser extent floodplains could thus have been specifically used as buffer environments in the lean seasons.

Such a difference in sustainability of environments may also have had repercussions for group size. According to Kelly (1992, 47) hunter-gatherer social units can have an extremely fluid composition. Groups may split in order to relieve

social tension often caused by subsistence stress. This is largely dependent on the degree to which everyone's subsistence is dependent on the same resource.

Implementation: potential complementary systems

As argued earlier the specific taphonomic characteristics of the studied sites preclude an in depth analysis of (regional) procurement strategies and seasonality. The available information is limited.

While for the Polderweg site the use of a winter base camp during phase 1 is confirmed (*e.g.* Louwe Kooijmans 2003), evidence for a similar use of coversand and river valley sites is very limited. It has been argued that the coversand (peat fen) area was used seasonally (*e.g.* Crombé *et al.* 2011^b, 468; see also Vermeersch (1989), but there is little archaeological evidence for this as most organic seasonal indicators are not preserved. Finds of hazelnut at for example Weelde-Paardsdrank or Jardinga may point to a presence in autumn, but the limited numbers and the fact that hazelnuts are suitable for storage (see Cappers/Ytsma 2002/2003) prevent a clear seasonal indication. At the river valley site of Liège-Place St.-Lambert (sector SDT and DDD), there are, however, minor indications for a predominant presence in deep winter and early spring, based on a study of the eruption of teeth in wild boar and the characteristics of the antler fragments found (see López-Bayón 1994, 133). Clearly a strong and consistent seasonal signature, as could be established for the Hardinxveld sites, indicates a strong association, between place, time and activity. If the weaker information at Liège is interpreted along the same lines, this might form an indication for a strategy whereby wetland or floodplain environments were used specifically in winter.

Arguably the stable character of wetland resources would also have allowed for a larger group size. In this respect Louwe Kooijmans (2003, 619) argued that several households or a microband might have inhabited Polderweg. Kelly (1992; 1995) further indicates that regular, non-aggregated, groups of hunter-gatherers comprise *c.* 25 individuals. Aggregation might occur in order to maximize the exploitation of aggregated resources, such as for example fish. Predictability also forms an important factor (see Kelly 1995, 214-216). Apart from fish and migratory species of birds one could also envisage seasonal migration of species such as red deer in this respect (see also Brouwer 2011; 2013; Jochim 1976).

In case a combined system of mobility existed, it is thus likely that group size was larger in the wetland or wetland margin settings, compared to dryland locations. Smaller groups and more frequent, but short visits would be in line with the erratic and homogeneous patterning of Late Mesolithic sites in the southern and perhaps northern coversand area. The artefactual similarities between the river valley sites and the upland coversand locations in the south and the way these differ from wetland sites such as Polderweg and De Bruin, may, amongst others, relate to a difference of degree in intensity or duration of wetland or floodplain occupation. In the latter case, of the Hardinxveld wetland sites, it is evident that the occupation lasted at least several months and may have been combined with a wetland margin setting such as that of Maaspoort where seasonal occupation is plausible as well. This, in combination with evidence for investment in aquatic technology (canoes, paddles, fish weirs etc.), argues in favour of a strong emphasis in wetland occupation and aquatic orientation of these communities. When hypothesizing a similar model involving sites in the (southern) coversand landscape and (Meuse) river valley sites the current evidence points to a more

distinct terrestrial component, at least for a significant part of the year when communities moved between sites in the coversand landscape, and a more limited floodplain aquatic orientation during sojourns in river valleys.

Modeling mobility

The available evidence for the studied sites only allows for a hypothetical modeling of both of the situations sketched above. These hypothetical systems have been depicted in fig. 5.43.

The upper section demonstrates the potential relationship of two mobility cycles (A-H and I-Q). It consists of a residentially organized system with frequent moves between habitation or exploitation areas and fewer, mainly logistically organized stays in the river valley. These may have been especially attractive in the leaner winter season and allowed for greater aggregation. Note the larger logistical range in the river valley as opposed to the coversand area.

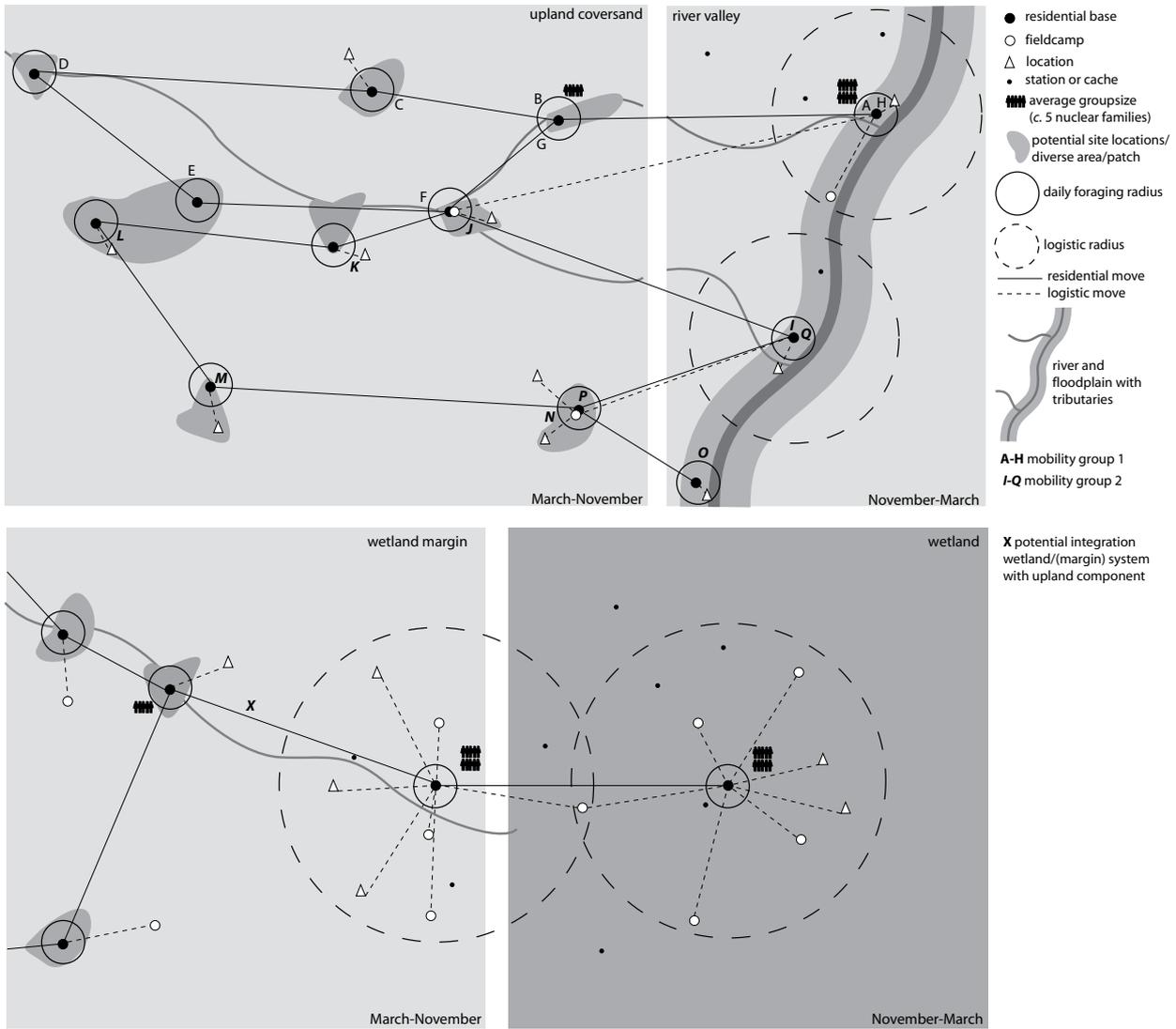
The lower section depicts a logistical system, based on the Hardinxveld sites, in combination with a wetland margin location (as the aforementioned Maaspoort site). Both sites were inhabited seasonally during several months. Exploitation of the environment was distinctly logistical and focused on the central sites. Other site types such as fieldcamps and caches are more dominant features of this type of settlement system, although distinct evidence for these types of sites has so far not been documented for the Late Mesolithic.⁷⁵ The wetland margin sites enabled a continued exploitation of the wetland area as well as the upland hinterland. A potential combination existed with a residentially mobile system (X). This could be envisaged when part of the group would split and lead a more mobile existence, for instance focusing on terrestrial hunting, in the summer months.⁷⁶

Of course both systems remain simplified models and reality, including diverse relationships of exchange and interaction, is infinitely more complex. They demonstrate the existence of two different and potentially complementary systems of habitation that may be substantiated by the character of the sites documented, especially when contrasting sites on the coversand with distinct wetland locations such as those of Hardinxveld.

5.6.6.3 Diverse systems of mobility: other approaches

It can be concluded that despite the deficiencies in the data available there are clear indications for diversity in the uniformity of the Late Mesolithic. The characteristics of some of the landscape and ecological settings defined argue in favour of different mobility strategies and economic emphases, and, in turn, of diversity within Late Mesolithic groups. These are most distinctive between sites in the coversand landscape (especially those on the southern coversand such as the Campine region) and typical wetland locations such as the Hardinxveld sites. These conclusions are supported by the scaled approach presented in the analysis. The lithic comparison in particular provides a comparative perspective that is only influenced by site formative processes to a limited extent.

The emphasis in this study of Late Mesolithic sites was placed on diverse structural and artefactual aspects of (mainly) excavated sites. A number of other types of studies have partially supported the perspective offered. These will now be briefly discussed



Isotopic perspectives

Research into the isotopic signatures of bones of Mesolithic hunter-gatherers in the upland area of the Meuse Basin clearly indicate the predominance of terrestrial resources (Bocherens *et al.* 2007) in comparison with for example hunter-gatherers in coastal and wetland settings, including those at the Hardinxveld sites (Richards *et al.* 2003^{a,b,c}; Richards/Schulting 2006^{a,b}; Smits/Louwe Kooijmans 2006; Smits *et al.* 2010).⁷⁷ Since this reflects on the emphases in diets it largely confirms the distinctions made earlier, especially if the upland Meuse Basin area and the coversand areas may be deemed similar in terrestrial nature. While it is not possible to demonstrate that the differences recorded for the sites analysed above in fact relate to different Late Mesolithic groups with different subsistence strategies on the basis of the data available, it is likely that there was a considerable degree of variation, which would also be reflected in isotopic signatures as supported by the studies mentioned above. On a gradual scale there probably were groups more oriented towards the exploitation of wetlands and groups with a larger terrestrial component.

Fig. 5.43 Hypothetical model of combined mobility cycles in upland coversand and river valley settings as well as wetland and wetland margin settings.

A diachronic perspective

Recently Crombé *et al.* (2011^b) have also discussed aspects of hunter-gatherer diversity based on a study of Final Palaeolithic to Final Mesolithic land-use in northwest Belgium from a diachronic perspective. They indicate the existence of a sequence of human responses to environmental change during the Pleistocene-Holocene transition. Over time regional site densities and mobility tended to decrease, while site size increased and hunter-gatherers in the later Mesolithic tended to favour wetter locations along rivers in relation to the increasing water table as a result of the inundation of the North Sea (*ibid.* 454, 468-469). They also argue that there is evidence for frequent reoccupation of locations and rapid mobility in the earlier Mesolithic and indications for an increased spatial structuring and more rigid organization of residential sites in the Middle and Late Mesolithic (Crombé *et al.* 2011^b, 454, 469; see also Amkreutz 2009).

As noted by Crombé *et al.* (*ibid.*) there appears to be a contrast between the diachronic land use trajectories in Sandy Flanders and the southern Netherlands, whereas Verhart (2008) notes a contrasting development and potential decrease in complexity and larger sites over time. One could question whether these regional differences arise from different choices made by different bands of hunter-gatherers, or the same group executing different mobility strategies in different landscapes.

Although interesting new trends are outlined, the nature of the research conducted is of a large chronological and general scale and mainly based on surface survey sites. Where Crombé *et al.* (2011^b, 467) detect a general trend towards decreasing mobility over a long time span and an increase in prolonged residential positioning, this study demonstrates and adds that reality is even more complex and that even within the Late Mesolithic there is much variability to be accounted for. Different groups of hunter-gatherers made variable and flexible use of a diverse set of environments and a number of co-existing or even complementary mobility systems may have been in use at the same time. The study by Crombé *et al.* (2011^b) does, however, support the main argument presented in this study, that the focus on aquatic resources and a wetland setting distinctly influences site use and mobility patterns.

A modeled land-use perspective

A complementary point of view, along the lines of earlier studies (*e.g.* Jochim 1976), was provided in a recent study focusing on modeling the economic potential and environmental characteristics of different environments in the central river valley area (roughly the delta area, eastern river valley area and adjacent Pleistocene uplands) in the Netherlands with Mesolithic sites dating to the Early, Middle and Late Mesolithic (Brouwer 2011; Brouwer-Burg 2012). The aim of the study was to detect whether the changing environment of the lower Rhine river valley which in 4000 years (between 10,000 and 6000 cal BC) shifted from polar desert [sic] to closed Atlantic forest with a deltaic environment also linked to changes in human behavior (Brouwer-Burg 2012, 25). A multi-criterion decision-based model was devised for three case-study areas and landscape reconstructions were made for 500 and 1000 year intervals (Brouwer-Burg 2012, 25; Brouwer 2013). This was combined with decision-making objectives and criteria that influenced how people mapped themselves onto landscapes in view of resource acquisition strategies and settlement placement practices (*ibid.*; Binford 1980).

Important behavioural rules that were defined included securing sufficient subsistence and raw material resources, while minimizing risk (see also Kelly 1995). What was deemed the most important criterion for site location choice involved finding reasonably dry locations with ample shelter (Brouwer-Burg 2012, 26). The subsequent modelling that took place focused on a number of adaptive foraging and collecting strategies with respect to large game, non-specific or wetland resources. These were subsequently combined with the modelled landscape for 25 x 25 km surface units and analysed for suitability, which was then compared to the archaeological evidence available (*ibid.*, 27).

The model confirmed the notion also mentioned here and in ethnography (see Binford 1990) that distinct wetland habitats were best exploited through a collector-type strategy. According to Brouwer-Burg (2012, 27) this accords well with the archaeological evidence from the Hardinxveld-Giessendam sites (see also Amkreutz 2009 for similar conclusions).

The study indicated that an inverse relationship exists between the patchiness of an area and the degree of organizational flexibility of hunter-gatherers in terms of procurement and mobility strategies (Brouwer-Burg 2012, 27). Highly patchy and heterogeneous habitats, such as wetlands, allowed only a small amount of organizational flexibility, were best exploited through collector strategies, characterised by decreased residential mobility and increased storage. Satellite-type configurations of camps should be expected with multi-family bases anchoring the settlement system. Conversely, areas with low patchiness and homogeneously distributed resources allowed hunter-gatherers far more leeway and enabled them to switch back and forth between collecting or foraging strategies. This may have involved fluid group membership and aggregation and fissioning occurring on an *ad hoc* basis. Settlement patterns are expected to be less 'neat' than in wetland contexts (*ibid.*, 28).

Different lines of evidence

The studies mentioned above differ in approach and data. To compare them directly would neglect the pitfalls existing in the analyses themselves (*e.g.* Bickle/Hofmann 2007; Milner *et al.* 2006) and the limited detail provided by long-term perspectives and modelled landscapes. In the last study the discussion on the 'patchiness' of landscapes for instance (see also Kelly 1995) should focus on contemporaneous areas and generates questions about what patchiness means. It is likely that the distribution, type and seasonality of resources coalesce into interesting regional combinations with characterizations that may either be homogenous, heterogenous, or both at the same time. Despite these shortcomings they fit the general approach adopted above with respect to the distinction between wetland and upland type of mobility and settlement system. In view of this, future research would benefit from a more close combination between these different sources of information in order to be able to present a complementary and more holistic idea of past behaviour.

5.6.6.4 Conclusions on mobility and settlement system

The approach of this study, comparing different scales of evidence for Late Mesolithic sites in the LRA, with respect to settlement location choice, site structure and lithic assemblage composition, clearly points to diversity in the way these hunter-gatherers used the landscape. Although not all sites yielded

qualitative information, it was possible to elucidate one general distinction. This distinction is based on the contrasts existing between sites situated on the southern coversand, mainly in the Campine area (as well as a number of sites on the northern coversand) and those in true wetlands, most notably, in this case, both Hardinxveld sites in the western part of the Dutch delta. Differences with respect to site location choice, site structure and investment in facilities were complemented by differences in the characteristics of the lithic toolkit. These pointed to a more expedient technology and structured site use and investment at wetland sites and a more curated technology and short-term, less structured behaviour at the upland coversand sites. At the latter sites the fabrication of lithic hunting equipment (points) was also distinct. Furthermore the role of the Wommersom quartzite and its distribution pattern may be interpreted in relation to its qualities for making reliable components within a (curated) toolkit. Taken together these different strands of evidence support the existence of different mobility and settlement systems. For the (southern) coversand sites a forager-type mobility system is suggested while the wetland occupation may best be characterised by a collector-type of mobility system (see also Binford 1980; 1982). These would fit the general landscape characterizations presented earlier. Activities on the (southern) coversand may have been more aimed at the hunting of terrestrial fauna, with increased mobility and movement between locations offering an expected range of resources (see also Crombé *et al.* 2011^b, 467). The aquatic wetland environment (see also Nicholas 2007^{a,b}) offered far more opportunities for longer stays, lowered mobility and favoured a collector-type of mobility system.

Information for sites in the other defined groups is more limited. Based on the available data it is likely that the northern coversand landscape due to similarities in natural environment and landscape, may have offered similar opportunities for occupation as the southern coversand landscape. Hearthpit sites and other sites may be interpreted along similar lines, although certain differences in their location and the existence of hearthpits as such should be taken into account with respect to for instance site function and occupation duration. In contrast the river valley sites around Liège and to some extent the wetland margin sites (for instance Hoge Vaart and Swifterbant) point to similarities, albeit on a lesser scale, with wetland sites. Especially the sites around Liège point to investment in places, structures and activities such as fishing. The sites and information available are, however, not sufficient at present to further elucidate these similarities.

To what extent the sites functioned in settlement systems is difficult to attest. For the winter occupation at the wetland sites of Hardinxveld it is plausible to assume a complementary wetland margin counterpart for occupation during the summer half of the year. It is also possible that groups may have split up and effectively combined aspects of mobility systems (see also Brouwer-Burg 2012). Based on similarities in lithic toolkit composition such a hypothesis has also been generated for the southern coversand landscape in tandem with sites situated in the river valley (*cf. supra*). It is plausible to assume that the delta and river valley wetland locations in particular offered an interesting site location choice in the lean winter seasons, when aquatic and associated resources could complement the diet.

Finally, there is little information regarding the extent to which systems of mobility differed, whether they could operate complementarily or were rather archetypical for most of the mobility and settlement system of a group. Overall

the degree of investment in wetland occupation as witnessed at the sites of Hardinxveld is distinct and points to communities that for an important part of the year lived in, invested in and focused on exploiting these wetland areas and did so for a considerable time. This indicates that a combination with an opposite and diverging lifestyle such as the one posed for the southern upland sites appears less likely, especially taking into account the distinct differences in toolkit composition and raw material procurement, housing and mobility. While the flexibility in these communities to combine and adopt different types of mobility and resource procurement should not be underestimated (*e.g.* Lovis *et al.* 2006^b), the wetland and coversand sites presented here should perhaps best be understood as opposite ends on a hunter-gatherer settlement system continuum. These ends do not preclude combinations, as sketched earlier, but do support the existence of certain emphases that characterise the communities involved and define the diversity present.

5.7 Implications for Neolithisation

It is increasingly clear that the study of the food producing transition requires understanding the foraging populations that formed the context of the transition... Further, the relationships between early horticulturalists and foragers are likely to involve connections which constrain and shape the decisions of both... Existing adaptive diversity among these [forager] groups ensured that decision-making was variable in the face of agriculture arriving...'(Madsen/Simms 1998, 258-260).

In this final section the repercussions of the diversity sketched will be briefly interpreted with respect to their importance for understanding the process of Neolithisation in the LRA. Since the data is qualitatively limited and data-points (sites) are relatively few and far between only some preliminary remarks are in place.

5.7.1 Theoretical background: Mesolithic influence and complexity

In detecting diversity with respect to Neolithisation, the main premise is that the differences in character between Late Mesolithic groups will have contributed to differences in development of the process of Neolithisation. In this respect it was argued by Zvelebil (2004^b, 45) that the direction and pace of farming reflects as much the existing Mesolithic social context as it reflects the conditions of Neolithic communities and regional ecological circumstances. Another important factor in relation to this is the actual distance involved in the interaction between hunter-gatherers and early farmers. This will also be touched upon below.

The role of complexity

In the past the discussion regarding the 'influence' of the Mesolithic substrate on Neolithisation focused on the multi-faceted topic of complexity. Over the years many scholars have tried to define complexity, which mainly refers to aspects of social organisation with repercussions for group size, subsistence, mobility and social 'stratigraphy' (*e.g.* Keeley 1988, 373; Neeley/Clark 1990; Price/Brown 1985, 4-7; Testart 1982, 523). Based on a wide array of ethnographic studies a number of causes (often demographic and environmental pressure or societal

change), consequences and conditions have been identified (Price/Brown 1985). Important changes associated with increasing complexity include intensification of production and technology, changes in the settlement system (reduction of mobility) and different structures of decision making, or increased hierarchy and differentiation (*ibid.*; Keeley 1988, 404; Kelly 1995). Archaeological discussions regarding complexity mainly focused on the Scandinavian Mesolithic and the development of the Kongemose and Ertebølle communities, often in relation to the importance of marine exploitation (Andersen 1994; 2004; Bailey/Milner 2003; Grøn 1987; Larsson 1990^a). It has been argued that an increased dependence on aquatic resources and increased complexity could have facilitated the adoption of farming due to increased sedentism, reduced risk and logistical strategies of procurement (Price 1996, 359). Others have argued that the same factors might have prevented hunter-gatherers from going over, 'buffering' any necessity to do so (*e.g.* Binford 1968; Price 2000^c; 2003; Rowley-Conwy 2001; Zvelebil/Lillie 2000).

Abandoning complexity

Over the past years the polarized debate concerning complexity among hunter-gatherers has been nuanced. Rowley-Conwy (2001) points out that there is no evolutionary trend from egalitarian OAS groups (Original Affluent Society) towards more complex groups of hunter-gatherers and criticizes the theoretical underpinnings of the above-mentioned causes of complexity. He also argues against the idea that complexity would form a logical step towards agriculture (as for example stated by Hodder 1990). Drawing amongst others on case-studies dealing with the Jomon culture, the Natufian and more recent groups of Arctic hunter-gatherers it becomes clear that (aspects of) complexity need not necessarily lead to incipient agriculture (*ibid.* 58-64).

For the LRA there is virtually no evidence for complexity among hunter-gatherers (*e.g.* Verhart 2003, 442; see also Raemaekers 1999, 184), although this depends on the extent to which the classical denominators of complexity are used and interpreted (see also discussion in Crombé *et al.* 2011^b). There is little or no evidence for status differences, specialisation, a rich ornamented material culture, cemeteries or a sedentary lifestyle. Yet, despite the extent to which taphonomy has rendered the identification of some of these factors impossible, the existence of characteristic differences between communities of Late Mesolithic hunter-gatherers with respect to settlement, mobility and food procurement has been demonstrated. These differences arose as a result of different necessities in adaptation (see also Rowley-Conwy 2001).

5.7.2 Interpreting diversity and Neolithisation

The above means that the aim is to define, or postulate to what extent the diversity existing would have facilitated aspects of Neolithisation. As argued above the main difference was that between the upland coversand area with its terrestrially oriented, residentially mobile communities and true wetland locations characterised by an aquatic economy, increased site investment and lowered mobility. Although there will have been a gradual transition between delta-based communities with an important wetland component and upland communities with a more limited

wetland component, the characteristics of the communities towards either side of the spectrum will probably have formed a variable background with respect to the development of Neolithisation.

As evidenced by a number of archaeological and ethnographic studies, the economic potential and buffer capacity of wetland areas is substantial (Binford 1990; Nicholas 1998^{a,b}; 2007^{a,b}; Van de Noort/O'Sullivan 2006; Zvelebil/Lillie 2000). As a basic hypothesis one could propose that in the absence of stress over area (territory) or resources, the characteristics of wetland settings offer a reliable and rich background for hunter-gatherer communities and no economic incentive to adopt aspects of agriculture. In line with this it was argued by Binford (1990, 149) that aquatic resources would first be used under conditions of demographic packing, while agriculture would only appear after substantial periods of time. In settings with little aquatic potential relatively quick moves directly towards agriculture could be expected under packed conditions. Apart from the qualities of the environment, Binford distinctly adds a factor of stress (demographic or resource related) to the mix.

In light of these considerations the LRA situation may now be characterized.

5.7.3 Aspects of diversity and distance

A crucial factor of importance involves distance, combined with intensity in contact and a potential pressure or stress with respect to resources. These factors in combination with the characteristics of the communities involved defined the trajectory of Neolithisation in the LRA.

A southern perspective

While some of the wetland communities were already in contact with fully Neolithic farmers from early on (Louwe Kooijmans 2003; 2007^a) as attested by the exchange of objects such as flint and later on pottery and *Breitkeile* (Raemaekers *et al.* 2011; Vanmontfort 2008^b; Verhart 2012), interaction was most likely indirect and not regular. Interaction will have been more direct and probably intensive in the south due to the immigration of LBK farmers into the loess area there around 5300 cal BC. Although the evidence is limited (Amkreutz *et al.* 2009) interaction may have been of a mutual or antagonistic character (Gregg 1988; Vanmontfort 2008^a). Of importance will have been the extent to which their livelihood as hunter-gatherers could continue. Continuation of terrestrial hunting and possibly seasonal floodplain use might over time have become fraught with competition over resources. The focus of these communities on terrestrial species in combination with the unpredictable and dispersed character of their distribution would have necessitated a higher degree of mobility and frequent moves (Crombé *et al.* 2011^b, 467), making them more vulnerable to competition.

While there are indications for avoidance and conflict in some areas (see Golitko/Keeley 2007; Vanmontfort 2008^a), overall there is little evidence on the nature of interaction, including the role played by groups such as the La Hoguette communities (*e.g.* Manen/Mazurié de Keroulin 2003). Despite developments noted for western Flanders with respect to site use and structure (Crombé *et al.* 2011^b) there is no evidence for distinct changes in behaviour or economy for Late Mesolithic sites over time (for instance those incorporating 'Final Mesolithic' elements such as LBK-like points). This may point to a continued consistency in

mobility and subsistence during the introduction of agriculture in the area. The actual shift towards an agricultural existence may therefore have been of a short-term nature when economic or social (see Verhart 2000) competition arose.

The evidence for the degree and nature of interaction between the hunter-gatherers in the south and the Neolithic arriving there is limited. After the sudden collapse of the LBK communities and somewhat later the Blicquy communities in the southern loess zone, new qualitative evidence for occupation dates mainly to the Middle Neolithic Michelsberg culture. This type of Neolithic is characterised by a different type of settlement system, including central sites and flint mines. Apart from the loess region other areas (sandy soils, Meuse valley) are now occupied as well. This also points to changes in the agricultural system and crop spectrum (e.g. Vanmontfort 2004; see also Bakels 2003; 2005; Crombé/Vanmontfort 2007; Lüning 1968; Schreurs 2005; Verhart 2000). This type of settlement system and economy was probably better adapted to settle and farm other areas compared to the more rigid extensive LBK economy (see also Bogaard 2004). It is generally accepted that by the end of the 5th millennium the Mesolithic and Neolithic lifeways south of the Rhine-Meuse delta and in the Meuse valley had coalesced into the Middle Neolithic Michelsberg culture. This shift echoes other shifts towards the Neolithic in Europe, particularly in Great Britain and Scandinavia (Price 2000^b; 2003; Sheridan 2004; 2007).

A wetland perspective

This development contrasts with the well-documented steps in the development of Neolithisation in the wetlands of the LRA. As argued above the communities there came into contact with the farming communities from early on. The evidence available indicates a very slow and gradual transition, starting with the procurement of foreign flint and artefacts, through the piecemeal introduction of pottery and domesticates to experimentation with crop cultivation (see De Grooth 2008; Louwe Kooijmans 1998^{a,b}; 2007^a; 2011; Out 2009; Raemaekers 1999; Vanmontfort 2008^b). At no stage is there evidence for drastic change or the sudden introduction of elements of the Neolithic package. While they thus engaged in interaction, the effects on society were probably less intense, indirect and, importantly, self-imposed.

The above-mentioned factors, distance and intensity of contact as well as the applicability of 'upland' farming to these areas, are defining characteristics of the development of Neolithisation in this area. Crop cultivation in many of the wetland areas (excluding the coastal ridges and upland margins) could only take place on a limited scale (see Bakels 1986; Out 2009). Furthermore as argued above the wetland communities had a lower residential mobility and a stable resource base which incorporated aquatic resources. This allowed for the investment in traditional settlement locations and territoriality. This position of relative wealth and stability might have mitigated the need to incorporate other resources or intensify contact (*contra* Price 1996). Everything points to a very gradual and *internally* controlled introduction and a process whereby much of the character of the initial Late Mesolithic communities remained unchanged for a long time.

5.7.4 Conclusion: diversity and Neolithisation

It is more than likely that the differences that existed between Late Mesolithic communities of hunter-gatherers in the LRA, aspects of which have been demonstrated above, will have significantly contributed to the eventual outcome of the process of Neolithisation. In general this resulted in two different trajectories of Neolithisation.

In the south the interaction with the LBK and subsequent Neolithic groups ultimately led to the disappearance of hunter-gatherer communities with the development of the Middle Neolithic Michelsberg culture (see Vanmontfort 2004; 2007). Interaction and contact could have swiftly led to acculturation, transformation or abandonment of previous lifeways, especially if competition over resources or territory, combined with economic or social incentives were a factor in this. The proximity between farmers and foragers could have placed a strain on resources and space, at least in some areas. Becoming a farmer or moving away were probably the two main options and eventually the decreasing margins for the latter and the benefits of the former will have brought about the end of a purely hunting and gathering existence. Unfortunately the archaeological resolution of contact and interaction in the south remains limited, preventing a proper analysis and comparison (*cf.* Amkreutz *et al.* 2009).

The wetland and wetland margin areas are characterised by a different trajectory. The impact that the Neolithic had and the change it brought was absorbed and incorporated much more gradually. One factor will have been distance; it is only after the Early Neolithic that the upland coversand areas bordering on the delta and the northern wetland areas were inhabited by agricultural communities. Another factor must have been suitability. The dynamic aquatic environment will not have been suitable for large-scale agriculture. Furthermore the agricultural system of the Early Neolithic (LBK and Rössen communities) only gradually developed into a more mobile, flexible and versatile system in the following centuries. Last but not least the communities of originally hunter-gatherers living in these parts will have formed an important factor in determining what new knowledge, practices, techniques and products would have been acquired and incorporated. Much points in the direction of a very gradual and internally controlled introduction. The characteristics of these developments, the communities living in these wetland areas and their long-term relationship with their surroundings (landscape and environment) will form the focus of the following chapters.

Notes

- 1 Important in this respect are for instance the !Kung San points reported on by Wiessner (1983) that potentially signify a strong regional identity, while on the other hand the almost complete absence of trapezes at the stratified Late Mesolithic wetland site of Polderweg (Van Gijn *et al.* 2001^a) may very well relate to functional issues, such as an economy focused on wetland exploitation.
- 2 It should be noted that in Belgium the Swifterbant culture is more often classified as Final Mesolithic, whereas in the Netherlands 'Neolithic' is more often used (*e.g.* Crombé/Sergant 2008, 76).
- 3 It is argued here that the meagre evidence existing for violence and conflict rather reflects the repeatedly documented intra-cultural violence between LBK communities (*e.g.* Price *et al.* 2006), than perhaps incidental conflicts with hunter-gatherers.
- 4 For further information regarding La Hoguette, Limburg and *Begleitkeramik*, the reader is referred to the following publications: Aimé/Jeunesse 1986; Amkreutz *et al.* 2009; Bakels 1992; Behre 2007; Van Berg 1990; Brounen 1999; Brounen/Hauzeur 2010; Brounen *et al.* 2010; Constantin 1985; Constantin *et al.* 2010; Gehlen 2006; Heinen 2006; Jeunesse 1986; 1987; 1994; Kalis *et al.* 2001; Lüning *et al.* 1989; Manen/Mazurié de Keroualin 2003; Modderman 1974; Schütz *et al.* 1991.

- 5 In this respect it should be questioned though to what extent radiocarbon dates and numbers of sites form proxies for population dynamics.
- 6 The site of Doel-Deurganckdok is not included despite its roughly similar position on a coversand ridge when compared to Melsele. This is based on the fact that the hearthpit features date to the transition of the Middle to Late Mesolithic (Van Strydonck/Crombé 2005). The Late Mesolithic trapezes, Montbani blades and Wommersom quartzite probably date to the same period as the Swifterbant pottery (Crombé *et al.* 2000). There is therefore not enough evidence to isolate an unambiguous Late Mesolithic occupation or set of artefacts.
- 7 During the Neolithic the landscape consisted of dry and sandy ridges of up to 10 m wide and of humid lows. One of these (depression B) may have contained the actual stream of the Scheldt (Parent *et al.* 1987^a, 7-9; see also Parent *et al.* 1987^b).
- 8 During the completion of this manuscript a new site was discovered at Well-Aijen. Preliminary research at this location in the form of contract archaeology demonstrated an interesting potential. Atop an old Meuse stream ridge a number of Mesolithic and Neolithic sites was discovered. Some of the sites demonstrated the existence of internal stratification. Furthermore, an ancient gully fill may shed light on the ecological and organic component of this type of occupation next to the Meuse. The site promises to yield interesting data on the Mesolithic occupation next to the Meuse at different time intervals including the Late Mesolithic. Furthermore there are indications for Early Neolithic and early Middle Neolithic occupation of Bischheim and/or MK affiliation. The site has only been investigated preliminarily with additional fieldwork planned between 2012 and 2014. The RCE has valued the site as being of regional and national importance (see Appendix I).
- 9 Models for the Mesolithic in Northeast Belgium indicate that, next to continued occupation locations near peat fens, there is an increase in settlement locations near streams in the Late Mesolithic. This might be correlated to the increased and more permanent discharge of lowland rivers from the Boreal onwards, making these reliable sources of water. It should however be noted there is an average error in the modeling of *c.* 200 m in determining the actual location of sites (Vanacker *et al.* 2001). For the region of Sandy Flanders Crombé *et al.* (2011^b, 463) indicate a more general move towards wet places in the Late Mesolithic.
- 10 This resulted in the asymmetric shape of the dunes and water situated on one side (pers. comm. B. Vanmontfort 2012).
- 11 No intensive study has been undertaken yet on correlating the location of Late Mesolithic sites with outcrops of rolled nodules from fluvial deposits or the main terrace underneath the Campine plateau. This would form an interesting avenue of research for gaining a better understanding of the motivations underlying settlement location choice (see also Van Gils/De Bie 2008).
- 12 At Liège-Place St.-Lambert these were fossil channels of the Légia, at Remouchamps-Station LeDuc a smaller channel associated with the Amblève and at Namur the site was situated at the actual confluence of the Meuse and the smaller Sambre (*e.g.* Gob/Jacques 1985; Mees *et al.* 1994; Remacle *et al.* 2000). The former site was situated at the exact point where the Légia crossed the small valley of the Pierreuse and entered the wider floodplain of the Meuse (see Van der Sloot *et al.* 2003, 81). Remouchamps-Station LeDuc was positioned at the point where the Amblève emerged from the Ardennes Massif and entered the wider floodplain before joining the Ourthe (Gob/Jacques 1985, 163-164).
- 13 The moving average method is a filter technique supported by Surfer 8.0. Using grid-based data the technique averages the counts of adjacent cells in order to 'smoothen' possible taphonomic or methodological inconsistencies. The segments selected for smoothening can be adjusted, for example for 2 x 2 or 3 x 3 m intervals. To prevent a biased averaging of neighbouring cells (disproportionately favouring and enhancing low counts in proportion to high counts), there is the possibility of adding a weight to the selected cells. Used in this way the smoothening technique is very suitable for detecting and revealing trends in distribution patterns (see also Wansleben/Louwe Kooijmans 2006). The technique is not useful for analysing spatially limited excavations. Problems related to the limited extents of excavations have been noted by *e.g.* Hodder/Orton 1976 and Czielska 1990^{a,b}).
- 14 Although it is not possible to prove the existence of a clearly delimited Late Mesolithic and Early Mesolithic zone, the existence of the former is reasonably well established through the distribution of trapezes and several groups of raw material as well as through refit data (see Verhart 2000, 69-123). In this sense the Late Mesolithic delimitation is accepted here. Since the different concentrations (Verhart uses the term clusters) form functionally different and related aspects of what was supposedly one site, the combined extent of these and their accompanying scatters is taken as the site extent. The resulting scatter is of a roughly ovoid shape. While Verhart (2000, 116 and fig. 2.26) defines five concentrations within the Late Mesolithic zone, three of these are accepted here. Concentration 5 is related to a combination of backed blades and might therefore be evidence of an event of abandonment (of a composite tool) (*ibid.* 123). It is however not of any dimensional value and therefore cannot be defined as a concentration here. Despite their isolated occurrence concentrations 3 and 4 are taken together here because of their spatial proximity and functional

correspondence. Although there is no conclusive explanation for interpretation of the empty zone between both clusters (*cf. ibid.* 126), it is believed here, also considering the distribution of finds surrounding the concentration, that both likely formed part of one whole. The empty space might have a taphonomic or functional explanation. Finally concentration 6 is added, consisting mainly of burnt flint associated with hearth 4.

- 15 This problem also occurs at sites where finds have been recorded three-dimensionally. The effects of bioturbation and superposition not only hamper the definition of spatial clusters as such, but also their delimitation, even at those few locations where all finds (instead of a selection) are point-referenced such as at Brecht-Moordenaarsven (Vermeersch *et al.* 1992, fig. 23). As was argued in the preceding, the use of statistical analyses can often do nothing to further unravel this.
- 16 The terminology including concentrations, clusters and scatters is often used indifferently. Here the terms have spatial connotations and are characterised by a difference in density.
- 17 Unfortunately the quantity and density of lithic remains proved less helpful in delimiting and characterizing concentrations. No counts were available for the individual concentrations selected. Artefact counts per excavated sector or trench moreover yielded highly variable results. This can partly be explained by taphonomic conditions and excavation strategy, but may also reflect occupation intensity. For example, at Helmond-Stiphoutsbroek (Arts 1994) the artefact density in the only trench (of 224 m²) that yielded a concentration amounted to 0.77 artefacts per m², while the density of sector 1 at Weelde-Paardsdrank (129 m² and containing 3 concentrations) amounted to 51 artefacts per m², when only counting the *in situ* remains. The low counts at Helmond may relate to the location of the trenches south of the main concentration of artefacts in combination with the mechanical removal of the medieval arable layer.
- 18 At Merselo-Haag a distinction could be made between concentrations 1 and 2 dominated by debitage activities, and concentrations 3 and 4 with evidence for retooling, maintenance, processing and consumption (Verhart 2000, 116), all within 9 m of each other.
- 19 The presence of burnt flint and charcoal in the activity areas at Merselo-Haag cannot be directly related to the hearths in view of their disparate distribution (Verhart 2000, 79). Although this may be explained taphonomically it is also likely that the burnt flint and charcoal form the remnants of dumps. Meeuwen-In den Damp yielded evidence for a secondary displacement of both knapping waste and a hearth, the waste apparently being pushed outward in a centrifugal process (Pilati 2001). At Weelde-Paardsdrank sector 5 (Huyge/Vermeersch 1982, plan 7), there are several partially overlapping concentrations of organic remains (*i.e.* charcoal, burnt bone and hazelnut shells). They may be interpreted as secondary refuse, since they cannot be associated with a distinct hearth.
- 20 Binford (2002, 184-187) for instance noted an area of increasingly specialized activities away from the core residential area. Some of these activities required considerable space (dog tethers, a stone boiling hearth). He also noted specific clean-up strategies, such as preventive maintenance in order to dispose of items away from intensively used areas (*ibid.*). Such peripheral activities may often be classified as dangerous or dirty, yet it should be realised that this argumentation is based upon our *etic* perspective of these activities (Sommer 1991, 67-73). David and Kramer (2001, 259, 279) point out the multitude of motives underlying spatial separation including gender and ritual behaviour.
- 21 The project was initiated after the finishing of this chapter and initial results could due to time constraints only be incorporated to a limited extent in the appendix (see Appendix I).
- 22 Only H1:II yielded sufficient spatial information. Several spatial units can be detected within the artefact density contour pattern of this site, composed of circular shapes and measuring *c.* 1 to 3 m (see Price *et al.* 1974, fig. 4). In this sense H1:II can be understood as a cluster composed of several concentrations. Since similar clusters have been found along the circular ridge at Havelte and elsewhere an analogous situation seems to exist to the preferred settlement locations in the southern coversand landscape.
- 23 The estimated dimensions are based on both the general distribution and the extent of the trapeze distribution (see Beuker 1989, fig. 3 and fig. 32). Although the densest of concentrations can be attributed to treefalls, the remaining accumulations, as well as the distribution of the natural stone (see Beuker 1989, fig. 40), indicate the existence of minor concentrations, and hence use moments within the zones defined.
- 24 The absence of hearthpits cannot be explained taphonomically: surface hearths could have been missed on the northern sandy soils, but hearthpits would have shown up in the south. As argued earlier (Chapter 4) specific research traditions may be of influence here as well. Crombé *et al.* (1999) for instance argue that the absence of hearthpits at most of the Belgian Mesolithic sites might be due to the limited area that is usually excavated.
- 25 The description of the distribution of organic remains on page 151 does not match the symbols used in Plan 7. According to the text the lozenges in the southwest should be squares representing charcoal, while bones and hazelnuts should spatially co-occur to the north of this.
- 26 A rather questionable Mesolithic hut feature was discovered at St.-Oedenrode (Heesters 1971). It provides a clear example of the difficulties in distinguishing between anthropogenic and natural features.

- 27 It is also possible that the huts of Polderweg might have been made in treefall features (see Crombé 1993). On the basis of the fact that the documented size differs from the treefalls analysed by Newell (1980), this is deemed unlikely by the excavators (Hamburg/Louwe Kooijmans 2001, 96). However, Bubel (2002/2003) has argued that the sizes documented by Newell are remarkably homogeneous.
- 28 Cribb (1991, 84-96) gives several examples of nomadic stone-based structures, including hearths, storage platforms and dwellings.
- 29 In the case of the non-megalithic burial practices in the LRA the existing evidence of mortuary practices points to a very diverse spectrum (see Louwe Kooijmans 2007^b).
- 30 A distinct number of Late Mesolithic dog burials have been documented (see also Morey 2006). One example is the Scandinavian site of Skateholm (Larsson 1990^{a,b}).
- 31 Other cremation graves are known from the coversand area at Dalfsen-Welsum and Oirschot V, both probably dating to the Middle Mesolithic. One Dalfsen grave concerns an elderly female with possible trauma to her head. The other was a 13-14-year-old child. In both cases other bones were also found, either human or animal (Verlinde 1974). In Oirschot, located in the southern coversand landscape, important parts of the body also seemed to be missing. The concentration of the bones there suggests that they were collected after burning and placed together (Arts/Hoogland 1987; see also Louwe Kooijmans 2007^b).
- 32 The reference to Binford 1983 with the original year of publication in brackets points to the papers mentioned as compiled in the 1983 volume 'Working at Archaeology' (Binford ed.). The original publications are listed in the references as well. The page numbers refer to 'Working at Archaeology'.
- 33 No technological information was available for Brecht-Moordenaarsven 3, Tietjerk-Lytse Geast I, Havelte-De Doeze-H1-I, and Swifterbant S11-S13. These sites yielded typological information.
- 34 It should be noted that the composition is partially influenced by the fact that flakes are themselves a waste product of blade production as well as by the standards used in the initial analysis for distinguishing between both.
- 35 The technological counts of blades, flakes, cores and core elements at both Hardinxveld sites differ from the published counts due to the incorporation of tools as 'groundforms' there. This has been correlated for. See Appendix II for further details.
- 36 One could think of a limited importance of microlith production and retooling and the effects of a focus on activities such as fishing and trapping.
- 37 Excluded are Brecht-Moordenaarsven 3, Meeuwen-In den Damp 1-1b, Hardinxveld-Giessendam-De Bruin, Swifterbant-S83 and Jardinga-Johannahoeve. The site of Tietjerk Lytse Geast I has been excluded because of differences in the system of artefact recording. It is the only site for which no retouched blades and flakes have been recorded. Rather than this representing the actual situation, informal tools have been incorporated in the counts under miscellaneous (pers. comm. B. Huiskes 2007). Unfortunately this prevents a comparison of the percentage composition of the tool assemblage with other sites. For Bergumermeer some information on number and percentage of tools is available from percentage counts in Newell and Vroomans (1972) and actual counts in Huiskes (1988, table 10). Points comprise *c.* 21% of the tool assemblage, scrapers about 20 % and borers and burins 5-6% each.
- 38 Next to debitage in the *style de Montbani* (*cf.* Rozoy 1968), Montbani blades form an important and characteristic aspect of sites on the southern coversand. These blades have either one or more unilateral notches, or show unilateral and irregular secondary retouch (*e.g.* Huyge/Vermeersch 1982, 191), often on the dorsal side (Robinson 2010, 141). Retouch may sometimes be inverse or alternating and on some occasions the opposite edge is worked. Often there is a degree of lateralization to one preferred side of notches and retouch (see Vermeersch/Lauwers 1982, 16). Frequent reworking of the edges may partially obliterate the difference between notched and retouched blades (Escalon de Fonton (1979) in Huyge/Vermeersch 1982, 181). It is not clear for what purpose these blades were used exactly (*ibid.* 191), but they have been associated with an increased utilization of plant resources (Gob/Jacques 1985, 175; Price 1987, 260).
- 39 The high number of 'other tools' at Lytse Geast is related to the many miscellaneous tools identified, which will probably incorporate retouched flakes and blades as well as notched and denticulated artefacts.
- 40 Counts for retouched flakes and blades at Helmond-Stiphoutsbroek include artefacts with 'steep' retouch as well as flakes and blades with use retouch.
- 41 Microlithic backed blades or bladelets might be interpreted as small inserts in composite hunting tools (Barton *et al.* 1995, 109). They are usually discussed or interpreted in association with points and other microliths (see De Bie/Caspar 2000; Huyge/Vermeersch 1982; Verhart 2000).
- 42 The upper half of the distribution within the second group (northern coversand landscape), can partially be attributed to the contribution of backed blades to the assemblages at Nieuw-Schoonebeek and Havelte-H1-I. Since backed blades are composite tools, these may skew the distribution in the combined graph.

- 43 Montbani blades, as well as knives, have also been associated with a greater utilisation of vegetative resources (Gob/Jacques 1985, 175; Price 1987, 260). The evidence for this is, however, mainly based on their generally late introduction within the time span of the Mesolithic and is thus not of a primary nature.
- 44 There are several statistical methods for interpreting site assemblages (Andrefsky 2005; Chatters 1987; Price 1978), also from a spatial perspective (Huiskes 1988; Newell/Vroomans 1972; Newell/Dekin 1978). Most of these require more detailed analytical data, or an existing subdivision into site types. Unfortunately many approaches are based on chronologically and spatially unreliable assumptions.
- 45 These communities could be interpreted as belonging to RMS groups (see Gob 1985; Heinen 2006)
- 46 Van Oorsouw (1993, 45) also argues that some Wommersom quartzite might have been present in Meuse gravels. This, according to her, could explain a higher percentage of GQW in Southern Limburg. Crombé and Cauwe (2001, 56) furthermore identify a shift in raw material use during the Mesolithic. The source of Tienen quartzite was mainly exploited during the Early and Middle Mesolithic, while Wommersom quartzite abruptly gained importance from the Middle Mesolithic onwards. This is a further refinement of the study by Gendel (1984).
- 47 At Polderweg, phase 1 yielded 7 GQW artefacts, including several blades (Van Gijn *et al.* 2001^a). De Bruin, phase 1 only yielded one artefact of Wommersom quartzite (Van Gijn *et al.* 2001^c). Further north the site of Hoge Vaart also yielded one artefact of Wommersom quartzite (Peeters *et al.* 2001, 22-23).
- 48 Since the (either/or) composition with respect to raw material is less influenced by lower numbers than in comparison to the typological and technological range of site assemblages, both Brecht-Moordenaarsven 2 and Meeuwen-In den Damp-1-1b are included when informative.
- 49 Van Oorsouw (1993, 10) argues that the specific debitage and use of GQW in the Netherlands might have differed from that at locations closer to the source. The evidence of the Dutch sites studied here, however, still seems in line with the presented Belgian evidence. Furthermore, the dataset used by Van Oorsouw is predominantly based on surface collections, also including other periods (*ibid.* 13-14). Although the number of Dutch sites in this study is much lower, the difference in procurement of GQW, does not necessarily seem to indicate a difference in use.
- 50 Further west in sandy Flanders, grey-spotted flint was more important than Wommersom quartzite in the production of armatures (Robinson 2010, 180). It should be noted that many of the sites in this study are surface complexes.
- 51 The presence of small quantities of GQW in the form of blades or tools at considerable distances from the Wommersom source (for example at Hardinxveld-Giessendam-Polderweg and Hoge Vaart-A27) might be indicative of this character of valued and sought-after exchange commodity.
- 52 At the river dune wetland site of Hardinxveld-De Bruin, the component identified as northern flint forms *c.* 13% of the assemblage in phase one (Van Gijn *et al.* 2001^c, 161). It is questionable whether the identification as northern flint is correct. If so, it appears that since most of the important resources were located at a distance of *c.* 70 km (see Louwe Kooijmans 2001^{a,b}; 2003) and since northern flint is not necessarily of superior quality, this is more informative of a shift in resources, than of a different strategy.
- 53 At Merselo and Hardinxveld-de Bruin respectively 41 and 3 flints of Hesbaye (light grey Belgian) type have been added to this category. At Hardinxveld-Polderweg and De Bruin, respectively 27 and 1 Rijkholt flints have been added to this category.
- 54 Currently these sites would be classified as Late Mesolithic without hypothesizing contact. It should be realised that the Hageland study is based on surface collections. There is thus a chance of admixture, even though the sites have been classified as 'Neolithiserend Mesolithicum' (Vermeersch 1976, 237). Vermeersch (*e.g.* 1976, 85 *et passim*) repeatedly mentions the occurrence of white patination on artefacts of Wommersom quartzite, something absent for many of the other sites.
- 55 One exception is Helmond-Stiphoutsbroek (see Arts 1994, table 1). The contribution of GQW there is 12.5 %, including the surface survey finds. When excluded the contribution increases to over 17%. Concerning the other sites beyond 80-90 km which generally demonstrate lower contributions, it appears Helmond is an exception.
- 56 Gendel (1984) did not incorporate the available sites from the Hageland in his study, most probably because they were at the time not attributed to a Late Mesolithic *sensu stricto* (pers. comm. B. Vanmontfort 2007). Nevertheless, Gendel suspected percentages nearer to the outcrop to be similar or higher (1984, 142). It should be noted though that Gendel (1984, 152-157) at the time mainly focused on the differences in use of GQW over time.

- 57 Note that the number of stone artefacts for De Bruin and the total could not be documented due to differences in recording (compare table Van Gijn *et al.* 2001^b, table 7.1 and Van Gijn/Houkes 2001 table 7.1). The entire span of occupation is set at 1000 years since both sites existed partially simultaneously. (Data on flint and stone derived from Van Gijn/Houkes 2001; from Van Gijn *et al.* 2001^a; Van Gijn *et al.* 2001^b; Van Gijn *et al.* 2001^c. Data on distances derived from Van Gijn/Houkes 2001; Van Gijn *et al.* 2001^b; Louwe Kooijmans 2001^{a,b}; 2003; Louwe Kooijmans/Verhart 2007.)
- 58 This is not meant to suggest the absence of intra-regional site variability (see Robinson *et al.* 2008).
- 59 The following publications represent a selection: Bettinger 1999; Binford 1980; 1982; 1990; Boaz 1998; Chatters 1987; Cribb 1991; Habu/Fitzhugh 2002; Hayden 1981; Kelly 1992; 1995; Kent 1991; 1992; Lovis *et al.* 2005; 2006^{a,b}; Politis 1996; Price 2005; Price/Brown 1985; Rafferty 1985; Smith 2003; Whittle 1997; Wiessner 1982; Woodburn 1980; 1988; Zvelebil 2006.
- 60 In this system subsistence procurement occurs on a daily basis using an ‘encounter strategy’ and usually no storage of food takes place. This opportunistic manner of exploiting the environment requires limited planning depth, anticipation and technological investment (see also Chatters 1987, 337; Rensink 1995, 86). Binford distinguishes two main components within this settlement system (1980, 9): ‘residential bases’ where most activities take place and which are located in the vicinity of resources, and ‘locations’, used for extractive tasks. Base camps are moved when resource depletion takes place (see also Kelly 1995). Depending on the extents of the available resource patches, the number and distance of residential moves and the size of the groups involved might differ (Binford 1980, 5, 10).
- 61 Choices in mobility might be strategically planned, or evolve as a reaction to change. They might have an embedded, cyclical character (Binford 1980; 1983 (1979)), but can also be of a singular nature (see Kent 1992, 635-638) or change from year to year (see Jochim 1991, 311). They may be reversible (Habu 2002; Layton 1999; Layton *et al.* 1991; Rowley-Conwy 2001) and need not be purely functional (Kelly 1995, 152-153).
- 62 Often this space differentiation will be related to the privatization of space (Kelly 1992, 56).
- 63 The Mesolithic site of Maaspoort near ‘s-Hertogenbosch in the wetland margin was probably in use at the same time and might have hypothetically fulfilled a seasonally complementary function to Polderweg and De Bruin (see Louwe Kooijmans 2001^a, 459; Verhagen 1991).
- 64 While in reality ‘actual mobility’ will be hard to distinguish archaeologically from ‘anticipated mobility’, and both converge most of the time (see Kent/Vierich 1989), it does imply that the degree of investment at certain sites might be related to ‘expected occupation’. From this it also follows that certain short-term sites, such as hunting locations, or temporary camps, might see a considerable degree of investment in case of high anticipated mobility (see also Kent 1992, 639).
- 65 In the following the terms houses, housing, huts, dwelling structures and dwellings will be used indiscriminately. It should, however, be noted that the terms dwelling and dwelling structure are a more neutral terminology for these habitation structures, at least for hunter-gatherer communities.
- 66 An extensive study of Janes among the Canadian Willow Lake Dene highlighted the complexity involved in choices between using round tipis or rectangular log cabins and the intricate life histories of the latter. These were often rebuilt, moved about and replaced. According to Janes the choice for log cabins might be related to the certainty of procurement of large amounts of resources. Tipis were mainly used for ideological, aesthetic and functional reasons (see Janes 1983, cited in David and Kramer 2001, 290; Janes 1989). There is clearly no simple evolutionary development from circular to rectangular structures, but only a very general trend.
- 67 Compare: *e.g.* Andersen *et al.* 1982; Andersson 2004; Blankholm 1987; Bokelmann 1991; Bokelmann *et al.* 1981; 1985; Grøn 1995; 2003; Hamburg/Louwe Kooijmans 2001; Karsten/Knarström 2003; Louwe Kooijmans 2001^a; Newell 1980; Sørensen 1992; Warren 2005; Woodman 1985).
- 68 His dataset (see Binford 2001) consists of 293 ethnographically documented groups of hunter-gatherers yielding sufficient information on mortuary practices. The correlations recorded are of course of a general character and variability and differentiation from the norm are present.
- 69 Recently another Mesolithic inhumation was discovered at the site of Dronten-N23 (Swifterbant-Bisonweg). The burial cross-cut some of the earlier hearthpits at the location (see appendix I).
- 70 While *Sagittaria latifolia* is indigenous to North America, related species such *Sagittaria sagitifolia* have been found at for example Hardinxveld-Polderweg (see Bakels/Van Beurden 2001; Out 2009). Plants such as waternut (*Trapa natans*) might also have been harvested with the aid of canoes.
- 71 We should remain aware of over-stressing the contrasts suggested. For instance the axes made of aurochs bone documented at Polderweg must have originated from the coversand area. People may have combined both strategies to a certain extent.
- 72 Of course bow-and-arrow hunting might also comprise fowling and several fishing strategies, but aside from the fact that these will often have formed a more limited component it is questionable whether flint-tipped arrows would have been used. See *e.g.* Clark 1952 for examples of typical arrowheads for hunting birds.

- 73 The procurement of terrestrial game might still have been profitable in winter (see Kelly 1995; Kelly/Todd 1988), especially in comparison to botanical resources. Nevertheless, if aquatic resources (*sensu lato*) were available during the winter these might have formed a more predictable and stable contribution to the diet.
- 74 At Polderweg various species of fish and fowl argue for a presence at least during mid-winter, but the site might have been in use from September to March and was at least visited in early autumn (Louwe Kooijmans 2003, 619). The seasonal signature for De Bruin is less evident, but indicates summer activity during its later phases. The most plausible option is a winter base camp with a logistical function during the summer (Louwe Kooijmans 2001^b, 518).
- 75 One could argue that a site such as the Swifterbant fishing and fowling camp of Bergschenhoek (see Appendix I) would function as such a field camp in a logistical system.
- 76 The model differs from the earlier model presented by Verhart (2000; 2003), in that riverine settings are combined with upland locations and presented in a seasonal system. Verhart presents coversand surface sites that are either located at the margin of the Peel or the margin of the Meuse and do not differ in tool composition.
- 77 Caution is required since isotope analysis is fraught with difficulties (*e.g.* Gehlen 2005; Milner *et al.* 2004). In the case of the Meuse Basin (Bocherens *et al.* 2007) it is important to note that most of the Mesolithic skeletal remains are of an early Mesolithic date. Middle Neolithic samples show increased importance of freshwater resources linked to the environmental restraints placed on hunting by the climax vegetation of the Atlantic forest. Later Neolithic bones again show an increase of terrestrial resources. This does not refute the idea that many upland Late Mesolithic sites were situated in suitable locations and that terrestrial hunting was an important activity. Therefore a distinct difference of degree with respect to wetland locations should still be expected.