Cultural Heritage Agency
Ministry of Education, Culture and Science

Nederlandse Archeologische Rapporten 062

Paradise lost?

Insights into the early prehistory of the Netherlands from development-led archaeology

J.H.M. Peeters, D.C.M. Raemaekers, I.I.J.A.L.M. Devriendt, P.W. Hoebe, M.J.L.Th. Niekus, G.R. Nobles & M. Schepers

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Colophon
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Illustrations: P.W. Hoebe and J.H.M. Peeters unless otherwise indicated
Cover image: excavations at Epse Olthof (Archeologie Deventer)
Copy editor: Suzanne Needs-Howarth
Authorisation manuscript: T. Terberger (Universität Göttingen / Niedersächsisches Landesamt für Bodendenkmalpflege)
Layout and production: Xerox/OBT, The Hague

ISBN/EAN: 9789057992926

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Cultural Heritage Agency of the Netherlands
P.O. Box 1600
3800 BP Amersfoort
www.cultureelerfgoed.nl

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Preface

This book presents the results of a synthetic analysis of archaeological reports dealing with aspects of the early prehistory of the Netherlands. The reports were produced in the context of development-led commercial archaeology over the past 10 to 15 years.

The Cultural Heritage Agency of the Netherlands (Rijksdienst voor het Cultureel Erfgoed; RCE) commissioned a project, undertaken by the Groningen Institute of Archaeology (GIA), which aims at a synthetic analysis of (mostly) excavation results concerning early prehistory (here defined as the Palaeolithic to the Middle Neolithic). The project is part of the RCE's Valletta harvest (Oogst voor Malta) project, which resides under the 'archaeological knowledge kit' programme (Kenniskaart Archeologie). The aim of the programme is to develop tools or utilities to support heritage management decision making from a national perspective.

The book is the result of a joint effort by the authors. Although we each made our own specific contribution, none of the chapters is authored by a single contributor. In order to account for the work done by each one of us, we wish to provide a broad outline of who did what.

Dr J.H.M. Peeters acted as project leader and wrote the running text on the basis of input (rough drafts, lists, tables, graphs and maps) provided by the other project members and expanded on many topics throughout the book.

Prof. D.C.M. Raemaekers acted as co-project leader; he also studied and analysed the reports in the context of the theme people and materials, with an emphasis on ceramics.

Dr I.I.J.A.L.M. Devriendt also studied and analysed the reports in the context of the theme people and materials, but particularly focussed on lithic technology (production, raw materials and tool use); jewellery; and burial.

P.W. Hoebe (BA) acted as database manager, assisted the other group members in extracting relevant data from the reports and analysed various aspects for the assessment of the information potential of the reports.

Drs. M.J.L.Th. Niekus studied and analysed the reports in the context of the themes people and materials and people and environment, but particularly focussed on lithic typochronology and Mesolithic pit hearths.

Dr G.R Nobles analysed the reports in the context of people and space, with an emphasis on spatial analysis at the intra-site scale and various methodological issues regarding fieldwork strategies.

Dr M. Schepers analysed the reports in the context of the themes people and materials and people and environment, with an emphasis on the use of organic materials, and aspects of environmental dynamics.

The book has greatly profited from comments on various drafts by Dr Luc Amkreutz (National Museum of Antiquities, Leiden) and Dr Bjørn Smit and Dr Eelco Rensink (Cultural Heritage Agency, Amersfoort). Prof. Thomas Terberger (Universität Göttingen; Niedersächsisches Landesamt für Denkmalpflege, Hannover) peer-reviewed and accepted the manuscript in terms of its scientific contents. Dr Suzanne Needs-Howarth (Toronto) thoroughly copy edited the text and improved it through her critical comments and queries for clarification. Furthermore, several individuals and archaeological firms took the trouble to provide us with high-resolution images from their reports: Günther Noens (Genth), Archol BV (Leiden), ADC BV (Amersfoort), BAAC BV ('s-Hertogenbosch), RAAP BV (Amsterdam), and BOOR (Municipality of Rotterdam). The authors want to thank all for their work and their willingness to cooperate. Any mistakes and omissions remain our responsibility.

Summary

Aim
Archaeological heritage is important. This notion has led the Dutch government to create legislation in order to protect archaeological values. Since 2007, the Dutch heritage legislation is part of the so-called Malta legislation, which represents the implementation of the Valletta Convention (1992). The 2007 law states that the 'disturber' has the obligation to investigate the (potential) presence of archaeological remains prior to the planned disturbance, and to subsequently take measures to safeguard this heritage, either in situ or ex situ. Archaeological heritage is primarily the responsibility of municipal or other local authorities. Hence, there is no nation-wide policy on how to deal with the legislative obligations. In the context of significance assessment and subsequent selection of which sites to excavate, version 1.0 of the national archaeological research agenda (Nationale Onderzoeksagenda Archeologie; NOaA; 2006) was intended to serve as a national scientific reference framework for decision making and a starting point for research design.

A recently conducted evaluation of the effectiveness of the heritage management cycle under the Malta legislation has revealed that reports resulting from development-led research lag behind with respect to the interpretation and synthesis of excavation results, relative to the research themes and questions in the NOaA 1.0. This raises the question: What can we learn from all these investigations that have found their way into reports? For this purpose, the Cultural Heritage Agency of the Netherlands (Rijksdienst voor het Cultureel Erfgoed; RCE) commissioned a project, undertaken by the Groningen Institute of Archaeology (GIA), which aims at a synthetic analysis of results concerning early prehistory (Palaeolithic to the Middle Neolithic). The project is part of the Oogst voor Malta (Valletta harvest) project of the RCE, which resides under the 'archaeological knowledge kit' programme (Kenniskaart Archeologie). The aim of the programme is to develop tools or utilities to support heritage management decision making from a national perspective. In the particular case of our study, the aim is to establish to what extent research questions from the NOaA 1.0 can be answered at a synthetic level, drawing from the published reports resulting from development-led projects from the period 2005-2014. The results of our study will feed in to an evaluation of the national research agenda and will eventually help inform a proposal for changes to the research questions for NOaA 2.0, which has recently been launched.

Approach
We have approached the analysis in a way that permits to simultaneously broaden and deepen insights under three overarching diachronic themes, each of which, in turn, can be approached from four analytical spatio-temporal dimensions: (a) local and short-term, (b) local and long-term, (c) regional and short-term, and (d) regional and long-term. The overarching themes connect to three broad arrays of the 'human realm of existence': people and materials, people and space, and people and environment. All three themes have a direct bearing on the study of human behaviour in the past on the basis of archaeologically recorded data and subsequent interpretation of the patterning found within.

In order to enable structured searching of reports, it was necessary to build a flexible database structure which allowed for the selection of reports concerning sites that potentially provide information on particular topics. In order to connect our research questions with the reports, we compiled a list of 50 'aspects' that we also deemed to be prerequisites for formulating answers to the research questions. These aspects range from physical archaeological evidence to field methods and applied analyses. The screening of reports on the basis of these aspects indicates which questions can potentially be answered based on the information provided in each report. Furthermore, the connection between each research question and report was stored in relationship to NOaA 1.0 research themes and the overarching themes, as defined under the umbrella of our analytical framework.

Assessment
The selected reports provided unbalanced coverage in terms of the representation of geographical regions, archaeological landscapes, and chronological and cultural attributions. This is due to differences in geological history, the nature of modern-day land use and spatial development, the nature of development-led fieldwork, the nature of political decision

making, as well as archaeological conceptual constraints. Any synthetic analysis of data derived from these reports has to take these biasing factors into account, most particularly where it comes to interpretations with a geographical component or the reconstruction of long-term occupation histories. Notwithstanding these restrictions, the analysis allows for a critical evaluation of existing insights and ideas, as well as a (re)formulation of hypotheses for future research.

Particular problems were encountered with regard to quantitative data, such as the mention of total numbers of (categories of) flint or pottery in the text, but no summary table; the use of vague quantitative terms (such as much, many, little), instead of exact numbers; or the provision of percentages without clear indication of sample or population size. Other types of problems concern issues of classification and subsequent presentation of data, the presentation of radiocarbon dates and the availability of primary data.

Analysis: people and materials

When considering the spatial scale of investigation of the relationship between people and materials, we were confronted with problems of representativeness. Mostly, results from development-led research can only be assessed at the local scale. The sites that have been subject to development-led excavation were selected on the basis of what one might call 'anticipated success'. Basically, this involves the selection of sites for which, in consideration of survey data, chances are high of finding the expected. Hence, the results from projects that were concerned with the investigation of 'familiar' contexts have produced insights that mostly fit or confirm the existing picture. On the other hand, the use-wear studies conducted to date have demonstrated considerable variability in tool use (flint and other rock) and have also provided evidence for the working of materials that themselves were not previously known from the archaeological record (shell and jet in the Mesolithic). In addition, these use-wear analyses give archaeologists much to think about concerning the relationship between tool typology and tool function.

With regard to long-term regional trends in Mesolithic tool types (microlithics), development-led projects have generated enough critical mass to deepen insights into typo-chronological developments. Partly, this has resulted in the confirmation of the established phasing of the Mesolithic. At the same time, it is also evident that there is considerable geographical variability. This may mirror different technological traditions, a hypothesis that connects to the distinction made between the Northwest Group and the Rhine-Meuse-Scheldt Group on the basis of typology many decades ago. The technological modes of production that seem to be connected with these two groups – and perhaps more – have received little attention. Yet, socio-cultural transmission of technological knowledge and practical expertise must underlie the persistent existence of these technological traditions, which themselves will have been subject to variation and change. It is more than worthwhile to consider just these aspects in future analyses.

Along the same lines, there is still much to gain regarding the study of ceramic technological traditions. Even more so than lithic studies, ceramic studies seem to serve relative dating purposes. It will require a major shift in archaeologists' minds to step beyond this superficial approach to ceramics. Research questions need to be more explicit regarding modes of production and use, the study of which can rely on various methods and techniques that are readily available. Because such data are as yet barely available, use of these techniques will allow archaeologists to gain knowledge not only in the local and short-term domains, but also in the regional and long-term domains.

The possibility of increasing our insight into the socio-cultural meaning of material (materiality) is not restricted to utilitarian objects. Several projects have provided information with regard to ritual or cultic dimensions of objects and burial practices. Often, the manifestation of belief systems through the treatment of objects and of the deceased are disconnected in archaeological studies, and development-led projects are no exception herein; in many cases, finds categories are decontextualised. The interpretation of particular finds contexts as ritual depositions may appear less straight forward than the identification of graves, but this is certainly not (always) the case. In the example of Rotterdam-Beverwaard, the Mesolithic cremation graves were only identified as such thanks to the analysis of the small number of calcined bone fragments. The presence of a perforated cobble mace head alone would not have led to the same conclusion. However, it makes one wonder about comparable finds contexts where bone remains are lacking. Hence, there is a need to pay particular attention to finds context in general, even when objects could just as easy be explained as having been left in a secular setting.

Analysis: people and space

We are somewhat ambivalent regarding the gain of knowledge around the theme people and space. The regional dimension of space appears to be one which can barely be addressed. Potential new insights into such topics as settlement location choice and settlement systems can only be evaluated when hitherto underrepresented landscape zones and geographical regions are investigated. However, because survey strategies largely build on the known archaeological record through predictive models, and sites selected for excavation fit those models, underrepresented zones and regions are simply not investigated.

Nonetheless, development-led projects have permitted to gain insight into long-distance transport of raw materials, notably red Heligoland flint (Late Palaeolithic), Wommersom quartzite (Mesolithic), and possibly flint from other sources along the coast of northern France and southern Scandinavia. Although the data are scanty and observations are incidental, they show that identification of potential raw material sources provides new insights into the geographical sphere of interaction in various time periods. Importantly, such insight draws our attention to the degree of mobility of groups and to the social interaction between groups.

Most of the acquired results relate to the local use of space, that is, the intra-site level. Spatial information about finds distributions and features is provided in all of the reports included in this study, but analysis of data and subsequent interpretations of patterns remain superficial. Efforts to increase our understanding of site-formation processes and palimpsests are an exception, despite the fact that the overwhelming majority of sites excavated manifestly result from long occupation histories and complex depositional and post-depositional processes.

There are several reasons for the present situation. First, the majority of sites investigated are palimpsests, which complicate the deciphering of the archaeological record at the site level; second, there is a lack of application of suitable spatial methods and techniques. In most cases, spatial patterns within finds distributions are mostly only subject to visual inspection of maps that present various attributes of finds categories. Statistical approaches are almost lacking, as are multiscalar techniques, which permit archaeologists to investigate spatial patterning amongst different finds categories. Connecting finds distributions to features and the identification of built structures equally suffer from a lack of thorough analysis. The approaches are complementary, for which reason we favour the application of multiple techniques – visual, statistical, multiscalar – to potentially increase insights into short- and long-term dimensions of the use of locations.

Analysis: people and environment

The number of data points for the theme people and environment is restricted. Some aspects have been shown to deserve attention, notably with respect to the use of animal and plant resources.

Bone, tooth, and antler, mostly calcined and mostly in small numbers, appear to be found more often at Mesolithic and Neolithic sites than one tends to think; the evidence adds useful information to the overall still poor record dating to early prehistoric times. Furthermore, animal bones whose anthropogenic origin is questionable can still provide information about the composition of the 'animal landscape' in terms of species diversity. This is a much needed source of information, as reference frameworks for subsistence strategies are largely founded on actualistic models of animal behaviour and communities. Yet other phenomena, such as arrangements of wooden stakes in stream beds, provide information about food procurement techniques, notably fishing techniques. ^{14}C-dates of such stakes point to surprisingly significant time depths.

Development-led research has made a considerable contribution to our knowledge about hunter-gatherer plant resources. Here we see that the application of modern techniques of analysis by specialists in the field leads to exciting results. Such apparently dull categories as charcoal and other charred plant remains can provide information that was not easily accessible until recent years. Insight into the exploitation of a range of plants for food has increased considerably, most notably with regard to wetland species, the remains of which have been found in charred condition. Research regarding the use of Mesolithic pit hearths has resulted in the development of a new hypothesis, notably their potential function in the process of wood-tar production.

Notwithstanding the fact that several potential interpretations of the pit hearth data are possible, the importance of the reported results carries further than just the possible use of the enigmatic Mesolithic pit hearths. Because these features are prominently present on many sites north of the Rhine throughout the Mesolithic, the question arises how differences in time and space can be explained, for instance, in connection with climate-driven models about vegetation succession. Other related questions refer to the time-depth of locational use – this can span more than 2000 years – in connection with such pits.

The same holds, to some extent, for research into human impact on the environment. Traditional models about the restricted influence of early prehistoric people, mostly hunter-gatherers, on their environment are now being questioned. Development-led research again has made a considerable contribution to this debate, mainly because of an open-minded involvement of specialists. The methods applied are traditional, but the frameworks of reference have changed under the influence of an international debate. In fact, development-led work in the Netherlands is at the forefront of these new developments. The publication of such results in scientific papers by professionals who work in development-led archaeology is, however, frustrated by the dictates of commercial continuity.

It is important to note that recent years have seen the development of innovative techniques that use data sources that also are (or can be) found in the Netherlands. Analysis of ancient DNA is potentially possible. A recent study of skeletal remains from Bell Beaker contexts in Europe – including the Netherlands – demonstrates the potential for genetic studies. Equally, the potential presence of aDNA in buried palaeosols – sediment aDNA – may shed light on animal, plant and human populations in 'extinct landscapes', which are so far only partly represented in the fossil physical record. Another source of information concerns stable isotopes – notably ^{15}N and ^{13}C. Although it has been known for a considerable time that stable isotope analysis can yield important information about human and animal diet and habitat, such analysis is not conducted in the context of development-led research. Often not even the ^{15}N and ^{13}C values are provided. A recent study of isotope data from Mesolithic human remains from the North Sea has shown that even contextless finds can provide meaningful information about human diet.

The research agenda and field practice

The reports on the more extensive projects make clear that in-depth study of finds categories and excavation data can contribute to the answering of research questions in the NOaA 1.0. We conclude that, for the most part, it is not so much the research questions themselves that are the problem, but, rather, their embedding in project outlines and strategies. Often the solution needs to be found in the first step of the research process, namely, the project outline (Programma van Eisen). Within an archaeological 'market' in which competition is primarily expressed in financial terms, commercial firms are evidently hesitant to do more than is required. The quality of the project outline therefore determines the quality of the research project to a large extent.

One characteristic of development-led archaeological research in the Netherlands is the use of predictive models. The rationale is that in the past resources were exploited using various strategies and technologies based on (expected) availability, experience and tradition. We conclude that it will be necessary to make model expectations more explicit. Next, we will need to establish to what extent results fit these explicit expectations in order to improve our predictive models. Diverging results can involve absence of the expected or presence of the unexpected. The latter readily causes problems if identified during fieldwork, as a change of strategy and methodology is often needed, which in turn normally has implications for the overall planning and budget. This factor in particular, frequently lead to decisions that turn early prehistoric remains into 'by-catch', which is reported on to only a minimal extent. Yet it is precisely this by-catch which may represent low-resolution phenomena (low-density finds scatters, isolated pit hearths, isolated projectile points) which are otherwise underrepresented in the archaeological record.

In many projects, preliminary stages of research include surveying by means of augering. Here two issues demand our attention. First, the augering depth is limited to the anticipated depth of disturbance. As a consequence of this standard procedure, one specific group of archaeological remains systematically receives too little attention: Middle and Late Palaeolithic remains covered by younger Pleistocene sediments. As yet, anticipated attention for Palaeolithic sites remains exceptional, and, as a consequence, finds fall systematically in the category 'by-catch'. Many development plans do, however, result in the disturbance of Pleistocene deposits, for instance, due to piling for foundations of buildings. Any Middle and Late Palaeolithic sites that are present are thus disturbed and inaccessible for archaeological research. Second, the detection of Stone Age sites by means of auger surveys faces many problems. Various statistical studies have demonstrated that only high-density scatters of at least a medium-sized horizontal extent – that is, palimpsests covering more than 1000 m2 – can reasonably be detected in a 20 × 25 m sampling grid. Therefore auger sampling as part of a standard prospection strategy is a disadvantageous starting position for the discovery of the kinds of smaller, high-resolution sites (e.g. low-density 'single event' scatters) that we would like to have more information on in order to answer many research questions in the NOaA 1.0. The only way to increase the chances of locating such sites is to anticipate their potential presence (e.g. based on palaeolandscape information) in situations where terrestrial deposits dating to the Pleistocene or Early-Middle Holocene are reached.

During excavation, more problems may arise. Stone Age sites are characterised by the presence of a scatter of finds, which comprise zones with higher and lower densities of materials. Within development-led projects, the focus is often on excavating the high-density zones, and not 'wasting' time and money on relatively empty zones. To maximise the outcome of the excavation, a phased excavation strategy has become common in Dutch archaeology. In this strategy, excavation starts with the excavation of a small grid cells with a relatively large distance between them. Differences in finds numbers are used to delineate clusters. Low-density zones are mostly excluded from further research. Here, two concerns need to be addressed. The first concern is that the use of grid-cell densities to predict variation in the density of the finds scatter is methodologically problematic. We must remember that finds scatters are of a fundamentally different nature than distributions of soil or geological units. Whilst soils and geological units, such as sediment layers, are continuous three-dimensional phenomena, artefacts as composite elements of sediment layers are not. It is important to note that Stone Age sites that have been extensively excavated (e.g. Hoge Vaart-A27, Dronten-N23, Ede-Kernhem and Schipluiden) demonstrate substantial quantitative variation regarding the number of finds within high- (or low-) density zones, even at short distances. This implies intrinsic uncertainty with regard to quantitative interpolation of archaeological sample data. The second concern is that the quantity-driven selective approach to excavation results in patchy and discontinuous excavation plans, in which clusters or concentrations of finds are often only partially excavated. This leaves little potential for the investigation of spatial aspects. Many techniques for spatial analysis are available, but their applicability requires continuous areas of fully excavated grid cells, preferably including empty zones to minimise edge effects.

With regard to the analysis phase of research, five concerns are raised. The first is that the description and analysis of cultural material is not standardised, which is a serious hindrance when one intends to use the results of an analysis for new research. The second is the near lack of functional analysis of ceramic, flint and stone tools. The third is a general lack of dedicated chapters or sections on spatial analysis. The fourth is that projects in which early prehistoric remains are found as a by-catch see limited involvement of Stone Age specialists. The final concern is that regional comparison is lacking in many reports due to the simple fact that datasets are often not available in the digital repository, in contravention of the regulations.

We propose that standards should also be developed for reports, which are currently highly diverse in terms of data presentation. Standards are often considered as undesirable straitjackets, but they should only be seen as a way to share information in a structured fashion, so as to allow for comparative analysis.

Towards a new research agenda

While we were conducting our study, the Cultural Heritage Agency of the Netherlands launched the National Archaeological Research Agenda 2.0 (NOaA 2.0). Although the NOaA 2.0 is intended to highlight the most important themes and to foster operationalisation in the field by means of practical suggestions, many questions implicitly have a high degree of complexity. Furthermore, empirical aspects are interwoven with interpretation, which complicates their day-to-day use in the practice of development-led work. Of course it is possible to draft a new set of research questions based on our analysis of reports resulting from development-led work. After all, we have shown what development-led research has contributed to the answering of research question from the NOaA 1.0. Since this contribution is rather limited, we could satisfy ourselves by stating that all questions remain relevant. In a way they do. But it is equally clear that several NOaA 1.0 question surpass the scope of the development-led context of research, notably, questions in the 'why' category. Indeed, we feel that such questions should be omitted.

The issues addressed above lead to a more fundamental question: What should be the role of development-led and academic research in the broader context of archaeological fieldwork (which should be aimed at the collection of data that can stand at the basis of question-driven knowledge gain), as well as analysis and interpretation? The answer to this question should set the baseline for the improvement of the NOaA 2.0, which certainly should and can serve a purpose in quality control. We are convinced that a more balanced and targeted set of research questions can come from the dialogue between the development-led community and the academic community, and for which the present study may well form the starting point.

Conclusions

Our synthetic analysis has made clear that basically all NOaA 1.0 research themes and questions remain either unanswered or partially answered. Several questions, particularly those in the 'why' category or which require synthetic work at the regional scale, are well beyond the possibilities of development-led projects. Any future research agenda that is intended to inspire development-led work and is concerned with the quality of the archaeological research needs to be better aligned with the potential and practice of what can reasonably be achieved within such a context. Importantly, our study also leaves us with the impression that there is a lot of potential to be tapped from all the work that has already been done. To tap this potential, all data need to become available, but even once that has been achieved, in many cases researchers will probably need to return to the finds material itself. So paradise is not lost, at least not entirely. Yet, it is necessary to develop further practices which lead to useful and accessible research results from development-led projects, in order to ensure that paradise doesn't crumble much further. This is the responsibility of the archaeological community as a whole.

Samenvatting

Doelstelling
Archeologisch erfgoed is belangrijk. De Nederlandse overheid heeft daarom wetgeving gecreëerd voor de bescherming van archeologische waarden. De Nederlandse erfgoedwet is sinds 2007 onderdeel van de zogenaamde Malta-wet, de uitwerking van het Verdrag van Valletta (1992). In de wet is gesteld dat de 'verstoorder' de verplichting heeft om voorafgaand aan de voorgenomen verstoring onderzoek te doen naar de (potentiële) aanwezigheid van archeologische resten en maatregelen te treffen om dit erfgoed in situ of ex situ veilig te stellen. Archeologisch erfgoed is de primaire verantwoordelijkheid van gemeentelijke of andere lokale autoriteiten. Als gevolg daarvan bestaat er geen nationaal beleid ten aanzien van de uitvoering van de wettelijke verplichting. Ten behoeve van de archeologische waardering en successievelijke selectie van vindplaatsen die in aanmerking komen voor opgraving, vormde de Nationale Onderzoeksagenda Archeologie (NOaA 1.0; 2006) het wetenschappelijk referentiekader voor besluitvorming en het vertrekpunt voor onderzoek.
Een recentelijk uitgevoerde evaluatie van de effectiviteit van de monumentezorgcyclus onder de Malta wetgeving bracht aan het licht dat rapporten tekort komen ten aanzien van interpretatie en synthetisering van opgravingsgegevens in relatie tot de onderzoeksthema's en –vragen uit de NOaA 1.0. Dit roept de vraag op wat geleerd kan worden uit al dat onderzoek dat haar weg heeft gevonden naar rapporten. Om hier een antwoord op te krijgen heeft het Groninger Instituut voor Archeologie (GIA) in opdracht van de Rijksdienst voor het Cultureel Erfgoed (RCE) een synthetiserende analyse uitgevoerd van onderzoeksresultaten betreffende de vroege prehistorie (Paleolithicum tot en met Midden-Neolithicum). Het project is onderdeel van het Oogst voor Malta-project dat deel uitmaakt van het Kenniskaart Archeologie-programma. Het doel van dit programma is de ontwikkeling van instrumenten en toepassingen ter ondersteuning van besluitvorming in de erfgoedzorg vanuit een nationaal perspectief. In het specifieke geval van de onderhavige studie is het doel om vast te stellen in welke mate onderzoeksvragen uit de NOaA 1.0 op een synthetiserend niveau beantwoord kunnen worden op basis van gepubliceerde rapporten die zijn voortgekomen uit ontwikkelingsgedreven 'Malta-onderzoek' dat in de periode 2005-2014 is uitgevoerd. De resultaten hiervan dienen ter evaluatie van de NOaA onderzoeksvragen en leveren bouwstenen voor een voorstel voor de onderzoeksvragen in de NOaA 2.0, welke recentelijk is opengesteld.

Aanpak
We hebben het onderzoek ingericht op een wijze die het mogelijk maakt om inzichten te verbreden en verdiepen onder drie overkoepelende thema's die ieder vanuit vier analytische perspectieven benaderd kunnen worden: (a) lokaal – korte termijn, (b) lokaal – lange termijn, (c) regionaal – korte termijn, (d) regionaal – lange termijn. De overkoepelende thema's, waaraan diverse NOaA 1.0 onderzoeksvragen zijn verbonden, hebben betrekking op drie brede velden van het 'menselijk bestaan': mens en materiaal, mens en ruimte, en mens en omgeving. Deze thema's hebben direct betrekking op de bestudering van menselijk gedrag in het verleden op de basis van archeologische gegevens en de successievelijke interpretatie van patronen die daarin gevonden worden.
Om op een gestructureerde manier te kunnen zoeken naar relevante rapporten was het noodzakelijk om een flexibele database structuur te ontwerpen die het mogelijk maakte om rapporten te selecteren die potentieel informatie bevatten over specifieke onderwerpen. Om een koppeling mogelijk te maken tussen onderzoeksvragen en rapporten zijn door ons 50 'aspecten' benoemd die tevens noodzakelijk zijn voor de beantwoording van de vragen zelf. Deze aspecten betreffen niet alleen archeologische resten, maar ook veldwerkmethoden en toegepaste analyses.
De filtering van de rapporten op basis van deze aspecten geeft tevens een indicatie van de vragen die potentieel beantwoord kunnen worden op grond van de informatie die in ieder rapport is verwerkt. De koppeling tussen iedere onderzoeksvraag en het rapport is tevens opgeslagen in relatie tot NOaA 1.0 thema's en de overkoepelende thema's zoals die zijn gedefinieerd in het kader van onze studie.

Waardering
De geselecteerde rapporten leverden een onevenwichtige dekking van vindplaatsen op ten aanzien van vertegenwoordigde geografische regio's, archeologische landschappen, en chronologische en culturele eenheden. Dit hangt samen met verschillen in de geologische ontwikkeling, het karakter van modern landgebruik en ruimtelijke ontwikkelingen, het karakter van ontwikkeling gedreven onderzoek, politieke besluit name, evenals archeologisch-conceptuele beperkingen. Iedere synthetiserende analyse van gegevens afkomstig uit de rapporten dient rekening te houden met deze vertekenende factoren, in het bijzonder waar het interpretaties betreft met een geografische component of de reconstructie van lange-termijn bewoningsgeschiedenissen. Ondanks deze beperkingen is een kritische evaluatie van bestaande inzichten en ideeën mogelijk, evenals de (her)formulering van hypothesen voor toekomstig onderzoek.
Uit ons onderzoek zijn specifieke problemen naar voren gekomen met betrekking tot kwantitatieve gegevens, zoals de vermelding van totalen van vondstcategorieën in de tekst bij het ontbreken van overzichtstabellen, het gebruik van vage kwalificaties (zoals veel, weinig) in plaats van absolute aantallen, of de vermelding van percentages zonder duidelijke vermelding van de populatieomvang. Andere problemen betreffen classificaties en gegevenspresentatie, de presentatie van koolstofdateringen en de beschikbaarheid van primaire gegevens.

Analyse: mens en materiaal
Ten aanzien van het onderzoek naar de relatie tussen mensen en materiaal werden we geconfronteerd met problemen van representativiteit in verband met de ruimtelijke schaal van onderzoek. Doorgaans kunnen de resultaten van Malta-onderzoek uitsluitend worden gewaardeerd op de lokale schaal. Vindplaatsen die in het kader van Malta zijn onderzocht, zijn geselecteerd op wat 'geanticipeerd succes' genoemd zou kunnen worden. Dit komt er feitelijk op neer dat vindplaatsen worden geselecteerd die op basis van de resultaten van vooronderzoek een gerede kans hebben dat gevonden zal worden wat wordt verwacht. Als gevolg daarvan hebben projecten die gericht waren op het onderzoek van 'bekende' contexten inzichten opgeleverd die in het bestaande beeld passen, of dit bevestigen. Anderzijds heeft gebruikssporenonderzoek aanzienlijke variatie in het gebruik van werktuigen (vuursteen, natuursteen) aangetoond, en zijn er aanwijzingen gevonden voor de bewerking van materialen die niet eerder in het archeologisch gegevensbestand waren aangetroffen (schelp en git in het Mesolithicum). De resultaten roepen ook de vraag op over de relatie tussen werktuigtypen en –functie.
Met betrekking tot lange-termijn regionale trends in mesolithische werktuigtypen (microlieten) heeft Malta-onderzoek voldoende kritische massa gegenereerd om het inzicht in typo-chronologische ontwikkelingen te vergroten. Deels heft dit geresulteerd in de bevestiging van de vigerende fasering van het Mesolithicum. Tegelijk is duidelijk geworden dat er sprake is van aanzienlijke geografische typo-technologische variabiliteit. Dit reflecteert mogelijk het bestaan van verschillende technologische tradities; een hypothese die aanhaakt op het onderscheid dat decennia geleden gemaakt is tussen de Noordwest Groep en de Rijn-Maas-Schelde Groep op grond van werktuigtypen. Technologische productiemodi die met deze groepen – misschien zijn er meer – verbonden lijken te zijn, hebben echter nog nauwelijks aandacht gekregen. Toch moet socio-culturele transmissie van kennis en praktische ervaring ten grondslag liggen aan de persistentie van deze technologische tradities, die echter wel onderwerp zijn geweest van variatie en verandering. Het is uiterst zinvol om aan dergelijke aspecten aandacht te schenken bij toekomstige analyses.
In dezelfde lijn is er nog veel winst te halen voor wat betreft ceramisch technologische tradities. Meer nog dan onderzoek van lithisch materiaal, dient onderzoek van aardewerk primair het doel van relatieve datering. Er is een grote mentaliteitsverandering onder archeologen nodig om voorbij deze oppervlakkige benadering van ceramisch materiaal te geraken. Onderzoeksvragen betreffende productie en gebruik moeten explicieter worden gesteld, terwijl het onderzoek gebruik kan maken van diverse methoden en technieken die direct beschikbaar zijn. Aangezien dergelijke gegevens nog nauwelijks beschikbaar zijn, kan de inzet van deze methoden en technieken leiden tot

kenniswinst op alle schaalniveaus (lokaal, regionaal; korte termijn, lange termijn).
De mogelijkheid om inzicht te vergroten in de socio-culturele betekenis van materialen (materiality) is niet beperkt tot gebruiksvoorwerpen. Diverse projecten hebben informatie opgeleverd over rituele of cultische dimensies van voorwerpen en het dodenritueel. Veelal worden manifestaties van geloofssystemen – de omgang met objecten en overledenen – uiteen getrokken in archeologische studies, en Malta-projecten vormen hierin geen uitzondering; in veel gevallen worden vondstcategorieën gedecontextualiseerd. De interpretatie van bepaalde vondstcontexten als rituele deposities mag minder eenvoudig lijken dan de identificatie van graven, maar dat is zeker niet altijd het geval. Te Rotterdam-Beverwaard bijvoorbeeld, konden mesolithische crematiegraven pas als dusdanig worden herkend na analyse van een kleine hoeveelheid verbrand bot. Uitsluitend de aanwezigheid van een Geröllkeule in één van de kuilen zou een dergelijke interpretatie niet hebben toegelaten. Dit roept de vraag op naar het karakter van vergelijkbare vondstcontexten waar botresten volledig afwezig zijn. Het is daarom noodzakelijk om meer aandacht te schenken aan vondstcontexten, zelfs wanneer de mogelijkheid bestaat voor een verklaring waarin objecten eenvoudigweg kunnen zijn achtergelaten in een seculiere setting.

Analyse: mens en ruimte

Ten aanzien van kenniswinst binnen het thema mensen en ruimte zijn we wat ambivalent. De regionale dimensie blijkt nauwelijks benaderd te kunnen worden. Potentieel nieuwe inzichten in onderwerpen zoals nederzettingslocatiekeuze en nederzettingssystemen kunnen alleen worden verkregen indien tot dusver ondervertegenwoordigde landschapszones en geografische regio's zijn onderzocht. Dit is echter niet het geval, aangezien prospectiestrategieën middels voorspellingsmodellen voortbouwen op de bekende archeologische gegevens, met als gevolg dat uiteindelijk onderzochte vindplaatsen zullen passen binnen de bestaande modellen.
Toch hebben Malta-projecten inzicht opgeleverd betreffende langeafstand transport van grondstoffen, zoals rode Helgolandvuursteen (Laat-Paleolithicum), Wommersomkwartsiet (Mesolithicum) en mogelijk vuursteen afkomstig van bronnen langs de kust van Noord-Frankrijk en Zuid-Scandinavië. Hoewel de gegevens fragmentarisch zijn en het incidentele observaties betreft, geven deze aan dat de identificatie van potentiële grondstofbronnen nieuwe inzichten kunnen opleveren in de geografische dimensie van interactie in diverse perioden. Belangrijk is dat dergelijke inzichten de aandacht vestigen op de mate van mobiliteit en sociale interactie tussen groepen.
De verkregen resultaten hebben vooral betrekking op lokaal ruimtegebruik, dat wil zeggen op intra-siteniveau. Ruimtelijke informatie over de verspreiding van vondsten en sporen wordt in alle rapporten gegeven, maar de analyse van gegevens en de daaruit volgende interpretaties van patronen blijven oppervlakkig. Pogingen om ons begrip te vergroten van siteformatieprocessen en palimpsesten vormen een uitzondering, ondanks het feit dat het overgrote deel van de onderzochte vindplaatsen duidelijk het resultaat zijn van lange gebruiksgeschiedenissen en een complex geheel van depositionele en post-depositionele processen. Er zijn verschillende oorzaken aanwijsbaar voor deze situatie. Ten eerste zijn de meeste onderzochte vindplaatsen palimpsesten, wat de ontcijfering van de archeologische gegevens moeilijk maakt; ten tweede is er een gebrek aan de toepassing van geschikte methoden en technieken. In de meeste gevallen worden ruimtelijke patronen in vondstverspreidingen uitsluitend onderworpen aan visuele inspectie van kaarten die verschillende attributen van vondstcategorieën vertegenwoordigen. Statistische methoden ontbreken vrijwel geheel, evenals meerschalige technieken die het de archeoloog toestaan om ruimtelijke patronen onder meerdere vondstcategorieën te onderzoeken. Ook de koppeling tussen vondstverspreidingen en grondsporen, en de identificatie van gebouwde structuren krijgt weinig analytische aandacht. De benaderingen zijn echter complementair, zodat wij er voorkeur aan geven dat meerdere technieken – visueel, statistisch, meerschalige technieken – gecombineerd worden om de inzichten in korte en lange-termijn dimensies van ruimtegebruik (potentieel) te vergroten.

Analyse: mens en omgeving
Het aantal data-punten voor het thema mensen en omgeving is beperkt. Sommige aspecten verdienden echter aandacht, vooral met betrekking tot het gebruik van dierlijke en plantaardige grondstoffen.
Bot, tand en gewei blijken vaker te worden gevonden – dikwijls gecalcineerd en zwaar gefragmenteerd – in mesolithische en neolithische contexten dan snel wordt gedacht; de gegevens voegen bruikbare informatie toe aan de doorgaans beperkte gegevens waarover we voor de vroege prehistorie beschikken. Verder kunnen dierlijke resten, waarvoor een antropogene context twijfelachtig is, informatie opleveren over de samenstelling van het ‘dierlijke landschap’ in termen van soortdiversiteit. Dit laatste is een wenselijke bron van informatie, omdat referentiekaders voor bestaansstrategieën vooral gefundeerd zijn op basis van actualistische modellen over dierlijk gedrag en populaties. Weer andere verschijnselen, zoals configuraties van houten staken in stroombeddingen, leveren informatie over technieken voor voedselvoorziening, vooral visvangst. ^{14}C dateringen van dergelijke staken wijzen op verrassend grote tijddiepten in de lokale exploitatie van bronnen.
Malta-onderzoek heeft een aanzienlijke bijdrage geleverd aan onze kennis over het gebruik van plantaardige bronnen door jager-verzamelaars. Hier zien we dat de toepassing van moderne wetenschappelijke methoden en technieken door specialisten belangrijke resultaten kunnen opleveren. Ogenschijnlijk saaie vondstcategorieën als houtskool en andere verkoolde plantaardige resten kunnen informatie opleveren die eerder niet toegankelijk was. Het inzicht in de exploitatie van plantaardige voedselbronnen is aanzien lijk verbreed, vooral wat betreft soorten uit wetland-contexten en waarvan verkoolde resten zijn gevonden. Onderzoek naar het gebruik van mesolithische kuilhaarden heeft geresulteerd in een nieuwe hypothese, namelijk een potentiële functie in het proces van houtteerproductie. Ondanks het feit dat diverse interpretaties van kuilhaardgegevens mogelijk blijven, reikt het belang van de gerapporteerde resultaten verder dan uitsluitend de mogelijke functie van deze raadselachtige mesolithische kuilen. Omdat deze verschijnselen prominent aanwezig zijn op veel vindplaatsen benoorden de Rijn gedurende het gehele Mesolithicum, rijst de vraag hoe verschillen in het voorkomen van kuilhaarden in tijd en ruimte verklaard kunnen worden, bijvoorbeeld in relatie tot klimaat gestuurde modellen van vegetatiesuccessie. Andere vragen hebben betrekking op de tijdsdiepte van locatiegebruik – deze kan meer dan 2000 jaar bestrijken – in relatie tot dergelijke kuilen. Hetzelfde geld tot op zekere hoogte voor onderzoek naar menselijke beïnvloeding van de omgeving. Traditionele modellen over de beperkte invloed van de vroeg-prehistorische mens, vooral jager-verzamelaars, op de omgeving staan nu ter discussie. Malta-onderzoek heeft ook op dit vlak een bijdrage geleverd aan deze discussie, vooral vanwege de betrokkenheid van ruimdenkende specialisten. De toegepaste methoden zijn traditioneel, maar de referentiekaders zijn veranderd onder invloed van de internationale discussie. In feite staat Malta-onderzoek in Nederland in de frontlinie van deze nieuwe ontwikkeling. De internationale publicatie van dergelijke resultaten in wetenschappelijke tijdschriften door professionals die in de Malta-context werken, wordt echter in de weg gestaan door de noodzaak van commerciële continuïteit.
Het is belangrijk om vast te stellen dat gegevensbronnen die met recente, innovatieve technieken kunnen worden onderzocht, ook in Nederland aanwezig (kunnen) zijn. De analyse van aDNA is in principe mogelijk. Een recent onderzoek van menselijke skeletresten uit klokbeker-contexten in Europa – inclusief Nederland – toont de potentie van genetische studies aan. Ook de potentiële aanwezigheid van aDNA in sediment (sedaDNA) – begraven paleosolen – kan licht werpen op dierlijke, plantaardige en menselijke populaties in ‘uitgestorven landschappen’ die tot dusver alleen maar fragmentarisch vertegenwoordigd zijn als fysieke resten. Een andere bron van informatie betreft stabiele isotopen, zoals ^{15}N en ^{13}C. Hoewel al geruime tijd bekend is dat de analyse van stabiele isotopen belangrijke informatie kan vrijgeven over het dieet en de leefomgeving van mensen en dieren, wordt dergelijk onderzoek niet uitgevoerd in de context van Malta-onderzoek. Zelfs ^{15}N en ^{13}C gegeven worden niet verstrekt, ondanks dat deze t.b.v. ^{14}C-analyse worden gemeten. Een recente studie van isotopengegevens van menselijke resten uit het Mesolithicum uit de

Noordzee heeft laten zien dat zelfs vondsten zonder context bruikbare informatie kunnen opleveren over dieet.

De onderzoeksagenda en de onderzoekspraktijk

De rapporten van de meer omvangrijke projecten maken duidelijk dat diepgaande studies van vondstcategorieën en opgravingsgegevens een bijdrage kunnen leveren aan de beantwoording van onderzoeksvragen uit de NOaA 1.0.
We concluderen dat de onderzoeksvragen zelf – voor het grootste deel – niet zozeer het probleem zijn, maar de inbedding ervan in onderzoeksplannen en -strategieën. In veel gevallen moet de oplossing worden gezocht in de eerste stap van het onderzoeksproces, het Programma van Eisen (PvE). In een archeologische 'markt' waarin competitie primair wordt uitgedrukt in financiële termen, aarzelen commerciële bedrijven om meer te doen dan wordt vereist. De kwaliteit van het PvE beïnvloedt daarom in belangrijke mate de kwaliteit van het onderzoek.
Eén kenmerk van Malta-onderzoek in Nederland is het gebruik van verwachtingsmodellen. De onderliggende gedachte is dat de exploitatie van bronnen in het verleden met behulp van verschillende strategieën en technologieën gebaseerd was op de (verwachte) beschikbaarheid, ervaring en traditie. We concluderen dat modelverwachtingen explicieter moeten worden gemaakt. Vervolgens dient te worden vastgesteld dat in welke mate de verkregen onderzoeksresultaten aansluiten op de geëxpliciteerde verwachting om modellen te kunnen verbeteren. Afwijkende resultaten kunnen betrekking hebben op de afwezigheid van het verwachte, of de aanwezigheid van het onverwachte. Dit laatste zorgt uiteraard voor problemen wanneer dit tijdens het veldwerk wordt vastgesteld, omdat dan aanpassing van de strategie of methodiek noodzakelijk is en wat weer gevolgen heeft voor de planning en middelen. Vooral deze factoren leiden dikwijls tot besluit name die resten uit de vroege prehistorie degraderen tot 'bijvangst' en waarover minimaal wordt gerapporteerd. Maar het is juist deze bijvangst die verschijnselen met een lange resolutie (strooiing met een lage dichtheid; geïsoleerde kuilhaarden; geïsoleerde pijlspitsen) vertegenwoordigd en die ondervertegenwoordigd zijn in het archeologisch gegevensbestand.
In veel projecten bestaat het vooronderzoek uit prospectie met behulp van boringen. Wat dit betreft vragen twee aspecten om aandacht. Op de eerste plaats wordt de boordiepte beperkt tot de geanticipeerde diepte van de verstoring. Als gevolg van deze standaardprocedure krijgt één specifieke groep archeologische resten systematisch te weinig aandacht: midden- en laat-paleolithische resten afgedekt door jonger pleistoceen sediment. Tot dusver is de geanticipeerde aandacht voor paleolithische sites uitzonderlijk, met als consequentie van vondsten systematisch in de categorie 'bijvangst' vallen. Veel ontwikkelingsplannen leiden echter tot verstoring van pleistocene afzettingen, bijvoorbeeld vanwege de fundering van gebouwen op heipalen. Potentieel aanwezige midden- en laat-paleolithische sites worden dan ongezien verstoord en onbereikbaar vanwege overbouwing. Een tweede probleem betreft de opsporing van steentijdvindplaatsen met behulp van boringen. Diverse statistische studies hebben laten zien dat alleen omvangrijke (> 1000 m2 – vondstspreidingen met een hoge dichtheid een redelijke kans hebben om te worden gedetecteerd in een grid van 20 x 25 m. Het gebruik van boringen is standaard prospectiestrategie levert dan ook een ongunstige uitgangspositie op voor de detectie van kleine sites met een hoge resolutie (lege dichtheid; eenmalig gebruikte locaties) die we juist willen hebben om veel vragen uit de NOaA 1.0 te kunnen beantwoorden. De enige manier om de kans op de detectie van dergelijke sites te vergroten, is te anticiperen op de potentiële aanwezigheid (bijvoorbeeld gebaseerd op paleolandschappelijke informatie) in situaties waar terrestrische afzettingen uit het Pleistoceen tot vroeg Midden-Holoceen aan snee komen.
Tijdens opgravingen kunnen meer problemen opduiken. Steentijdvindplaatsen worden gekenmerkt door een strooiing van vondstmateriaal waarin zones met hoge en lage dichtheid voorkomen. In de context van Malta-onderzoek ligt de focus meestal op het opgraven van zones met hoge dichtheden materiaal en wordt geen geld 'verspild' aan relatieve lege zones. Om de opbrengst van een opgraving te maximaliseren wordt doorgaans een gefaseerde strategie toegepast, waarbij de opgraving start met het uitgraven van kleine vakken (gridcellen)

die relatief ver uiteen gelegen zijn. Verschillen in vondstaantallen worden vervolgens gebruikt om clusters te begrenzen. Zones met lage dichtheden worden meestal niet onderzocht. Dit brengt twee problemen met zich mee. Ten eerste is het voorspellen (interpoleren) van variatie in vondstdichtheden op basis van monsterpunten methodisch problematisch. Vondstverspreidingen zijn van een fundamenteel ander karakter dan bodemkundige of lithologische eenheden; de laatsten zijn 3-dimensionale verschijnselen, de eerste zijn dat als samenstellende elementen van een bodemkundige of lithologische eenheid niet. Het is belangrijk om vast te stellen dat intensief onderzochte steentijdvindplaatsen (bijvoorbeeld Hoge Vaart-A27, Dronten-N23, Ede-Kernhem en Schipluiden) grote verschillen in vondstdichtheid laten zien, zelfs over korte afstanden. Dit impliceert intrinsieke onzekerheid met betrekking tot de kwantitatieve interpolatie van monstergegevens. Ten tweede leidt de op kwantiteit gerichte selectie tot ongelijke en discontinue opgravingseenheden waarin clusters of vondstconcentraties dikwijls 'onvolledig' zijn onderzocht. Dit belemmert het potentieel voor de analyse van ruimtelijke aspecten. Er zijn veel technieken voor ruimtelijke analyse beschikbaar, maar de toepassing ervan vraagt om continue vlakken die bij voorkeur ook lege zones omvatten om randeffecten te minimaliseren.
Voor wat betreft de analysefase van onderzoek hebben we vijf problemen naar voren gebracht. Ten eerste is de beschrijving en analyse van cultureel materiaal weinig gestandaardiseerd, wat het gebruik van resultaten voor nieuw onderzoek in de weg staat. Ten tweede is er beperkt aandacht voor de functionele analyse van aardewerk en lithisch materiaal. Ten derde is er een gebrek aan specifieke hoofdstukken betreffende ruimtelijke analyse. Het vierde probleem is dat in projecten waarin vroeg-prehistorische resten als bijvangst zijn gevonden, de inzet van specialisten (vrijwel) ontberen. Op de laatste plaats ontbreekt het aan regionale vergelijkingen, als was het maar omdat datasets dikwijls ontbreken in digitale depots ondanks de wettelijke regelgeving.
We stellen voor dat standaarden ontwikkeld worden voor rapporten, die nu nog uitermate divers zijn voor wat betreft de presentatie van gegevens. Standaarden worden vaak gezien als onwenselijke dwangvesten, maar ze moeten worden gezien als een manier om op gestructureerde wijze informatie te delen om zo vergelijkende analyses mogelijk te maken.

Naar een nieuwe onderzoeksagenda

Tijdens de uitvoering van ons onderzoek werd de NOaA 2.0 opengesteld door de RCE. Hoewel de NOaA 2.0 bedoeld is om de belangrijkste onderzoeksthema's naar voren te halen en om de operationalisering ervan voor veldwerk te faciliteren middels praktische suggesties, hebben veel vragen impliciet een hoge graad van complexiteit. Verder blijken empirische aspecten verweven met aspecten van interpretatie, die de dagelijkse uitwerking ervan in de praktijk van Malta-onderzoek ingewikkeld maakt. Natuurlijk is het mogelijk om op basis van onze analyse een nieuwe set onderzoeksvragen te formuleren. We hebben immers laten zien dat Malta-onderzoek een bijdrage heeft geleverd aan de beantwoording van NOaA 1.0 onderzoeksvragen. Daar deze bijdrage echter beperkt is, zouden we ons tevreden kunnen stellen met de constatering dat alle vragen relevant blijven, wat in zekere zin ook het geval is. Maar het is ook duidelijk dat diverse NOaA 1.0 vragen de reikwijdte van Malta-projecten overstijgen. Het betreft vragen in de 'waarom' categorie en deze zouden uit de onderzoeksagenda geschrapt moeten worden als deze gericht moet zijn op de uitvoering van Malta-onderzoek.
Deze punten leiden tot een meer fundamentele vraag: wat zou de rol moeten zijn van Malta en academisch onderzoek in de bredere context van archeologisch veldonderzoek (dat gericht zou moeten zijn op het verzamelen van data die aan de basis kunnen staan van vraag-gedreven kenniswinst), analyse en interpretatie? Het antwoord op deze vraag zou het vertrekpunt moeten zijn voor de verbetering van de NOaA 2.0, die zonder twijfel een rol zou moeten en kunnen hebben in de kwaliteitszorg. Wij zijn er van overtuigd dat een meer gebalanceerde en gerichte set van onderzoeksvragen kan volgen uit een dialoog tussen de Malta-gemeenschap en de academische gemeenschap; daartoe kan deze studie als basis dienen.

Conclusies

Onze analyse heeft duidelijk gemaakt dat vrijwel alle NOaA 1.0 onderzoeksthema's en vragen onbeantwoord of deels beantwoord zijn gebleven. Diverse vragen, vooral in de 'waarom' categorie en waarvoor synthetiserende analyse op een minimaal regionale schaal nodig is, liggen buiten de mogelijkheden van Malta-projecten. Een onderzoeksagenda die bedoeld is om Malta-onderzoek te inspireren en gericht is op de kwaliteit van archeologisch onderzoek, dient beter gestroomlijnd te worden met het potentieel en de praktijk van wat redelijkerwijs in een dergelijke context bereikt kan worden. Maar het is ook belangrijk dat we uit ons onderzoek de indruk hebben gekregen dat er een enorm potentieel beschikbaar is in al het werk dat al is uitgevoerd. Om dat potentieel af te kunnen tappen moeten alle gegevens beschikbaar komen, hoewel dan nog in veel gevallen teruggegaan zal moeten worden naar het materiaal. Het paradijs is dus niet verloren, althans, niet volledig. Maar het is noodzakelijk om kaders te ontwikkelen die leiden tot bruikbare en toegankelijke onderzoeksresultaten uit Malta-projecten, om te voorkomen dat het paradijs verder afbrokkelt. En dat is de verantwoordelijkheid van de archeologische gemeenschap als geheel.

1 Research framework

1.1 Introduction

The essence of archaeological research is that we learn about the human past and that we develop an understanding of how the behaviour of, and choices made by people in the past have led to where we are today. It is a scientific quest for knowledge that delivers the ingredients for narratives about what people were doing and thinking in a socio-cultural and environmental context that differs from our own. And this knowledge needs to be based on the interpretation of mostly scarce archaeological remains and traces of ancient landscapes encapsulated in the subsoil. The subsoil is, however, far from stable. A myriad of processes lead to continuous change in, for instance, chemical or biological characteristics below the present-day land surface. Mostly invisible, these dynamics result in progressive alteration of the archaeological and palaeoenvironmental records. In contrast, physical disturbances, such as construction, agriculture and natural erosion lead to a directly observable impact on the archaeological heritage.

Archaeological heritage is protected under Dutch law. Since 2007, the Dutch heritage legislation has been part of the so-called Malta legislation, which represents the implementation of the Valletta Convention (1992). Renamed Wet op de archeologische monumentenzorg (literally: law on the care for archaeological monuments) in 2007, the heritage legislation is implemented by the Cultural Heritage Agency of the Netherlands (Rijksdienst voor het Cultureel Erfgoed), which is part of the Dutch ministry responsible for education, culture and science (Ministerie van Onderwijs, Cultuur en Wetenschap).The 2007 law states that the 'disturber' has the obligation to investigate the (potential) presence of archaeological remains prior to the planned disturbance, and to subsequently take measures to safeguard this heritage in situ or ex situ. Archaeological heritage is primarily the responsibility of municipal or other local authorities, who all need to have policies in place in order to embed archaeological investigations in the authorisation process for any development that involves disturbance of the subsoil. Sometimes multiple local authorities jointly develop such policies at the regional level. Provincial authorities also have their own policies – mostly of a more general nature – to which local or regional policies need to adhere. Finally, national authorities are involved in the development and monitoring of legislation, and they have an advisory role in the context of projects initiated by (semi-)governmental organisations. In addition, the national authorities engage in projects where the archaeology to be impacted is considered to be of national importance.

With local authorities bearing the primary responsibility for archaeological heritage, there is no nation-wide policy on how to deal with the legislative obligations. Indeed, policies can differ from one municipality to another, even when they are adjacent. Hence, the practical execution of the disturber's obligation to conduct archaeological investigation is highly variable, and the fact that policy is implemented at the sub-national level can even lead to different approaches for a single site when that site straddles a municipal boundary line. Commercial firms that have to conduct these investigations operate within an established heritage management cycle of inventorying, assessing significance, selecting how to deal with the site (excavation/in situ preservation/no action), and reporting (fig. 1.1). These firms also have to work within the constraints of time and money set by developers, which may lead to conflicting interests between archaeology (research) and development (saving on costs).[1] In the context of significance assessment and subsequent selection, version 1.0 of the national research agenda for archaeology (Nationale Onderzoeksagenda Archeologie; NOaA) is intended to serve as a national scientific reference framework for decision making and a starting point for research design. However, there is a growing tendency towards the development of regional or even local research agendas, which potentially undermines the achievement of a common baseline for the assessment of archaeological significance.

A recently conducted evaluation of the effectiveness of the heritage management cycle under the Malta legislation has revealed that the NOaA 1.0 has come to be a directive for project outlines, known in Dutch as Programma van Eisen (PvE), which are intended to define the goals, strategy and methodology of excavations. However, the evaluation also

[1] Groenewoudt & Peeters 2006.

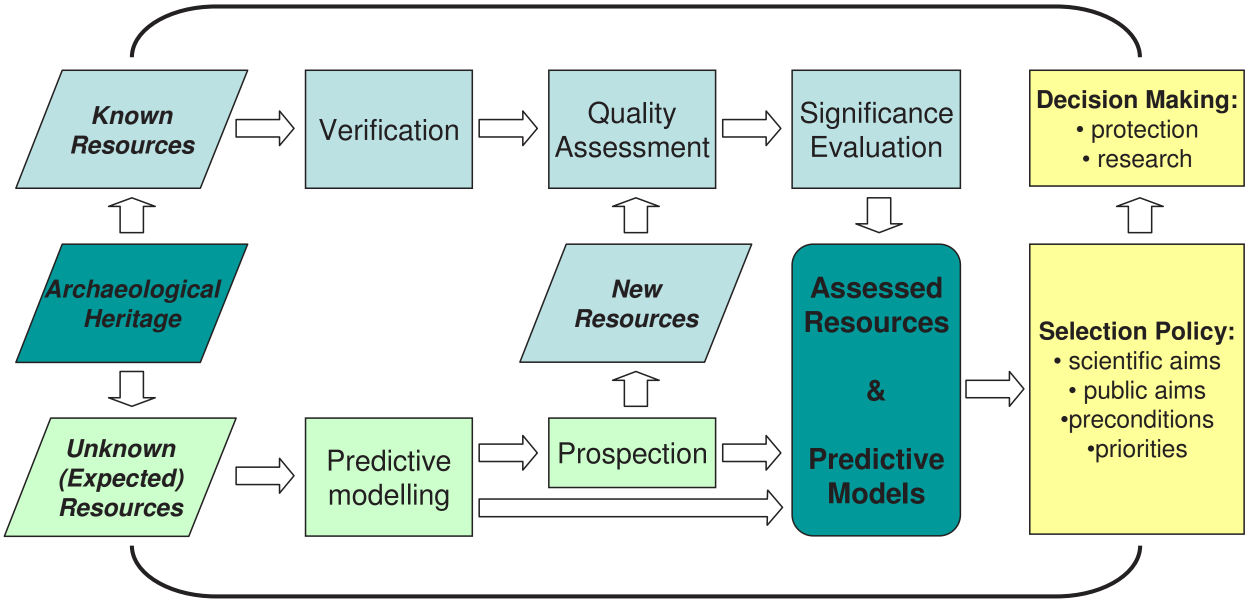


Fig 1.1 The cycle of archaeological heritage management in the Netherlands explicitly involves both the known and the unknown (expected) heritage (from Groenewoudt & Peeters 2006).

revealed that reports lag behind with respect to the interpretation and synthesis of excavation results, relative to the research themes and questions in the NOaA 1.0. This raises the question: What can we learn from all these investigations that have found their way into reports?

For this purpose, the Cultural Heritage Agency of the Netherlands (Rijksdienst voor het Cultureel Erfgoed; RCE) commissioned a project, undertaken by the Groningen Institute of Archaeology (GIA), which aims at a synthetic analysis of (mostly) excavation results concerning early prehistory (here defined as the Palaeolithic to the Middle Neolithic). The project is part of the RCE's Valletta harvest (Oogst voor Malta) project, which resides under the 'archaeological knowledge kit' programme (Kenniskaart Archeologie).[2] The aim of the programme is to develop tools or utilities to support heritage management decision making from a national perspective. In the particular case of our study, the aim is to establish to what extent research questions from the NOaA 1.0 can be answered at a synthetic level, drawing from the published reports resulting from development-led projects. The results of our study will feed in to an evaluation of the NOaA research questions and will eventually help inform a proposal for changes to the research questions for NOaA 2.0, which has recently been launched (see section 7.2).

In the following sections, we provide a general outline of the analytical framework and practical approach that form the basis of this study. Chapter 2 presents further details about the development of a knowledge system, the assessment of reports, the geographical and chronological representativeness of selected reports, and data mining. The chapters 3, 4 and 5 present the results in connection with the NOaA 1.0 research questions. These chapters will, however, also include critical comments with regard to problems encountered. Hence, we not only address the aspect of knowledge gain, but also the aspect of knowledge gaps. The critical discussion will be continued in chapter 6, and suggestions for improvement will be made in connection with the practice of development-led research. Chapter 7 draws general conclusions from our study and presents a look into the future of the national research agenda.

1.2 Analytical framework

As mentioned above, the aim of this study is to bring together and analyse excavation results, in order to deepen and broaden our knowledge about the early prehistoric past of the Netherlands, relative to the research themes and questions in the NOaA 1.0. The broad range of

[2] Lauwerier *et al.* 2017.

research questions listed in the NOaA 1.0 are grouped under five thematic headings, which can be translated as follows: (a) human colonisation and early occupation history of the Netherlands; (b) land use and settlement systems; (c) food economy, relationship between humans and environment; (d) burial and deposition of human remains; (e) cultural traditions/social relationships and interaction. Within these themes, for the archaeological time period covered by this study, a chronological distinction is made between Middle Palaeolithic, Late Palaeolithic and Mesolithic, and Neolithic. In addition, a number of research questions refer to particular archaeological phenomena (e.g. pit hearths), fieldwork strategies, or the analysis of data and finds.

A synthetic analysis of the reported excavation results in direct reference to the NOaA 1.0 research questions will without doubt lead to deeper insight into specific questions, yet also risks missing the connections between various aspects of interest. In fact, this is the crux of the problem with the body of reports that have resulted from development-led archaeology: Questions are answered one by one, but seldom in tandem or within a broader thematic perspective. In order to avoid such fragmentation of knowledge, we will approach the problem in a way that permits us to simultaneously broaden and deepen our insights under three overarching diachronic themes, each of which, in turn, can be approached from four analytical spatio-temporal dimensions (section 1.2.4).

The overarching themes (fig. 1.2) connect to three broad arrays of the 'human realm of existence': people and materials (section 1.2.1); people and space (section 1.2.2); and people and environment (section 1.2.3). All three themes have a direct bearing on the study of human behaviour in the past on the basis of archaeologically recorded data and subsequent interpretation of the patterning found within. It is important to note here that we use the division into archaeological periods (Palaeolithic, Mesolithic, Neolithic, and further subdivisions) in a strictly chronological sense, not to refer to sets of material culture or human lifeways (e.g. economy, socio-cultural relationships, ideology).

1.2.1 People and materials

The study of the relationships between people and materials is perhaps the most obvious from an archaeological perspective. Our primary source of archaeological information consists of objects made out of a broad range of natural resources, as well as features resulting from human interference. Not surprisingly, finds and anthropogenic features receive a great deal of attention in reports in terms of both description

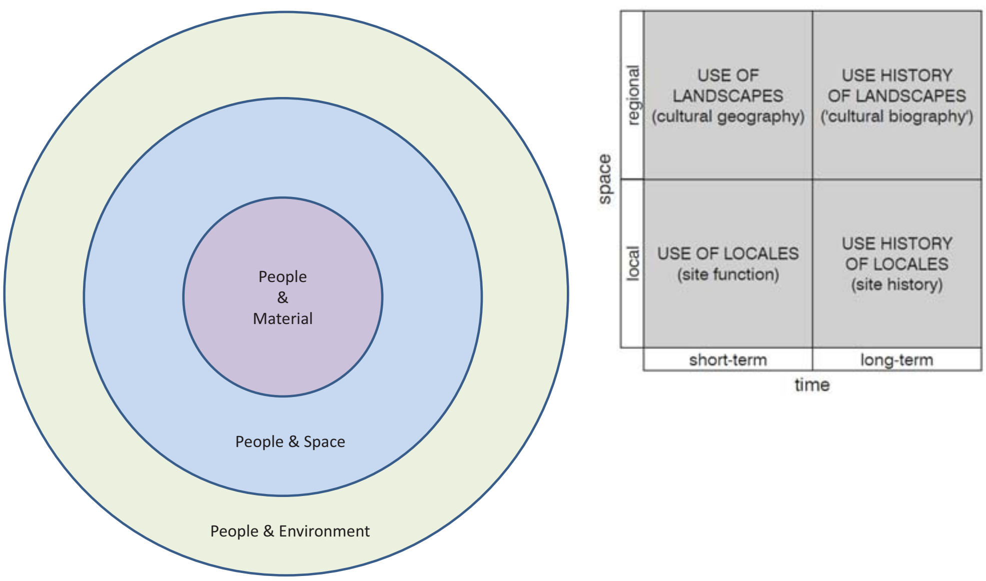


Fig 1.2 The three overarching themes that are central in this study connect people to different scales of interaction and are approached from multiple scales in terms of space and time.

and analysis. Mostly, this results in a typological, technological and/or functional classification of (assemblages of) materials to support a chronological and functional characterisation of a site or a complex of sites. However, other aspects of 'materials' also need to be taken in consideration – for instance, the role of pottery and grinding stones as socio-ideological factors in connection with the preparation of food.[3] Another example is the role of objects in ritual contexts,[4] or the role of particular objects – which, from an archaeological perspective, may not even be considered 'special' – to connect geographically separated places in the landscape.[5] Thus, the 'materiality' of various aspects of people's behaviour can take different forms. However, the question is: Is the range of interpretive possibilities entirely considered within development-led archaeology at the research design stage (that is, in the Programma van Eisen), or given the proper attention in reports? The answer is most probably 'No', because less straightforward interpretations often depend on contextualisation within a synchronic and diachronic and spatial framework that exceeds that of the excavated 'window' (i.e. the site).

1.2.2 People and space

The study of the spatial behaviour of people involves analysis at the intra- and/or inter-site level. Intra-site analyses focus primarily on the identification of spatial structures (e.g. houses, storage facilities, wind breaks) or zones with a distinctive functional signature (i.e. activity areas). Inter-site analyses aim at the identification of functional differences and relationships between sites, for instance, to reconstruct 'settlement systems' or draw inferences about mobility strategies. Development-led archaeology is particularly concerned with the intra-site level of spatial behaviour.[6] However, major problems emerge from the palimpsest character of the great majority of sites that are normally selected for excavation. High-density scatters of material remains and features typically result from long-term, repeated use of a particular place, and these are difficult to decipher and understand in terms of meaningful components of behaviour.[7] Studies aimed at increasing our insight into the 'structure' of palimpsests in order to develop a better understanding of the underlying processes of palimpsest formation are few, but they offer hopeful perspectives.[8] The application of complementary analytical techniques derived from different theoretical and methodological concepts has recently shown that surprisingly useful results can be obtained, for instance, in the case of several Late Neolithic settlement sites in the province of Noord-Holland.[9] So, instead of considering palimpsest sites/distributions to be impossible to understand in terms of spatial behaviour, efforts can be made to turn such configurations into valuable sources of archaeological information. The fact that it may be difficult, if not mostly impossible, to identify discrete spatial entities that can securely be considered 'contemporaneous' does by no means imply that palimpsests are a dead-end street.

1.2.3 People and environment

Just as the previous two themes are the 'bread and butter' of archaeological research, the study of the relationship between people and environment is another theme that is prominent in Dutch archaeology, including within development-led archaeology. 'Landscape' figures as a structural element in many project outlines, but it seems to be variably perceived and investigated. Also, in the context of early prehistoric archaeology, the concept of landscape is frequently considered to be synonymous with natural scenery. Landscape thus has a connotation of a state of being, rather than a dynamic whole. Consequently, little attention is paid to the interaction between people and the landscape. In our opinion, the term environment seems more appropriate than the term landscape in this context, first, because people experience their surroundings as they move and, second, because the environment is multidimensional in terms of agency, as perceived by individuals who operate within a particular socio-ideological and ontological context. By placing these interactions in the foreground, the spatial and temporal scales become more pertinent, as not all changes in the environment will have been of relevance at the

3 E.g. Devriendt 2014; Raemaekers *et al.* 2013.
4 E.g. Louwe Kooijmans 2003; Van Gijn 2010.
5 E.g. Kamstra *et al.* 2016.
6 Within this theme, we will only partly address the inter-site level of use of space. The number of new data-points that has been acquired from 2005 to 2014 is most probably too restricted to generate new insight into, for instance, choice of settlement location. In addition, much development-led research is prompted by survey results that are rooted in existing models of spatial behaviour at the (supra-)regional scale, hence leading to self-fulfilling expectations. Any new insights will therefore be of an anecdotal nature.
7 Bailey 2007.
8 Gordon 2009; Peeters 2007.
9 Nobles 2016. Fokkens, Steffens & Van As 2016 have expressed their doubts about the interpretive possibilities of these particular datasets (see section 4.3.1 for further discussion).

human scale. Millennial- and centennial-scale environmental dynamics, for instance, due to climate change, may be of archaeological interest for studying long-term patterns of behavioural change, but they are probably less informative for studying regional patterns of subsistence at the scale of several generations. Also, the use of the environment is not simply bound to economic factors, but is also related to historic and cosmological factors, which can be expressed through the duration and particular use of localities.[10] The question, then, is: At which scales is landscape – or, as we prefer to term it, environment[11] – considered in the context of development-led archaeology?

1.2.4 Spatio-temporal dimensions

The themes described above will be connected with an analytical framework that distinguishes four space–time dimensions:

- Local and short-term (use of locations);
- Local and long-term (use-history of locations);
- Regional and short-term (cultural geography);
- Regional and long-term (cultural biography).

The local scale refers to the spatial units ('windows') as investigated through excavation. The regional scale refers to some defined spatial entity which exceeds the local scale, and corresponds to an area the size of a so-called 'archaeological landscape'. An archaeological landscape is defined by the national heritage agency as a landscape with particular geological histories and subsoil characteristics, or as a landscape containing archaeological phenomena with characteristics that are related to the geological history of one particular landscape.[12] These are, however, of variable size. For our purpose, the synthetic analysis of excavation results at the two local dimensions involves research questions that refer to the site and its direct surroundings. Synthetic analysis at the two regional dimensions involves research questions that require a broader contextualisation of data to permit interpretations at a non-local scale. Hence, the various analytical scales provide a tool for investigating patterns within the archaeological record. The reality in the past no doubt consisted of a complex of interwoven space/time dimensions.

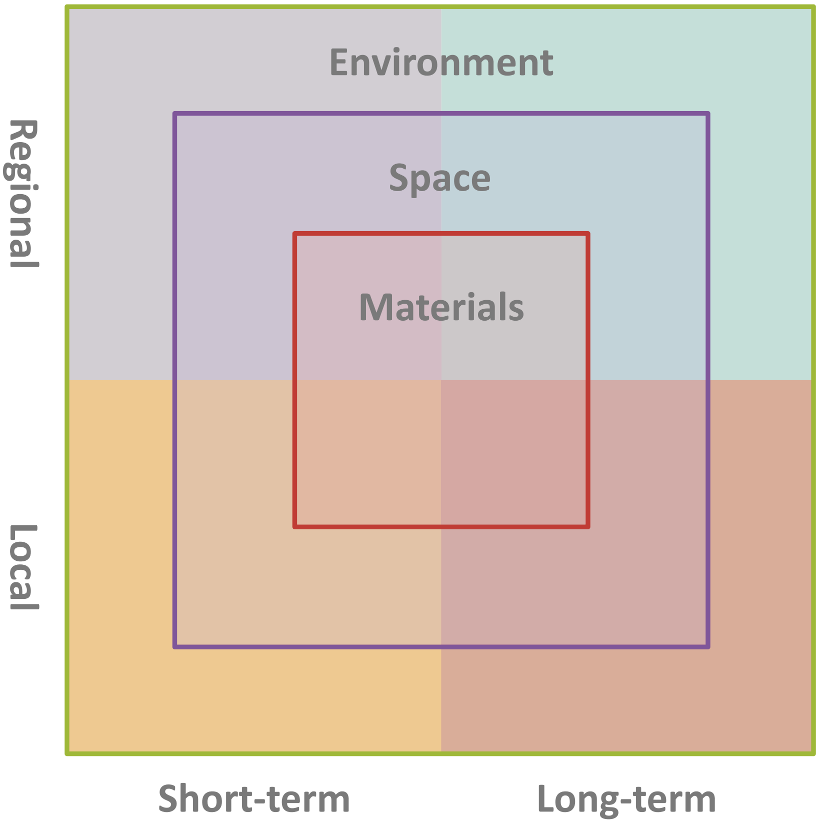


Fig 1.3 The themes and spatio-temporal dimensions combine to form 12 knowledge domains.

1.2.5 Knowledge domains

The connection of the three diachronic themes and four spatio-temporal dimensions of analysis lead to twelve so-called knowledge domains, each of which covers different aspects of behaviour taken from variable perspectives (fig. 1.3).[13] The four dimensions, in theory, apply to each overarching research theme. However, specific NOaA 1.0 research questions can be of relevance to more than one research theme, and will thus contribute to more than one knowledge domain. In the thematic chapters (chapters 3, 4 and 5), the knowledge domains will not explicitly serve to structure the discussion. However, we will use these domains in our broader discussion of what development-led archaeology has contributed to our understanding of the past (chapter 6).

10 Cf. Amkreutz 2013; Peeters 2007, 2009a, 2009b.

11 *Landscape* is a vague concept, referring to an undefined stretch of land which is characterised by a selected range of features (e.g. 'mountain landscape'; 'river landscape'; 'hedgerow country'). *Environment* refers to the broader range of phenomena that a landscape is composed of, such as trees, animals, terrain features and water. These are also the phenomena that are studied more directly, e.g. through the analysis of botanical macroremains, pollen and microfauna and through relief mapping.

12 Rensink *et al.* 2015.

13 For example: People and space – Local and short-term; People and space – Local and long-term.

1.3 Report selection

In agreement with the RCE request, we made a selection amongst the available reports for the purpose of our synthetic analysis. Only reports with the following characteristics were eligible for our analysis:

- The report describes the results of a commercial, development-led fieldwork project.
- The report was published between 2005 and 2014.
- The subject matter of the report includes material from the Palaeolithic up to and including the Middle Neolithic (i.e. early prehistory).

The basis for the selection procedure was formed by the national Archis database, in which information about all archaeological investigations and observations is stored (e.g. administrative data; spatial, geological, and typological aspects; archaeological interpretation).[14] Reports about specific fieldwork projects are linked to the system, although in reality this appeared to not always be the case. Missing reports could, in some cases, be obtained from the DANS-EASY database, which serves as the digital repository for research data and documentation.[15]

The reports were screened for their potential usefulness for this study based on the three criteria above and, beyond that, based on whether, as a corpus, they are able to provide coverage of the following:

- survey versus excavation (trial trenches, full excavation);
- early prehistoric finds anticipated versus not anticipated ('by-catch');
- academic involvement versus no academic involvement;
- overall 'quality': (a) generic versus specific (data based); (b) clarity of presentation (by subject, by excavation unit); (c) level of synthesis (integrated research results, question-by-question answers).

The assessment process is further described in section 2.3. It should be mentioned here that the assessment did not include an analysis of potential correlations with preconditions or restrictions set by the clients (e.g. municipal authorities, the state or private companies), the project outlines and budgets, and the commercial archaeological firms involved. Although these quality-driving factors influence the quality of the research and the resulting reports, an analysis of these factors would require a different approach and would involve issues that are beyond the scope of this study.

1.4 Practical approach

This study was conducted in two phases. The first phase involved a survey of the available reports to evaluate their potential as a useful source of information relative to (a) the research themes (as noted above) and (b) a set of related NOaA 1.0 research questions that seemed viable for a synthetic analysis. The second phase involved the actual synthetic analysis including an in-depth evaluation of the reports as a source of information.

In the first phase, an initial list of questions was compiled by our specialist group, based on the questions provided in the NOaA 1.0. This resulted in a list of no fewer than 72 questions, many of which were subsequently combined (being interrelated research questions) or removed based on whether we thought it was feasible for them to be answered within the context of development-led research. The latter category particularly involved broad questions that require regional-scale inter-site analysis. The potential for research questions to be answered depended, of course, on the information provided in reports. The final list comprised 34 research questions, each of which was connected with a set of 'aspects' (i.e. keywords or terms such as 'flint', 'Wommersom quartzite' or 'grave'). With the aspects linked to the publications and questions, the reports could be easily sorted for their richness of information (sorted by number of linked aspects) or for specific categories of information (e.g. presence of human remains). Likewise, because we were then able to list the number of publications that were available in connection with each specific research question, it was now clear to us how answerable certain questions would be. The process and outcome of this exercise are discussed in further detail in chapter 2.

The second phase involved the retrieval of information in connection with specific research questions, and analysis of that information to the extent that the quality and quantity of data allowed. The outcome of this synthetic analysis is presented in chapters 3 to 5.

14 An offline version of the Archis database was made available by the Cultural Heritage Agency (Rijksdienst voor het Cultureel Erfgoed [RCE]). This version allows for more rigorous and flexible data analysis and querying than does the online front-end query environment (https://archeologieinnederland.nl/bronnen-en-kaarten/archis). Archis stands for Archeologisch Informatiesysteem (archaeological information system).

15 DANS stands for Data Archiving and Networked Services. It is an institute of the Dutch royal academy of sciences (Koninklijke Nederlandse Academie van Wetenschappen; KNAW) and the Netherlands Organisation for Scientific Research (known by its Dutch acronym, NWO).

2 Knowledge system and report assessment

2.1 Introduction

The preceding chapter provided an outline of the analytical framework and a general characterisation of the reports resulting from development-led research, as well as a brief description of the practical approach. This chapter presents a detailed description of the structure of the knowledge system, the process of report assessment, data mining procedures, and problems encountered during data mining.

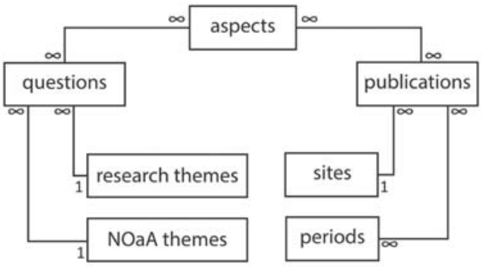


Fig 2.1 Schematic representation of the aspect-related connection between research questions and publications (reports).

2.2 Knowledge system

In order to enable structured searching of reports in connection with the analytical framework and the interrelated NOaA 1.0 research questions, as outlined in chapter 1, it was necessary to build a flexible database structure (fig. 2.1). The structure was designed to allow for the selection of reports concerning sites that potentially provide information on particular topics, such as raw material procurement, or the function of pit hearths. To enable us to make connections between our research questions and the reports, we compiled a list of 50 'aspects' that we also deemed to be prerequisites for formulating answers to the research questions (table 2.1). These aspects range from physical archaeological evidence to field methods and applied analyses. The screening of reports on the basis of these aspects indicates which questions can potentially be answered based on the information provided in each report. Because the database structure permits querying in both directions, a query on a particular research question generates a list of potentially relevant reports, and the selection of a report generates a list of potentially answerable

Table 2.1 Aspects initially used to connect research questions to reports.

ID	Aspect	ID	Aspect	ID	Aspect
1	artefacts: flint	18	features: storage	35	landscape data
2	artefacts: stone	19	features: post holes	36	dating: OSL
3	artefacts: ceramics	20	features: hearths	37	dating: ^{14}C
4	artefacts: organic	21	features: waste pits	38	site function
5	artefacts: bone	22	features: agricultural	39	site function: activity areas
6	resources: flint	23	Structures	40	site function: settlement
7	resources: stone	24	spatial data: artefact distribution plot	41	site function: cemetary
8	resources: ceramics	25	spatial data: features	42	structures: houseplans
9	flint technology	26	structure: burial/grave	43	artefacts: other
10	flint typology	27	grave goods	44	collection method: trench
11	ceramic decoration	28	special deposition	45	collection method: grid
12	faunal remains	29	XRF analysis	46	collection method: point
13	human remains	30	micro-morphology	47	collection method: other
14	botanical remains: macro plant	31	organic residue analysis	48	spatial data: DANS
15	botanical remains: pollen	32	use-wear analysis	49	spatial data: further analysis
16	botanical remains: seeds, fruits	33	Palaeoecology	50	spatial data: palimpsest
17	botanical remains: wood	34	Palaeogeography		

questions. Furthermore, the connection between each research question and report was stored in relationship to NOaA 1.0 research themes and the overarching themes, as defined under the umbrella of our analytical framework (see chapter 1). This permitted further thematic sorting, which made it possible to generate lists of reports that are of potential relevance to thematic sets of research questions.

The final set of 34 research questions that were distilled from the NOaA 1.0 variably connect to the overarching themes. Appendix I provides a listing of the NOaA 1.0 questions in connection with the research themes as defined in chapter 1. As is apparent from figure 2.2, the great majority refer to the theme 'people and materials', due to the fact that the analysis of material culture is at the heart of many archaeological studies (see section 1.2.1). The themes 'people and space' and 'people and environment' each cover somewhat less than half of the research questions. When we break these numbers down, we see that 19 questions relate to more than one theme, which leaves 15 questions unique to a single theme, mostly that of 'people and materials'. Combined with the spatio-temporal dimensions (section 1.2.4) further configurations are possible, since research questions can be related to one or more of these analytical dimensions. The possibility to connect individual research questions to more than one overarching research theme, spatio-temporal dimension, or knowledge domain (fig. 2.3), demonstrates the difficulty of providing a structured framework for synthetic analysis based on the existing construct of the NOaA 1.0. We will discuss this problem further in chapter 6 in connection with the research agenda, fieldwork and reporting.

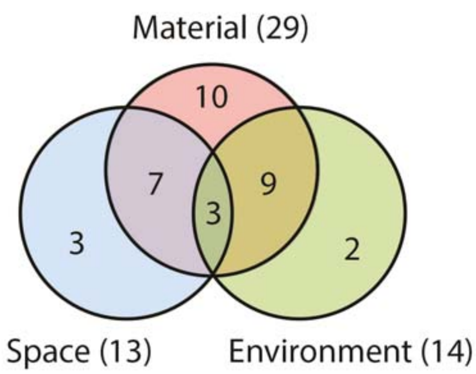


Fig 2.2 Number of NOaA 1.0 research questions in relation to the overarching research themes.

2.3 Report assessment

2.3.1 Report selection and preliminary assessment

The complete list of reports in the Archis database was first filtered by publication date (between 2005 and 2014), which resulted in a list of c. 750 reports. Next, entries that included a starting date of occupation that was later than the Middle Neolithic were deselected, because these fall outside the scope of this project. Unfortunately, this did not eliminate all reports that were unsuitable for our analysis. Querying for early prehistoric sites only proved somewhat problematic, as information about the dating of a site and the archaeological periods actually represented is neither specifically nor systematically provided within Archis. Instead, only the starting period and end period are given. Provided a site covers only a restricted and well-identifiable time range, this does not

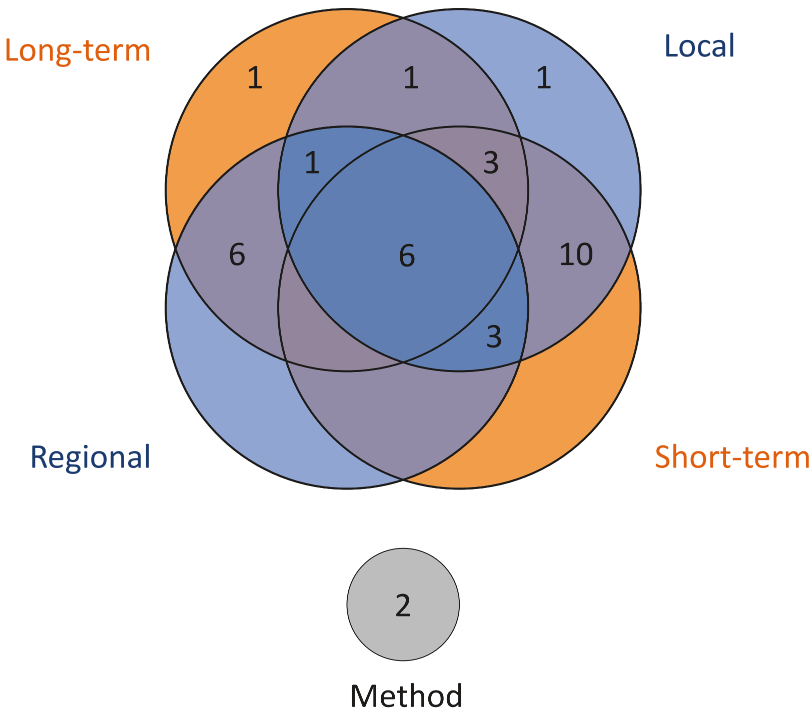


Fig 2.3 Number of NOaA 1.0 research questions in relation to the spatio-temporal dimensions.

lead to any problem in this instance. However, uncertainty about the dating of the phenomena uncovered often leads to a wide chronological attribution. Entries of non-diagnostic flint artefacts, for instance, are often given the broad range of Palaeolithic up to Iron Age. Other finds categories, such as charcoal and stone artefacts made of rocks other than flint, are often given a date range from the Palaeolithic up to the post-medieval period. In other cases, excavations may have produced remains from multiple periods. Consequently, queries involving start dates within one or more of the periods covered by the category 'early prehistoric' are not necessarily going to return results for reports covering early prehistoric remains. In order to reduce the amount of 'noise' within the selected set of reports, manual screening was necessary.

As the aim of the project is to conduct a synthetic analysis of results from development-led work in connection with the NOaA 1.0, it was decided to give priority to reports that present the results of excavations. In contrast to surveys (auger sampling, test trench or test pit sampling), excavations mostly will have covered extended and continuous surfaces and are expected to have produced high-resolution data, which potentially allows for more solid interpretations. This, however, does not imply that surveys provide no valuable information from which to develop new insights. Observations can potentially add to the analysis of, for instance, land-use patterns on a wider geographical scale, although the interpretive possibilities are expected to be limited due to the lack of sufficient data to put these in context. However, to assess the potential information value of survey results within the context of this project, detailed manual examination of such reports would have been required. Because we could not be certain a priori about the actual gain, we decided that manual screening of survey reports would use up too much of our budget. Consequently, reports on surveys were deselected. Again, this did not eliminate all reports that were unsuitable for our analysis, because the two types of reports were not always correctly categorised. The solution was to remove those entries from the list that contained keywords pertaining to surveying in the report title. Even this turned out to be not a fool-proof solution, because a certain number of survey reports got 'trapped' in the final selection. We kept them in the final selection as a 'random' sample of survey reports. In addition, we purposefully added reports on some rather sizeable surveys (e.g. Well-Aijen) because of their anticipated value for our study.[16] Furthermore, we added some reports on archaeological watching briefs, e.g. for the purpose of pipelines or channels (e.g. Olieveld Schoonebeek),[17] because these potentially provide insight into the archaeological significance of areas that are normally not excavated due to the absence of settlements, which remain the prime concern of most development-led work.

Appendix II lists the titles of the selected reports. In the following text, general references to reports will consist if the publication identification number (PUBID) used in appendix II; where reference is made to specific topics or sections, we provide the full reference, which is listed in the bibliography. The final list comprises 139 publications of varying size and subject matter – 85 on excavations, 30 on surveys, and 24 on archaeological watching briefs. A total of 84 reports are explicitly concerned with early prehistoric archaeology. The remaining 55 reports have a focus on a later periods; early prehistoric archaeology is considered of secondary importance.

A preliminary assessment of the reports for their information potential was conducted on the basis of the number of linked aspects (fig. 2.4). These aspects involve archaeological phenomena (materials, features) as well as methods and approaches (e.g. ^{14}C-dates, optically stimulated luminescence (OSL) dates, pollen analysis, excavation method). Obviously, the number of linked aspects is no direct indication of information value: reports that do not contain many aspects can contain a lot of information on just one aspect, for instance, a site with a single-period flint assemblage without many other preserved finds categories. Nonetheless, it can be argued that reports with many linked aspects potentially offer better possibilities for contextualisation of specific data due to the broader range of topics that can be covered. As expected, the number of linked aspects is generally higher for reports on

16 Appendix II: PUBID 592.
17 Appendix II: PUBID 482, 483, 485, 489.

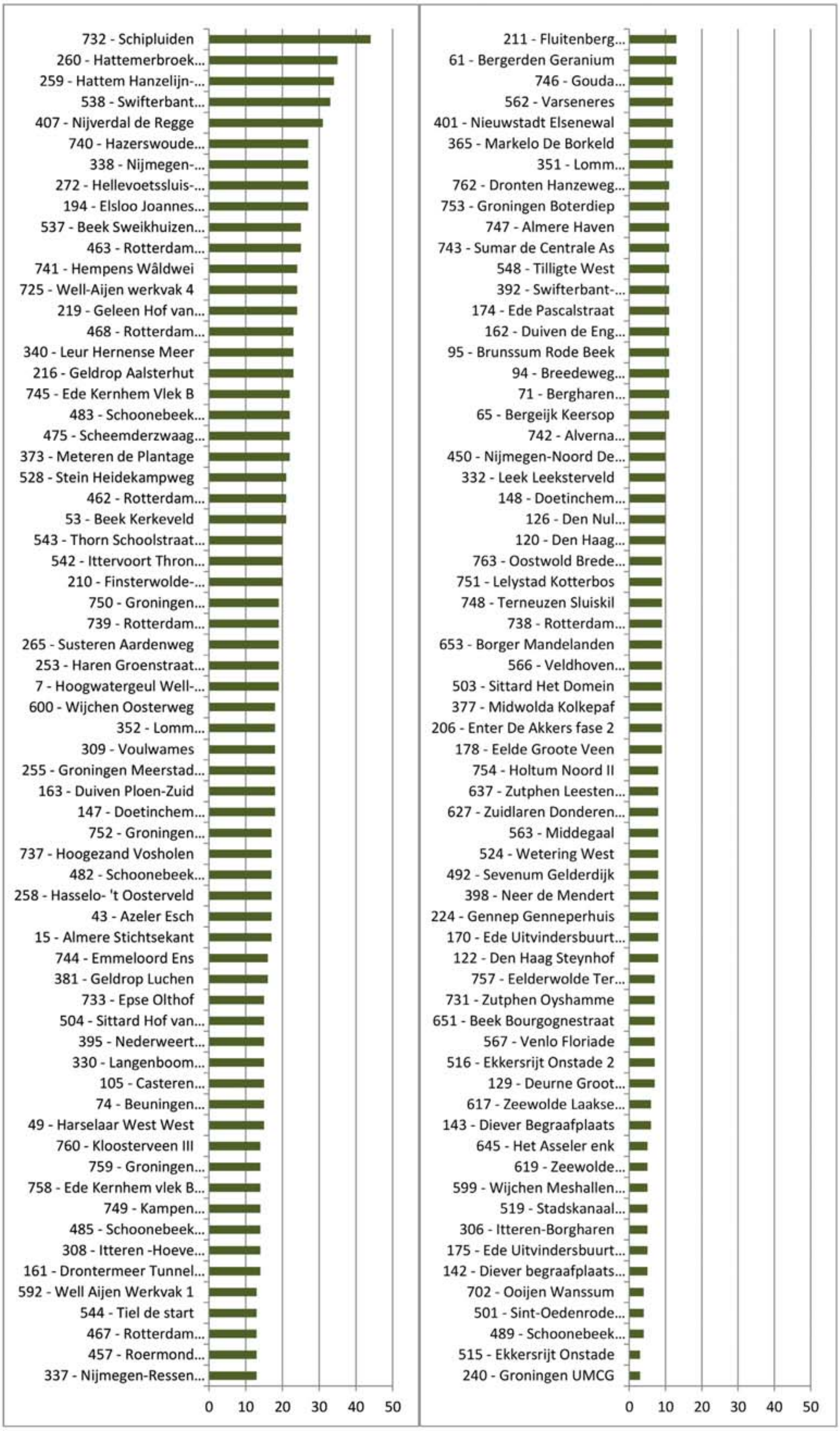


Fig 2.4 Number of aspects per report/site.

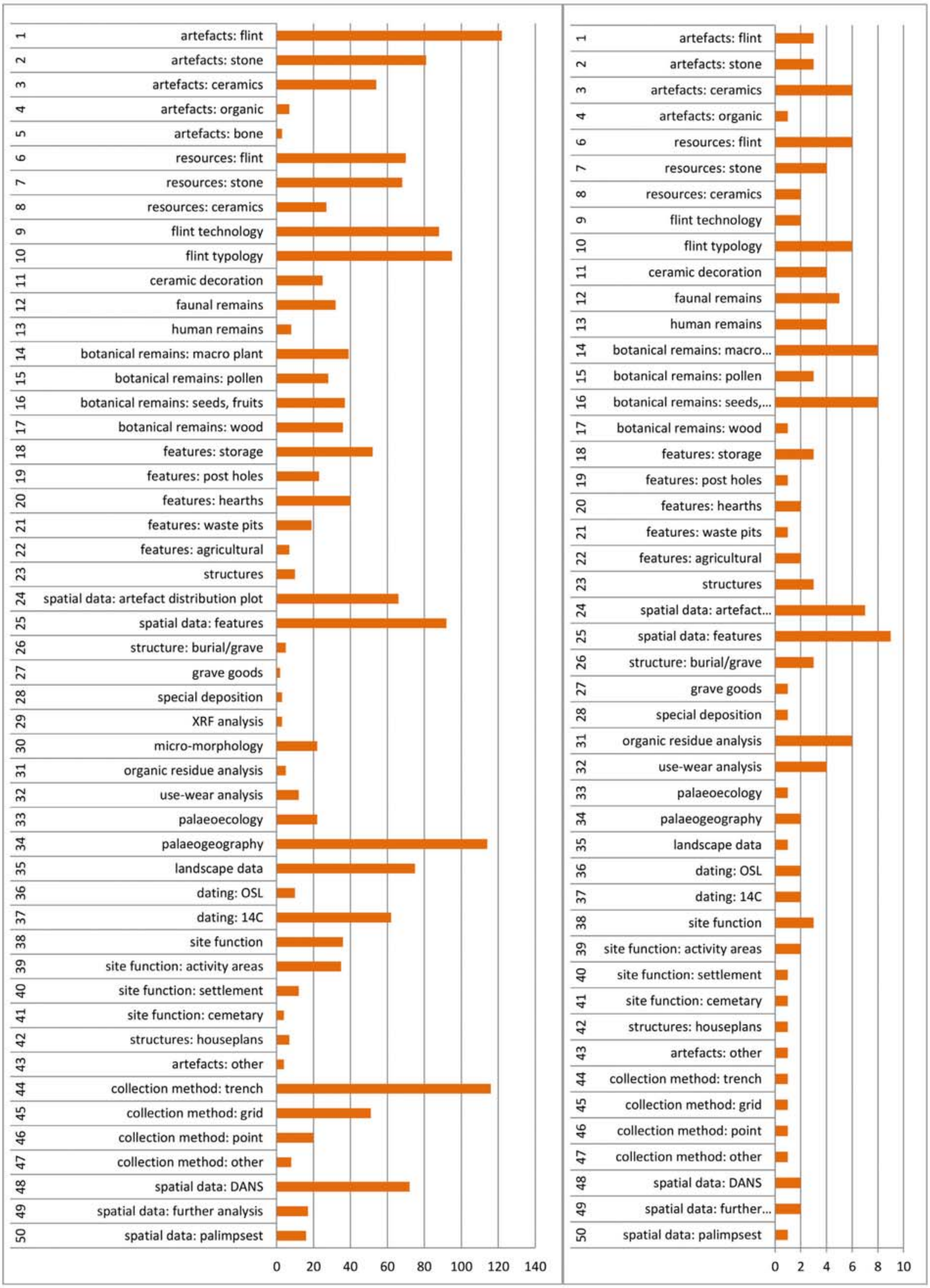


Fig. 2.4 Continued number of reports per aspect (left), and number of research questions per aspect (right).

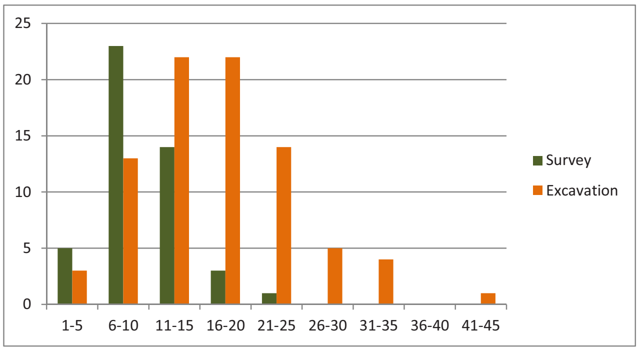


Fig 2.5 Number of reports of surveys and excavations per aspect frequency class.

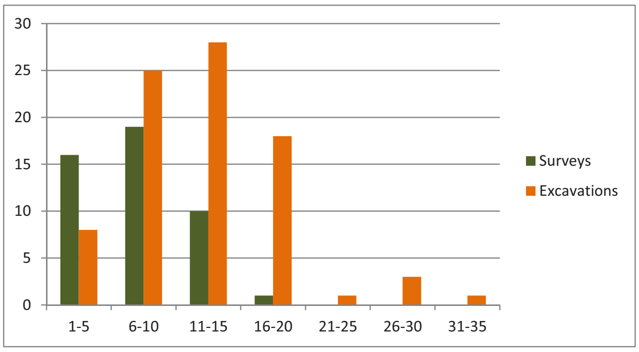


Fig 2.6 Number of reports of surveys and excavations per aspect cluster frequency class.

excavations compared with reports on surveys and archaeological watching briefs (fig. 2.5). As figure 2.5 shows, initially, the number of excavation reports increases in proportion to the number of aspects, but drops when more than 20 aspects are linked. The number of survey reports drops when more than ten aspects are linked. In order to get a clearer picture of the relationship between the nature of fieldwork (excavation, survey) and the aspects in reports, we clustered some aspects in order to reduce the number of aspects (table 2.2). Figure 2.6 shows a slightly different distribution in comparison with figure 2.5, but the trends remain the same with regard to survey and excavation.

Because aspects are linked to the reports in our database, it was possible for us to assess whether a report had the potential to help us answer a specific research question. The reports were sorted based on their inclusion of these aspects – such as hearths or graves, dwelling structures, pottery, botanical remains, faunal remains, or human remains. A notable difference between survey and excavation reports is the absence of burials/cemeteries and built structures in the former (table 2.3). This is to be expected, since burials and cemeteries, being relatively rare phenomena, have less chance of being recovered in the context of surveys, even in test trenches. Built structures are normally identified once larger surfaces have been investigated, but are in fact rather exceptional in early prehistoric contexts. Hence, survey reports are primarily connected with common finds categories, such as flint, stone, ceramics, macrobotanical remains, as well as categories of features, such as postholes and hearths. With regard to methods and approaches, less common specialisations, such as X-ray fluorescence (XRF) analysis, organic residue analysis and OSL dating, are missing in the survey reports. This leads to the conclusion that the information potential of survey reports will generally be lower than that of excavation reports, and that it will be restricted to material finds categories.

2.3.2 Geographical and chronological coverage

It became clear from our study of the 139 reports that development-led fieldwork conducted between 2005 and 2014 resulted in the discovery of at least 139 early prehistoric sites; some projects (e.g. two large-scale projects near Knooppunt Hattemerbroek,[18] as well as the Well-Aijen survey[19]) cover complex palimpsest configurations of overlapping and merged sites. For the purpose of the present study, it is important to assess the potential of this body of sites for answering research questions in a wide geographical setting. The distribution of these sites can potentially be of interest for the development of models of variability in landscape use. In addition, the analysis of diachronic patterns of site distribution and the nature of activities can inform us about long-term dynamics of landscape use.

Geographical distribution

Figure 2.7 shows that the sites discussed in the 139 reports are unevenly distributed. The majority are located in the eastern half of the Netherlands, with a cluster of sites located in the western part of the country, roughly between Leiden and Rotterdam. The geographical distribution of these sites is primarily influenced by three factors.

[18] Appendix II: PUBID 259, 260.
[19] Appendix II: PUBID 592.

Table 2.2 Aspect clusters in relation to initial aspects.

Type	Cluster ID	Aspect cluster	Aspect ID	Aspect
Evidence	1	flint	1	artefacts: flint
			6	resources: flint
			9	flint technology
			10	flint typology
	2	stone	2	artefacts: stone
			7	resources: stone
	3	ceramics	3	artefacts: ceramics
			8	resources: ceramics
			11	ceramic decoration
	4	organic artefact	4	artefacts: organic
			5	artefacts: bone
	5	other artefact	43	artefacts: other
	6	macrobotany	14	botanical remains: macro plant
			16	botanical remains: seeds, fruits
	7	wood	17	botanical remains: wood
	8	faunal remains	12	faunal remains
	9	human remains	13	human remains
	10	burial/grave	26	structure: burial/grave
			27	grave goods
	11	cemetery	41	site function: cemetary
	12	special deposition	28	special deposition
	13	hearths	20	features: hearths
	14	pit / feature	18	features: storage
			21	features: waste pits
			22	features: agricultural
	15	post holes	19	features: post holes
	16	activity area	39	site function: activity areas
	17	structure	23	structures
	18	house plan	42	structures: houseplans
	19	settlement	40	site function: settlement
	20	site function	38	site function
Methods and approaches	21	ecology	15	botanical remains: pollen
			33	palaeoecology
	22	palaeogeography	34	palaeogeography
	23	landscape analysis	35	landscape data
	24	micro-morphology	30	micro-morphology
	25	XRF analysis	29	XRF analysis
	26	OSL dating	36	dating: OSL
	27	14C dating	37	dating: ^{14}C
	28	organic residue analysis	31	organic residue analysis
	29	use-wear analysis	32	use-wear analysis
	30	collection method: trench	44	collection method: trench
	31	collection method: grid	45	collection method: grid
	32	collection method: point	46	collection method: point
	33	collection method: other	47	collection method: other
	34	display: distribution plot	24	spatial data: artefact distribution plot
	35	display: features	25	spatial data: features
	36	further spatial analysis	49	spatial data: further analysis
	37	DANS data available	48	spatial data: DANS
	38	spatial data: palimpsest	50	spatial data: palimpsest

Table 2.3 Frequency of excavation and survey reports per aspect cluster.

Aspect cluster 'evidence'	N survey reports	N excavation reports
Flint	42	79
Stone	20	60
Ceramics	12	43
Organic artefacts	2	6
Other artefact	0	4
Macrobotany	9	35
Wood	7	29
Faunal remains	9	23
Human remains	1	7
Burial/grave	0	5
Cemetery	0	4
Special deposition	1	2
Hearths	11	29
Pit/feature	9	45
Postholes	4	19
Activity area	8	27
Structure	0	10
House plan	0	7
Settlement	0	12
Site function	3	33
Aspect cluster 'method/approach'	**N survey reports**	**N excavation reports**
Ecology	9	27
Palaeogeography	37	76
Landscape analysis	18	57
Micromorphology	4	18
XRF analysis	0	3
OSL dating	1	9
^{14}C dating	16	45
Organic residue analysis	0	5
Use-wear analysis	2	10
Collection method: trench	39	76
Collection method: grid	15	36
Collection method: point	3	17
Collection method: other	5	3
Display: distribution plot	19	47
Display: features	20	72
Further spatial analysis	1	16
DANS data available	22	42
Spatial data: palimpsest	3	13

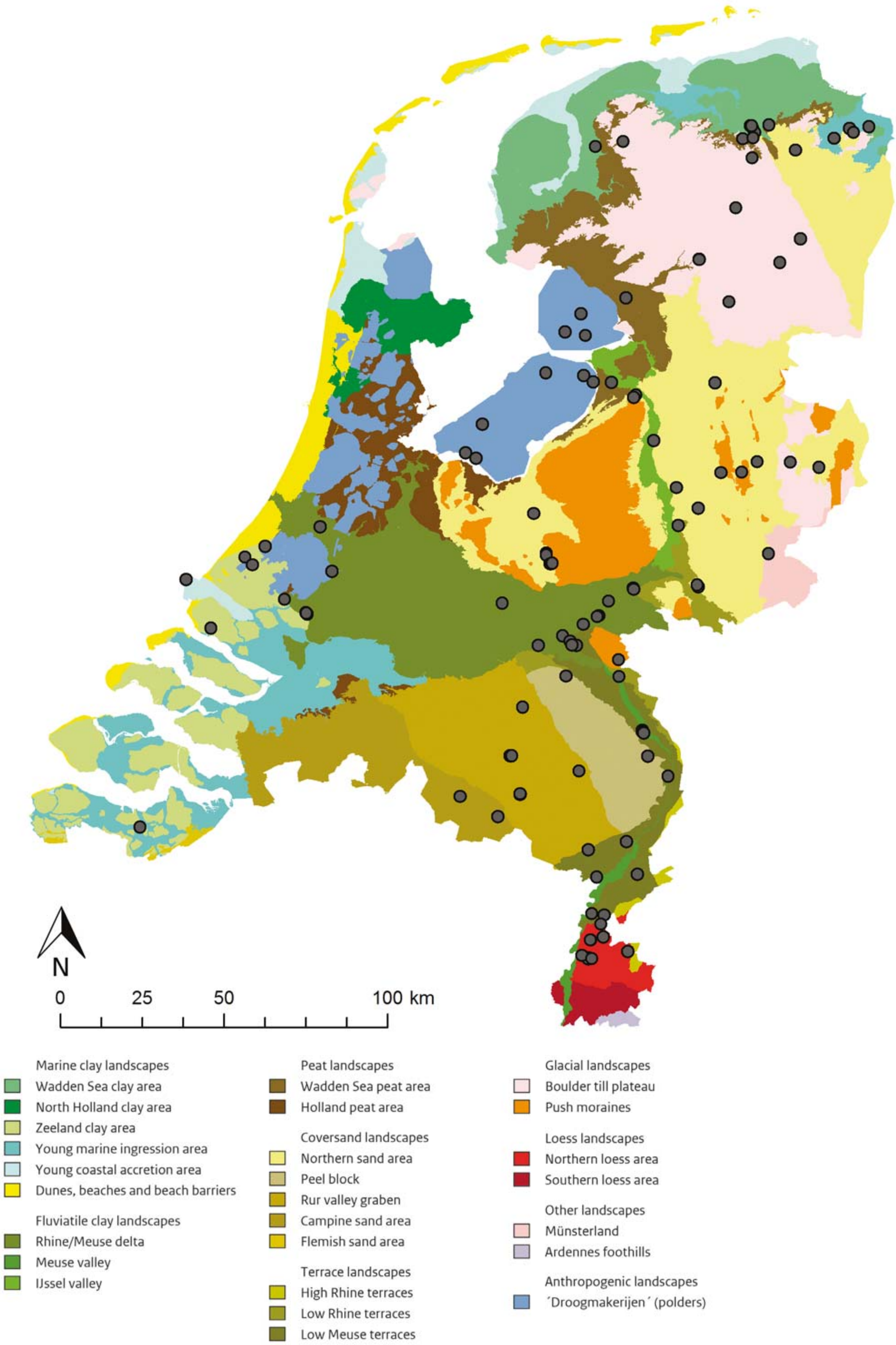


Fig 2.7 Geographical distribution of all selected sites/reports (background: 'archaeological landscapes' as defined by the Cultural Heritage Agency of the Netherlands).

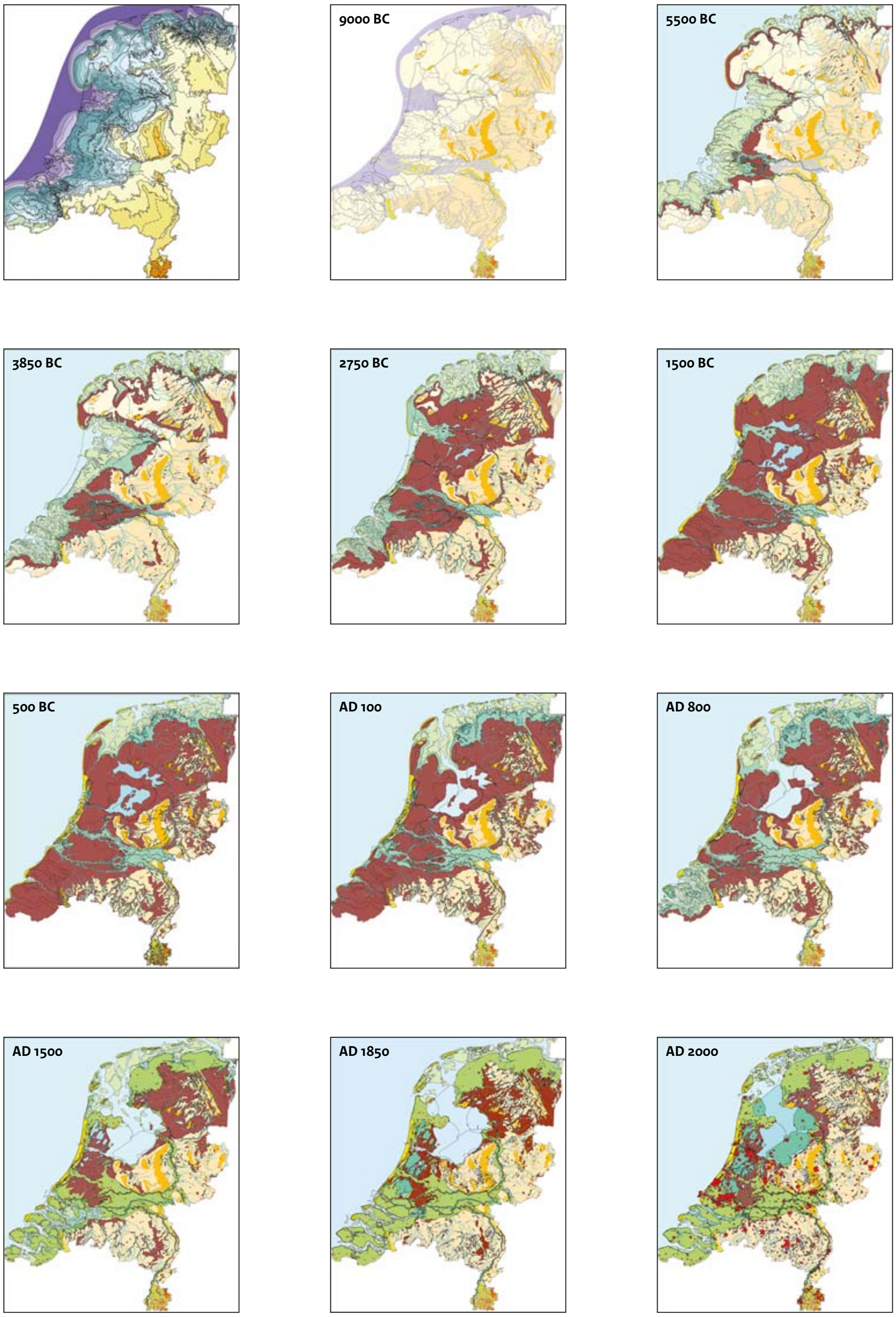


Fig 2.8 Time series of palaeogeographical reconstructions of the Netherlands, showing the major landscape changes throughout the Holocene (from Vos 2015). The maps make clear that the present-day situation is the result of far-reaching natural and anthropogenic processes, which have largely influenced the formation of the archaeological landscape in terms of differences in the nature of initial pattern formation (location, materials, features), as well as the subsequent transformation of initial patterns in terms of preservation and detectability.

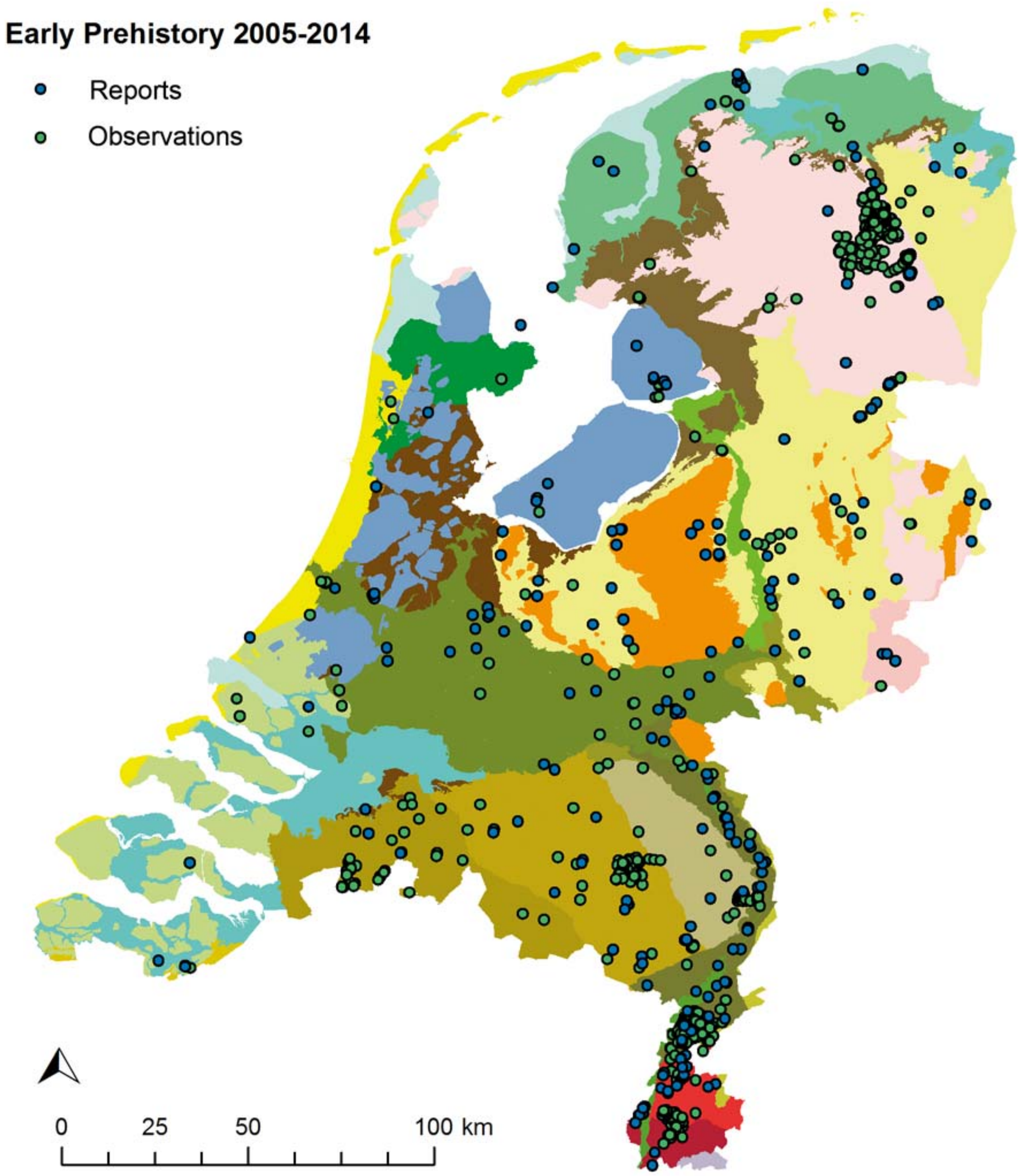


Fig 2.9 Distribution of deselected reports and observations made between 2005-2014 (background: 'archaeological landscapes' as defined by the Cultural Heritage Agency of the Netherlands).

The first factor is the geological history of the Netherlands, which has a considerable effect on site discovery. On the one hand, processes of continuous sedimentation and peat growth have resulted in traces of early prehistoric activity having been covered with thick layers of clay, sand and peat, rendering most prehistoric archaeology inaccessible. This is particularly relevant for the central and western parts of the Netherlands. On the other hand, processes of large-scale erosion have resulted in the disappearance of early prehistoric land surfaces and layers of sediment, notably in the south-western (province of Zeeland) and north-western (province of Noord-Holland) parts of the Netherlands. This erosion is particularly due to Holocene coastal dynamics (fig. 2.8), which are partially influenced by human activity.[20] As a result, traces of early prehistoric activity have largely disappeared in these areas; however, where this is not the case, early prehistoric land surfaces and archaeological layers are deeply buried, up to 20 m below Amsterdam ordnance datum (OD). For this reason, only a small number of sites within our sample are located in the provinces of Zeeland, Noord-Holland and Utrecht or in the coastal regions of the provinces of Friesland and Groningen. In geological terms, the presence of sites between Leiden and Rotterdam is mainly due to the presence of Late Pleistocene and Early to Middle Holocene sand dunes – river dunes and coastal dunes – in the Rhine-Meuse estuary and along the coast.[21] These sand dunes are often found close to the present-day surface and are within reach of archaeological and geological surveying methods.

The second factor influencing the geographical distribution of sites is the location of planned development. This is wholly to be expected, as the focus of this project concerns the results of development-led archaeology. Linear patterns in the distribution reflect the trajectories of railways and pipelines, as well as floodplain adjustments. It is important to bear in mind that such projects are generally initiated and financed by the Dutch state. Archaeological work in the context of these projects is often subject to involvement of the national cultural heritage agency. Examples are the construction of the A73 highway and the floodplain adjustments (known in Dutch as the Maaswerken) north of Maastricht (province of Limburg), which have led to numerous excavations. The building of houses and the development of business parks also form an influential factor. Not all regions are equally dynamic in this respect, and not all local authorities are equally concerned about archaeological heritage. Nature reserves, such as the national parks De Veluwe (province of Gelderland) and the Utrechtse Heuvelrug (province of Utrecht), are devoid of development. Other areas primarily have an agricultural or recreational function and see only limited urban development.

The third factor, that of decision making, renders the picture far more complex. Empty regions in the distribution map of selected sites (fig. 2.7) are not necessarily devoid of archaeological observations and fieldwork (fig. 2.9). Here the history of landscape exploitation and historical development – medieval and post-medieval peat reclamation in the western part of Noord-Brabant, for instance – may (partly) explain the absence of sites in that area in our database.[22] This is not to say that none of the sites pre-dating these large-scale reclamation activities have survived, only that there is a fair chance that many will have been heavily disturbed.[23] Archaeological surveys in such areas will often result in the discovery of disturbed contexts, which easily leads to the decision not to conduct an excavation, because knowledge gain is expected to be limited in these cases.[24] The decision whether or not to excavate is taken by policy-makers, in many cases at the municipal or provincial level, and not all of these policymakers are supported by an archaeological advisor.

In addition, the process of archaeological inventory making in the Netherlands is strongly influenced by the use of predictive models, such as the map of archaeological potential (Indicatieve Kaart van Archeologische Waarden; IKAW).[25] This also plays a role in decision making. Zones with low potential values are frequently – although certainly not always – selected for development purposes, in the hope of avoiding costly archaeological investigation. However, because most models of archaeological potential rely on relationships amongst archaeological observations and geomorphological features and soil characteristics,[26] there is an inherent risk of false quantitative correlations and model self-fulfilment due to a lack of independent model testing (validation).[27] In some cases where rich archaeological sites are found during survey, an alternate location for development is chosen, or measures are taken to preserve the site(s) in situ.[28]

This combination of factors – geological history, present-day development, and decision making – underlies the geographical distribution of development-led surveys and excavations, as shown in figure 2.7. The basic layer of the maps shows the 'archaeological landscapes', as distinguished by the National Heritage Agency, which are defined on the basis of landscape features (geogenesis and landforms) and archaeological characteristics.[29] Within each

20 Vos 2015.
21 The sand dunes are known to be rich in archaeological remains (see e.g. Amkreutz 2013; Louwe Kooijmans 2001a, 2001b) and are therefore subject to survey.
22 Leenders 1996.
23 An example is the Mesolithic site of Tilburg-Kunstcluster, where the heavily disturbed remains of a Mesolithic campsite were discovered within an area showing traces of (post-)medieval reclamation activities (Dijk *et al.* 1994).
24 A recently published overview of the archaeology of the western portion of the province of Noord-Brabant clearly demonstrates that the overwhelming majority of investigated sites date to later prehistoric and early historic times (Ball & Van Heeringen 2016). Burial structures, house plans and other structures (e.g. wells) that are characterised by deep features (pits, trenches, posts) form the majority of the recovered phenomena. Remains from early prehistoric times are extremely scarce.
25 Groenewoudt & Peeters 2006. The IKAW map, version 3 of which was published in 2007, is only sporadically used today, as it has been replaced by maps produced on a regional or a municipal scale. Because the responsability for archaeological heritage lies in the hands of local authorities, this is logical. However, the basic principle of the IKAW, which distinguishes zone of low, medium and high potential, has been maintained.
26 Deeben *et al.* 2002.
27 Kamermans *et al.* 2009; Van Leusen & Kamermans 2005; Verhagen 2007. Moreover, the archaeological record seems inherently unfit for the purpose of validation of predictive models (Brouwer Burg *et al. 2016; Lovis 2016; Peeters & Romeijn 2016; Whitley 2016).*
28 Van der Reijden *et al.* 2011.
29 Rensink *et al.* 2015.

'archaeological landscape', further landscape zones are distinguished, which basically represent characteristic landforms.[30] We will briefly consider the distribution of surveyed and excavated locations in connection with four of these 'archaeological landscapes' and the biasing factors described above.[31]

Rhine-Meuse delta. This landscape can be described as a wide river valley composed of typical floodplain and stream gully features, aeolian river dunes and peat. Surface elevation decreases from east to west, from c. 14 m to −1.5 m Amsterdam OD, which results in increasingly extended peat plains in the western part of the delta. Typically, landforms at the present-day surface are of Holocene age, with the exception of river dunes, which mostly formed during the Late Glacial (Younger Dryas), but continued to be formed during the Early Holocene.[32] However, this landscape hides a complex lithological and geomorphological stratigraphy that is related to its long geological history as a river valley in the Pleistocene and the Holocene. The complexity of the sub-surface build-up – clay, loam, sand, gravel, peat – is largely due to the alternation of erosion and sedimentation at multiple spatial scales.[33] In general terms, the number of surveys and excavations, which potentially could reveal early prehistoric archaeology, increases to the east. This is partly due to intense economic activity and related construction work, and partly due to the occurrence of landforms dating to the Late Pleistocene and first half of the Holocene close to the present-day surface. In the western half of the Rhine-Meuse delta, hardly any excavations have been conducted. Archaeological remains that are early prehistoric in age can only be found at considerable depths,[34] making excavation exceedingly expensive. Hence, excavation can only be considered in cases where highly elevated palaeolandforms, such as river dunes, are encountered. Typically, deeply buried deposits that are of potential interest but that are expected to bear few archaeological remains are often excluded from the heritage management process altogether.[35] In addition, deeply buried sites are not considered threatened because construction or disturbance will not reach the archaeological levels.

Meuse valley. As the upstream extension of the Rhine-Meuse delta, the Meuse valley landscape describes a narrow zone bordered by the Meuse River terraces, which describe yet another archaeological landscape. The valley is variable in width and sometimes deeply incised; in its wider parts, the valley floor consists of an undulating floodplain with remnant gullies and small river dunes. Local differences in elevation amount to c. 5 m, whilst the overall difference in elevation decreases in northern direction, from c. 50 m to 12 m Amsterdam OD. Sand and gravel deposits are common, and these are frequently covered with loam. Extensive aggregate extraction of gravel and coarse sand, as well as floodplain adjustment for water management purposes, has instigated most archaeological surveying and excavation. This is particularly the case north of Maastricht. Because aggregate extraction and water management works are controlled by the national authorities, involvement of the national heritage agency has had major influence on development-led fieldwork. However, early prehistoric remains are relatively scarce, because the Meuse Valley landscape is principally of younger Holocene age. Landscape zones dating to the Pleistocene consist of local outcrops, but are mostly represented in the bordering Meuse terrace landscape. Early Holocene deposits occur occasionally farther north. Archaeological surveys and excavations that involve early prehistoric remains are confined to such relic features.

Campine sand area. Bordering the southern limits of the Dutch coastal and river regions, this landscape, a tectonic high, is characterised by a gently undulating relief intersected by many brook valleys. The sandy nature of the subsurface encountered today is to the result of large-scale peat reclamation in medieval times, in particular in the western half of the area. This has caused major soil degradation and sand drift at various spatial scales. Elsewhere, Pleistocene coversand deposits are encountered at the surface in between the brook valleys, which themselves have an infill of peaty fluvial deposits; Early Pleistocene deposits are present relatively close to the surface. Except for the sand drifts, differences in elevation from the valley floor to the sandy plateaus are between 2 and 5 m. The overall difference in elevation is from c. 40 m to c. 0 m Amsterdam OD in northerly direction. Despite the fact that Pleistocene terrestrial deposits can be found at or near the surface practically everywhere,

30 Rensink *et al.* 2015.
31 At the time of writing, only these four archaeological landscapes have been defined in greater detail (Rensink *et al. 2015*).
32 Vos & Cohen 2015.
33 Busschers 2008; Hijma 2009.
34 Holocene deposits reach a thickness of c. 15 m near Rotterdam, in contrast to c. 1 m at the Dutch–German border.
35 See, for instance, the notes to the archaeological base map of the municipality of Gouda (Groenendijk 2011). An exception is made with regard to deeply buried (>2 m) Holocene meander belt deposits, for which a high archaeological potential was established at Gouda-Westergouwe; archaeological survey is required where such deposits occur within development plans exceeding 100 m², even at depths greater than 2 m.

surveys are almost exclusively restricted to the middle and eastern parts of the Campine sand area.[36] None has led to excavations involving significant early prehistoric archaeology – not even in the case of major archaeological fieldwork in connection with the construction of the high-speed railway (Hoge Snelheidslijn Zuid).[37] Concentrations of Palaeolithic, Mesolithic and Neolithic flint artefacts collected at the surface do, however, attest to the early prehistoric use of the entire area, but these also point to major disturbance of sites. In many cases only the deeper features (postholes, pits and ditches) seem to have survived the anthropogenic landscape-forming processes that have occurred since the end of the Middle Ages; most of these features are of late prehistoric or (early) historic age.

Northern loess area. This landscape, which covers only a small portion of the extreme south-eastern part of the country, is characterised by a strongly accentuated relief. Pleistocene loess deposits (partly colluvial) and underlying alluvial Meuse deposits are incised by brook valleys and dry valleys. Surface elevation ranges from 40 m to 180 m Amsterdam OD. Aggregate extraction in quarries has led to deep exposure of Pleistocene (and older) deposits, but even construction works necessitating only superficial disturbance can easily cut into Pleistocene deposits. Early prehistoric remains are widely known from this area, dating to, amongst others, the Middle Palaeolithic, the Late Upper Palaeolithic, the Early Neolithic (LBK) and the Middle Neolithic (Michelsberg). Archaeological surveys and excavations concentrate in the economically dynamic western part of the area, along the Meuse valley. Compared with other parts of the country, the number of excavations involving remains of early prehistoric occupation is high, due to the particular geological situation.

Temporal distribution

The temporal distribution of the sites selected for our synthetic analysis is summarised in table 2.4. Prior to presenting any further discussion, we should note various problems that influence the assessment of the information potential. First, archaeological time is categorised in periods of variable lengths, with somewhat arbitrary boundaries that sometimes overlap. Figure 2.10 provides the chronology that is generally used in the Netherlands. Clearly, the chronology becomes somewhat fuzzy in connection with cultures, groups and traditions. Figure 2.11 expresses how defined socio-cultural entities overlap or succeed one another in time. Differences in the number of sites from one period to the next do not necessarily reflect any 'prehistoric reality', such as shifts in population density or occupation history. Second, most of the sites in this analysis comprise material from more than one archaeological period, based on either radiocarbon dates or typo- and technological information. Third, the possibilities of anchoring finds assemblages chronologically are (partly) dependant on finds quantity and, related to that, the chances of diagnostic elements being present, as well as the availability of associated and reliable dates.

Assessing the potential information value of such chronological 'divides' is, however, not easy, as the availability of chronological anchoring points is highly variable within the set of selected sites. Chronological attribution of archaeological remains is frequently based on typological or technological arguments instead of radiocarbon dates. As a result, the chronological framework remains extremely coarse. In exceptional cases, large numbers of radiocarbon dates and stratigraphic arguments permit more detailed analysis. Below we will therefore restrict ourselves to a broad outline of the chronological coverage of the sites, and we will discuss potential gaps and biases within the dataset.

Table 2.4 Number of excavated sites and periods represented. A single site can represent several periods.

Period	Excavation	Total sites
All sites	85	139
Palaeolithic	10	17
Late Palaeolithic	10	17
Mesolithic	56	90
Early Mesolithic	17	25
Middle Mesolithic	25	31
Late Mesolithic	24	35
Neolithic	58	78
Early Neolithic	24	34
Middle Neolithic	37	48

36 It is not clear why this is the case. Possibly it coincides with differences in the number of spatial developments.

37 Ball & Van Heeringen 2016; Kranendonk *et al.* 2006.

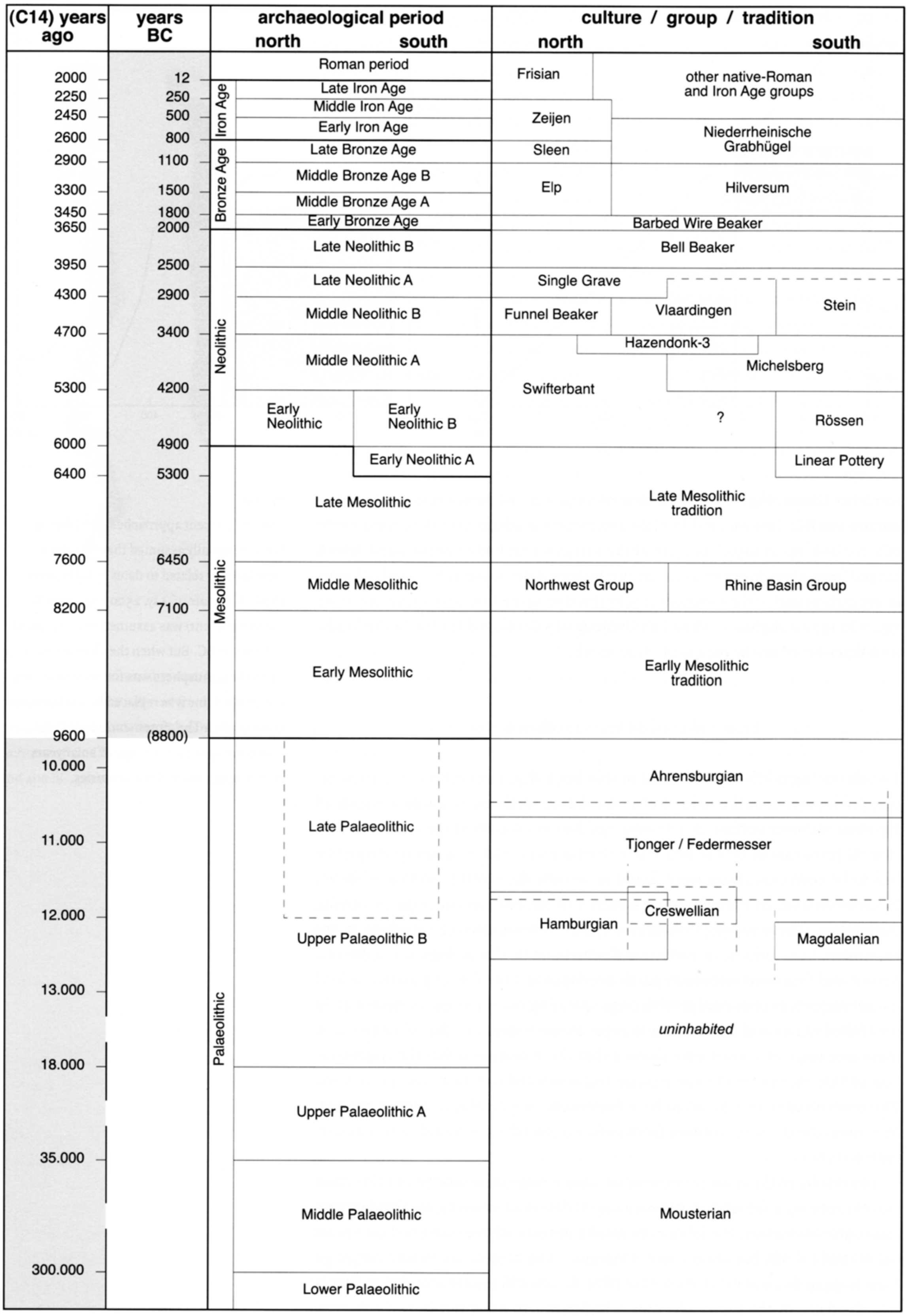


Fig 2.10 Schematic chronology of the prehistory of the Netherlands (from Van den Broeke, Fokkens & Van Gijn 2005).

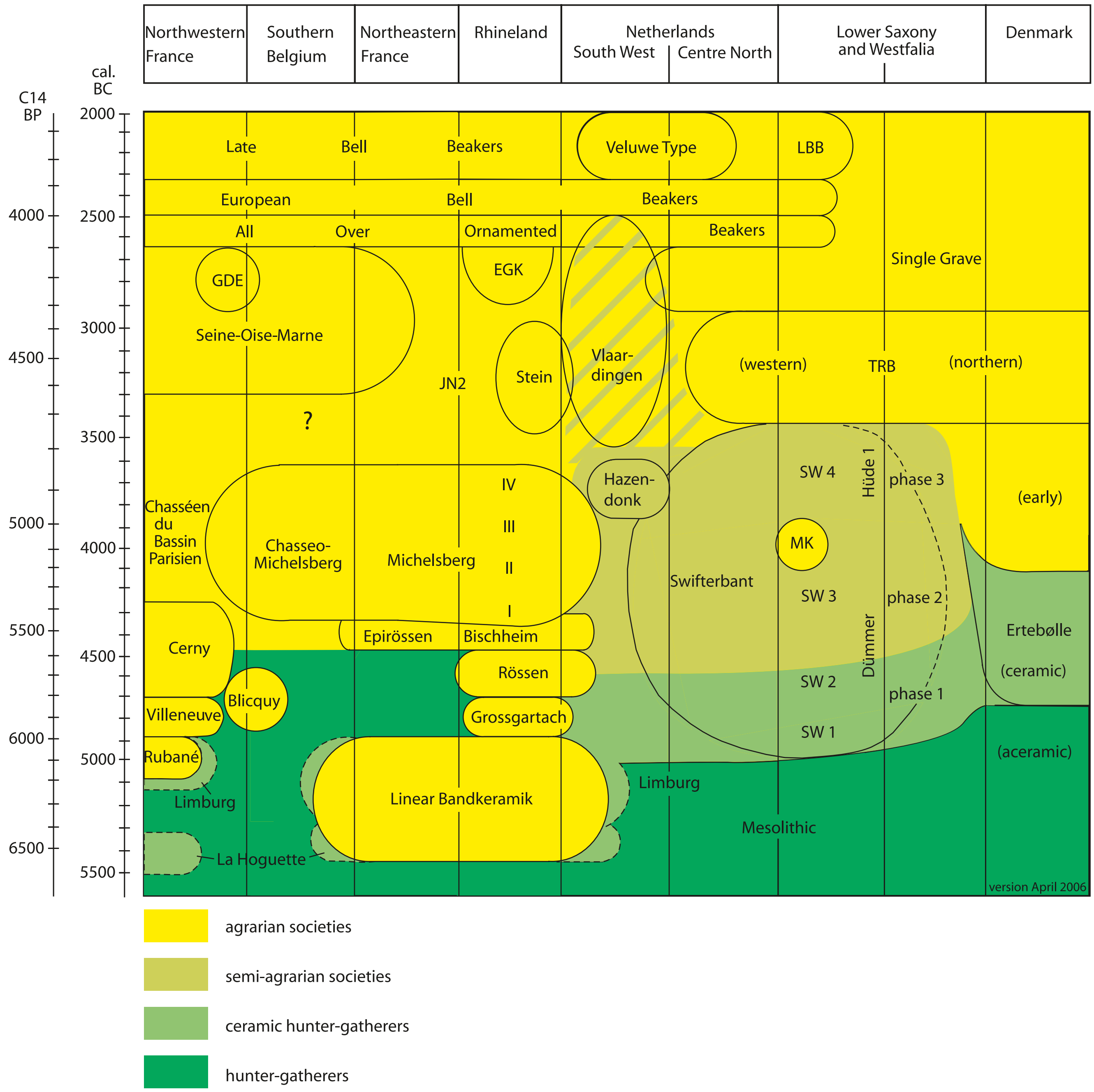


Fig 2.11 Chrono-geographical diagram showing the mosaic of socio-cultural groups/traditions in NW Europe during the Neolithic; colours reflect 'stages' of neolithisation (from Louwe Kooijmans 2008).

Palaeolithic

The selected reports do not involve any Middle Palaeolithic or Upper Palaeolithic archaeology. Although reference is made to the Middle Palaeolithic for Wezuperbrug-Oranjekanaal, where remains of woolly mammoth were found,[38] this site was excluded due to the absence of evidence for human (i.e. Neanderthal) intervention. A handful of Middle Palaeolithic artefacts have been reported from the site of Nederweert-Rosveld.[39] As a single dot on the map, representing only a few artefacts originating from a heavily disturbed context,[40] this site has also been excluded from our selection. Finally, charcoal features that are interpreted as hearths have been reported from Bergeijk-Keersop, and a radiocarbon date of c. 29,430 BP (GrA-42737) would place them in the Early Upper Palaeolithic.[41] However, the anthropogenic nature of these features cannot be confirmed, and finds, such as flint artefacts are lacking (there is one unworked chunk of poor-quality flint). Because the archaeological nature of this site is highly questionable, it has been excluded.[42]

The earliest sites represented in our selection of reports date to the Late Palaeolithic and are located in the eastern half of the country (fig. 2.12). Finds from these sites have been attributed to one or more cultural groups: Hamburgian, Federmesser Gruppen and Ahrensburgian. Seven sites have an unclear cultural signature but are likely to be of Late Palaeolithic age in view of technological and stratigraphic considerations. There is no mention of finds attributable to the Magdalenian, but this may be a coincidence, as the Magdalenian is sparsely represented in the Dutch archaeological record in general.[43] The distribution of these Late Palaeolithic sites conforms to our current knowledge of the geographical occurrence of these cultural groups. Hamburgian sites are not found south of the Rhine,[44] whilst Federmesser Gruppen sites are encountered throughout the Netherlands.[45] Ahrensburgian sites have previously been encountered in the northern and southern parts of the eastern half of the country.[46] In a general sense, the presence of Late Palaeolithic hunter-gatherer groups in the western half of the Netherlands is, as yet, poorly known due to the geological history of that part of the country. If they are preserved, Late Pleistocene land surfaces are deeply buried. Occasional finds of Hamburgian and Federmesser Gruppen artefacts along the west coast provide evidence for the presence of the people associated with these artefacts.[47] Because there are no apparent reasons for different patterns of land use, we assume continuity of geographical distribution patterns with the eastern half of the Netherlands. Hence, the only marked difference concerns the Hamburgian, which is, as yet, only represented north of the River Rhine.

The majority of Late Palaeolithic sites discovered in the context of development-led fieldwork occur in 'archaeological landscapes' which were already known to contain such remains. Typically, these are the 'boulder clay area', the 'northern sand area', and the 'Ruhr valley graben'. More striking are a number of sites in the 'lower Meuse terrace' and 'Meuse valley' landscapes. Due to alluvial dynamics, land surfaces of Late Palaeolithic age have been subject to erosion and have a patchy occurrence. The small number of sites discovered in this landscape context can potentially inform us about facets of land use that are not represented in the other areas. The same may be true for a Hamburgian site discovered at the border of the 'IJssel valley' and 'northern sand area'.

Mesolithic

Sites dated to the Mesolithic are well represented in the reports (fig. 2.13). The great majority is situated in the eastern half of the Netherlands. In the western half, a small 'cluster' of sites is reported in the surroundings of Rotterdam;[48] these are amongst the most western Mesolithic sites that have been investigated in the Netherlands thus far. Although related to river dune contexts, which are landscape features known to be of archaeological significance, these sites can potentially also inform us about unknown facets of land use and habitation. The offshore location at Rotterdam-Maasvlakte 2, at a depth of −20 m Amsterdam OD is exceptional in this respect. We can identify no explicit geographical differences in site occurrence between the early, middle and late phases of the Mesolithic that might corroborate or reject current models of increased use of river valleys towards the Late Mesolithic.[49] Several seem to represent multiphase sites, where locations were used throughout the Mesolithic.

38 Aalbersberg *et al.* 2013.
39 Hiddink 2005.
40 Research into site taphonomy was conducted by the national heritage agency (Deeben *et al.* 2010).
41 Appendix II: PUBID 65.
42 It should be noted that a find such as this would have been of major importance had the anthropogenic nature of the features been established; it would have provided the first evidence for the presence of anatomically modern humans in the north-west European sandy plain during the Early Upper Palaeolithic, after the disappearance of Neanderthals (cf. Roebroeks 2014).
43 Rensink 1993, 2010.
44 Rensink & Niekus 2016.
45 Deeben & Niekus 2016a.
46 Deeben & Niekus 2016b.
47 Stapert 1981; Veerman 1971.
48 The cluster of sites is a consequence of the fact that the archaeological unit of the municipality of Rotterdam is aware of the potential of the region for the presence of Stone Age sites.
49 Crombé *et al.* 2011; Verhart 2008.

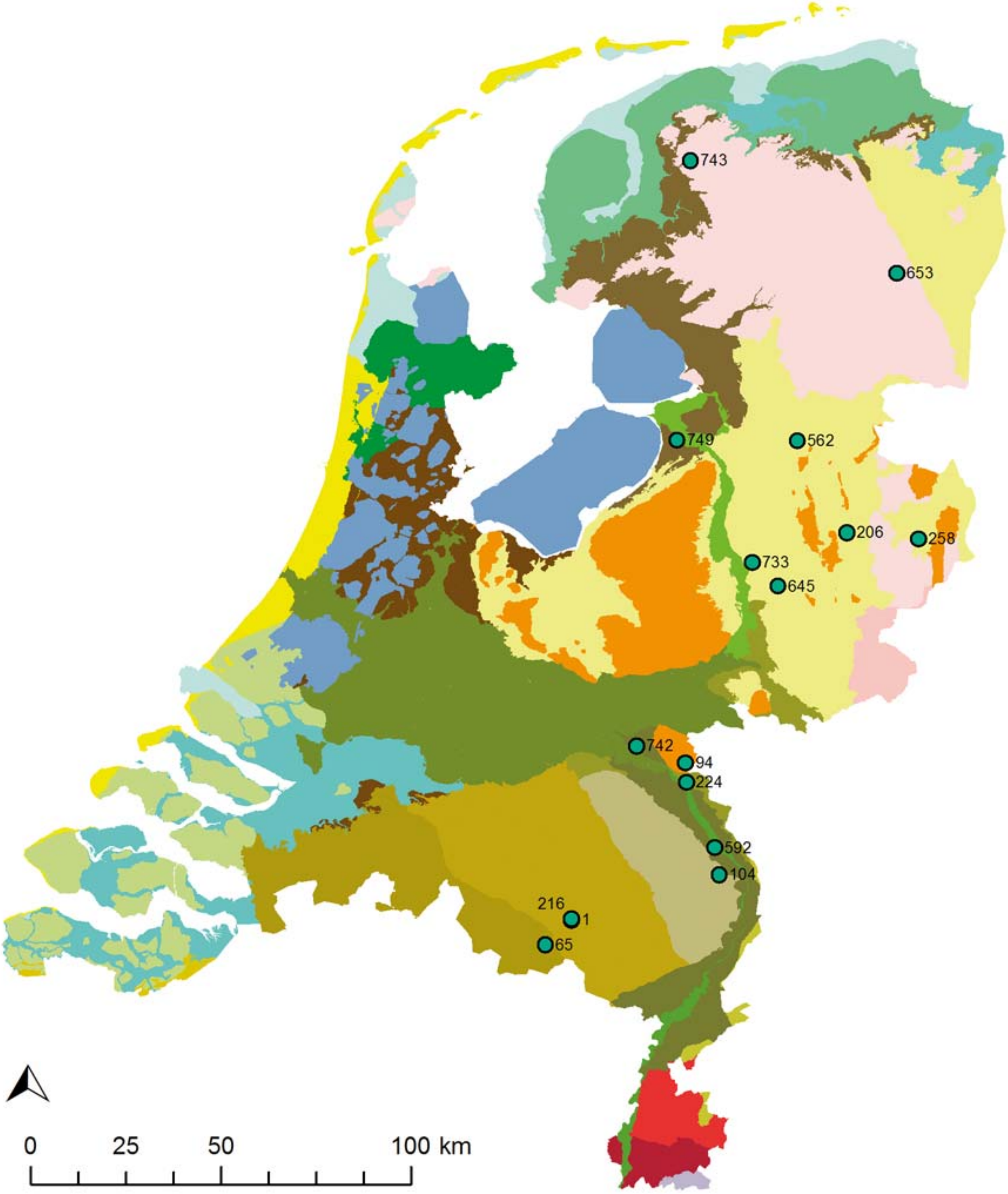


Fig 2.12 Distribution of the selected sites/reports mentioning Upper/Late Palaeolithic finds (background: 'archaeological landscapes' as defined by the Cultural Heritage Agency of the Netherlands).

The sites occur in a wider range of 'archaeological landscapes' than do the Late Palaeolithic sites discussed above. The distribution of Mesolithic sites resulting from development-led fieldwork conforms to the general picture, but again with the exception of the 'lower Meuse terrace' and 'Meuse valley' landscapes. Several occurrences – Well-Aijen in particular – in the 'Meuse valley' landscape settings are still under investigation, and have, as yet, only been reported upon in the context of surveys. This preliminary information will probably shed only limited new light on our knowledge of the Mesolithic.

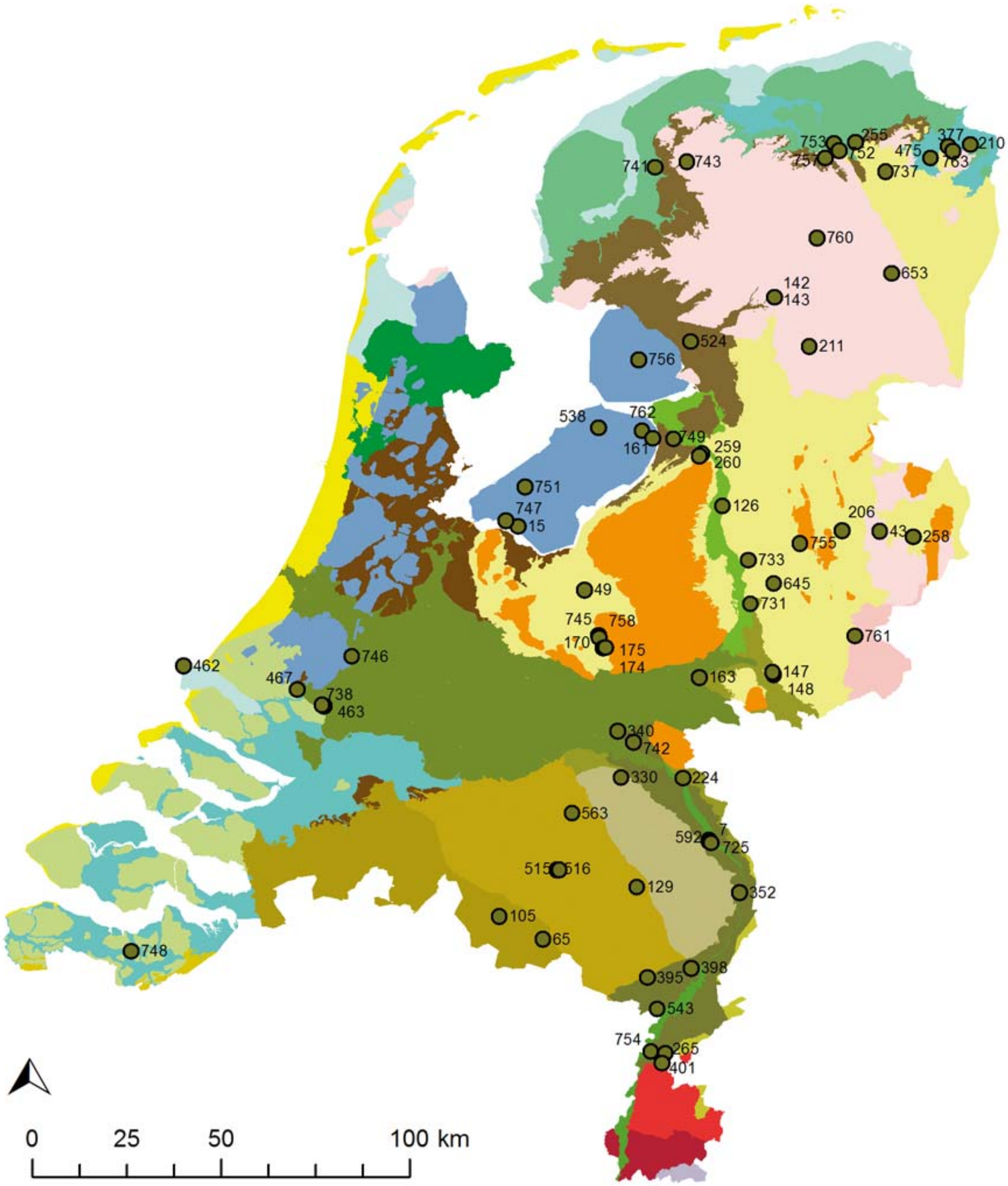


Fig 2.13 Distribution of the selected sites/reports mentioning Mesolithic finds (background: 'archaeological landscapes' as defined by the Cultural Heritage Agency of the Netherlands).

Neolithic
As it is the case for the Mesolithic, a considerable number of reports involve Early or Middle Neolithic remains (fig. 2.14). Typically, these are situated more often in the wetland areas of the central and western Netherlands, compared with the sites dating to earlier periods. Also, there is a distinct concentration of Early and Middle Neolithic sites in the southern loess area of Limburg. A breakdown by 'cultural assignment' suggests that the sites are somewhat more bound to a single phase of cultural context. This is partly due to the well-identified LBK sites on the loess plateaus, which are characterised by

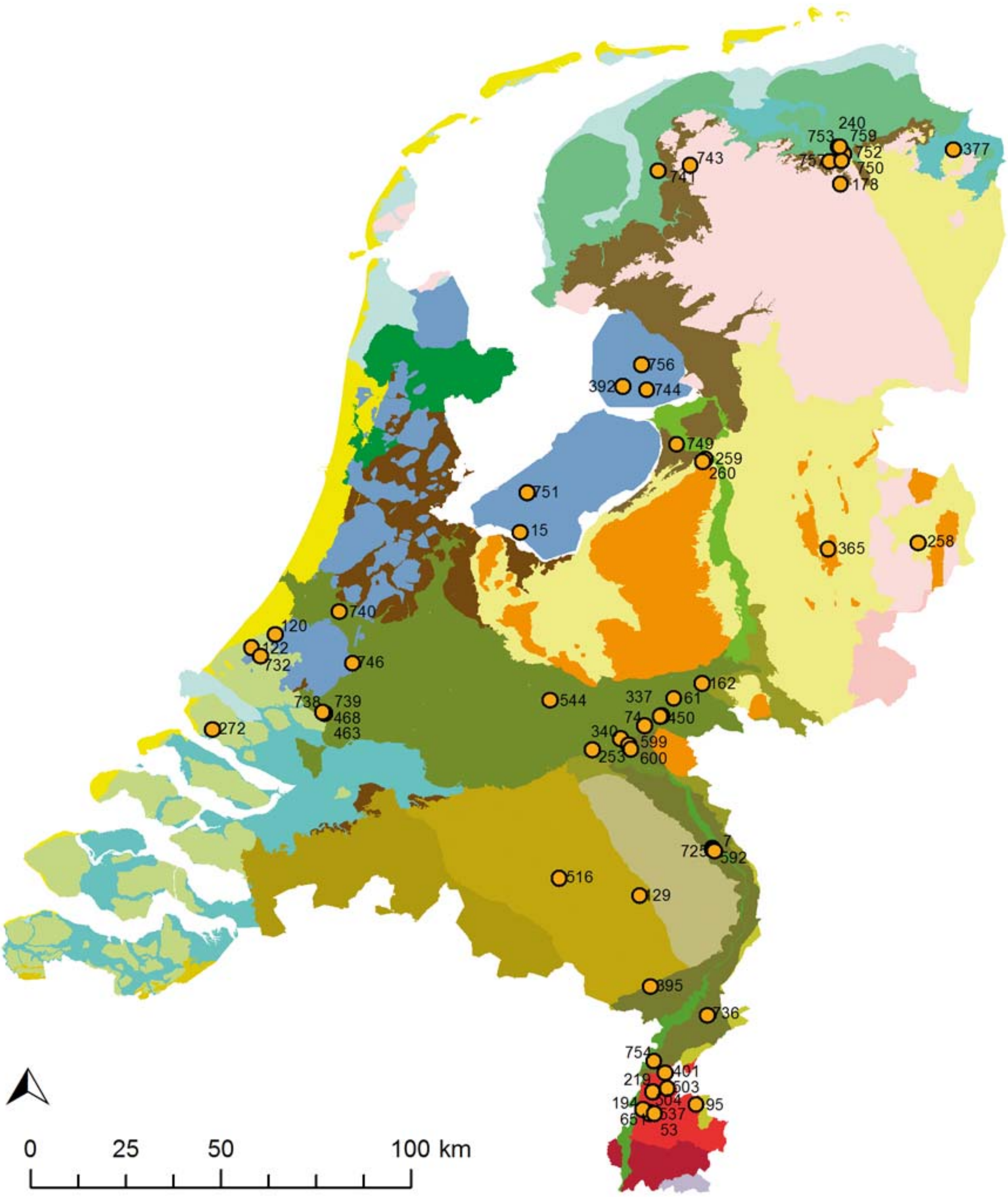


Fig 2.14 Distribution of the selected sites/reports mentioning Early-Middle Neolithic finds (background: 'archaeological landscapes' as defined by the Cultural Heritage Agency of the Netherlands).

clear house plans and pits. Furthermore, this could well be a self-fulfilling effect of cultural attribution of distinctive finds and not a reflection of prehistoric reality. For instance, the positive identification of a single Michelsberg pottery fragment will lead to the 'cultural labelling' of a site as Michelsberg, even though the site may contain material belonging to other cultural entities that is simply not diagnostic. In this respect it is important to bear in mind that the archaeological distinction of cultural groups or traditions in the Neolithic is based on pottery. In the absence of pottery fragments, cultural attribution of finds assemblages is often difficult. For instance, it is impossible to distinguish between the Late Mesolithic and the Early Neolithic Swifterbant Culture on the basis of flint artefacts.[50]

To an extent, such problems may also hold for the relationship between cultural assignment and geographical occurrence (fig. 2.15); the new data reveals little to no deviation from the established 'cultural territories'. LBK is reported from the south-east (province of Limburg); Swifterbant shows up in the Rhine-Meuse delta and the northern Netherlands; Michelsberg and Stein are identified in the south-east (province of Limburg) and along the Meuse valley; and the Hazendonk and Vlaardingen are confined to the Rhine-Meuse delta.[51] However, distinguishing amongst these cultural labels is far from easy, even for specialists in this domain. What would be called Stein in the south-east would be called Vlaardingen in the west. Indeed, much is due to differences in regional research history and to conceptual differences in how to interpret variability in material culture at various spatial scales.[52] On the other hand, the application of these archaeological constructs does help to identify noteworthy patterns. For instance, some sites in the Rhine-Meuse Delta are labelled TRB (the German abbreviation of Funnelbeaker Culture) in the Archis database, whilst most TRB sites are situated in the north and east of the country, where one would expect to find them. Clearly, this prompts questions about diagnostic viability.

Taken together, the selected reports provide unbalanced coverage in terms of the representation of geographical regions, archaeological landscapes, and chronological and cultural attributions. This is due to differences in geological history, the nature of modern-day land use and spatial development, the nature of development-led fieldwork, the nature of political decision making, as well as archaeological conceptual constraints. Any synthetic analysis of data derived from these reports has to take these biasing factors into account, most particularly where it comes to interpretations with a geographical component or the reconstruction of long-term occupation histories. Notwithstanding these restrictions, the analysis allows for a critical evaluation of existing insights and ideas, as well as a (re)formulation of hypotheses for future research.

2.4 Thematic data mining

With the database finished and the relationships amongst questions, aspects and publications set, we started our thematic data mining. This proved less straightforward than we had hoped, as the manner in which data is presented is mostly highly fragmented or incoherent (see examples below). This became particularly apparent when we attempted to create automated thematic overviews of the available data.[53] Whilst many reports present the data in an exemplary manner, others lack clear data summaries or were found to be incomplete. Particular problems were encountered with regard to quantitative data.

- Mention of total numbers of (categories of) flint or pottery in the text, but no summary table;
- Use of vague quantitative terms, such as much, many, little, instead of exact numbers;
- Provision of percentages without clear indication of sample or population size (totals and subtotals not given).

This last problem – which we also saw in graphical quantifications, such as pie and bar charts – was encountered most often in reports where early prehistory was so-called by-catch. A more rigorous approach to quantitative data presentation, which follows basic conventions, is the least we can ask for.

Other types of problems concern issues of classification and subsequent presentation of data. Examples concern the raw material characterisation of flint and the cultural attribution of pottery. The characterisation of flint is highly variable and appears clearly related to differences in the level of expertise amongst researchers. The breakdown of origin in terms of extraction context (primary, secondary); geographical origin (northern/southern, Scandinavian/Limburgian); and type assignment (e.g. Rijckholt, Valkenburg, Banholt) varies amongst reports, whereas different terms may be used to characterise the same source (e.g. Limburgian/southern/Rijckholt flint). With regard to ceramics, data appear to be presented according to variable groupings. Data from a single site can be presented according to cultural group assignment for one category of finds and for the assemblage as a whole for another category of finds. For example, the pottery from Hazerswoude-Rijndijk was analysed by cultural

50 Cf. Peeters 2007.
51 For a discussion about the status of these cultural groups, see Beckerman and Raemaekers (2009).
52 Cf. Ten Anscher 2012.
53 This forced a manual data-mining approach.

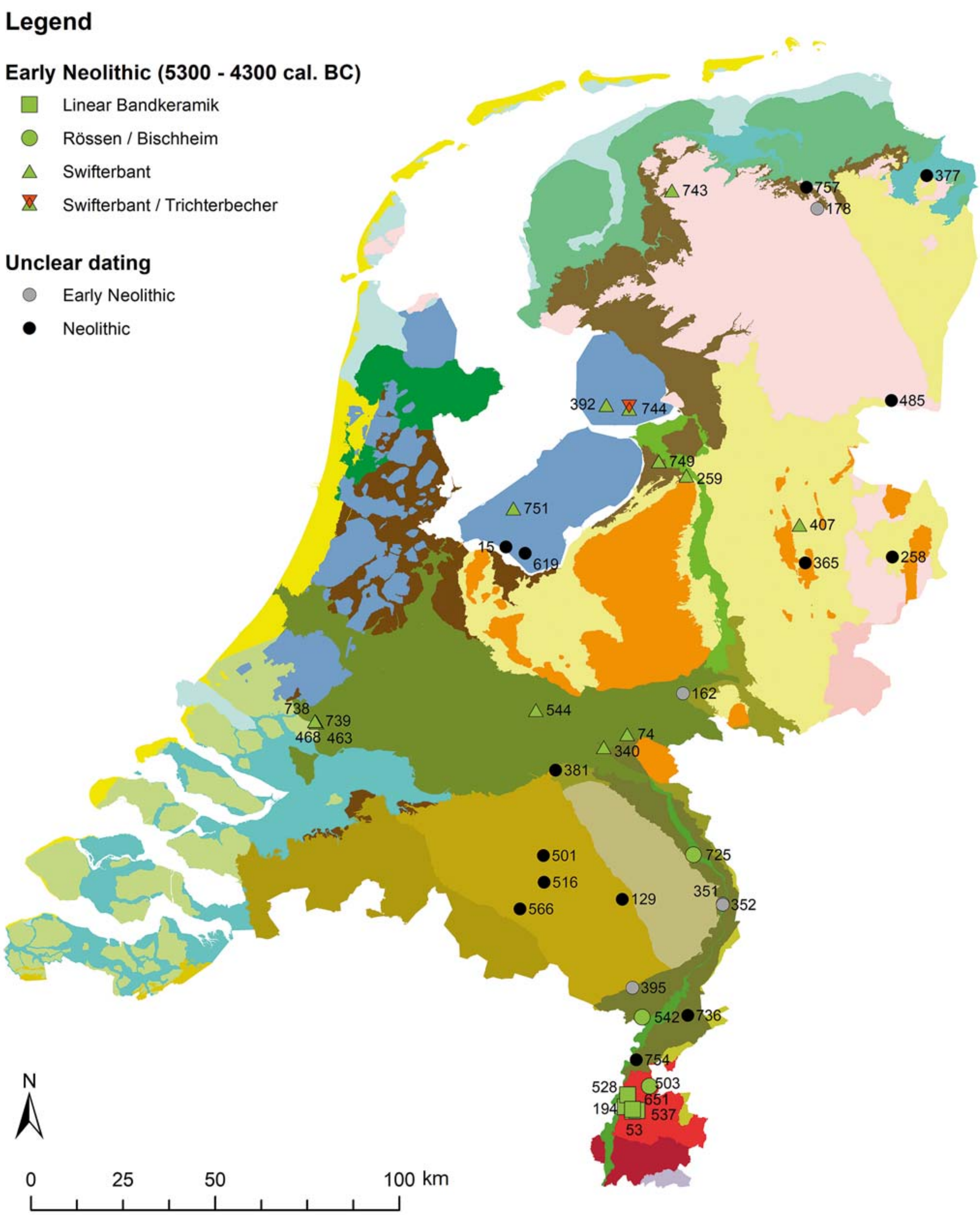


Fig 2.15 Distribution of the selected sites/reports referring to specific socio-cultural groups/traditions of the Neolithic (background: 'archaeological landscapes' as defined by the Cultural Heritage Agency of the Netherlands).

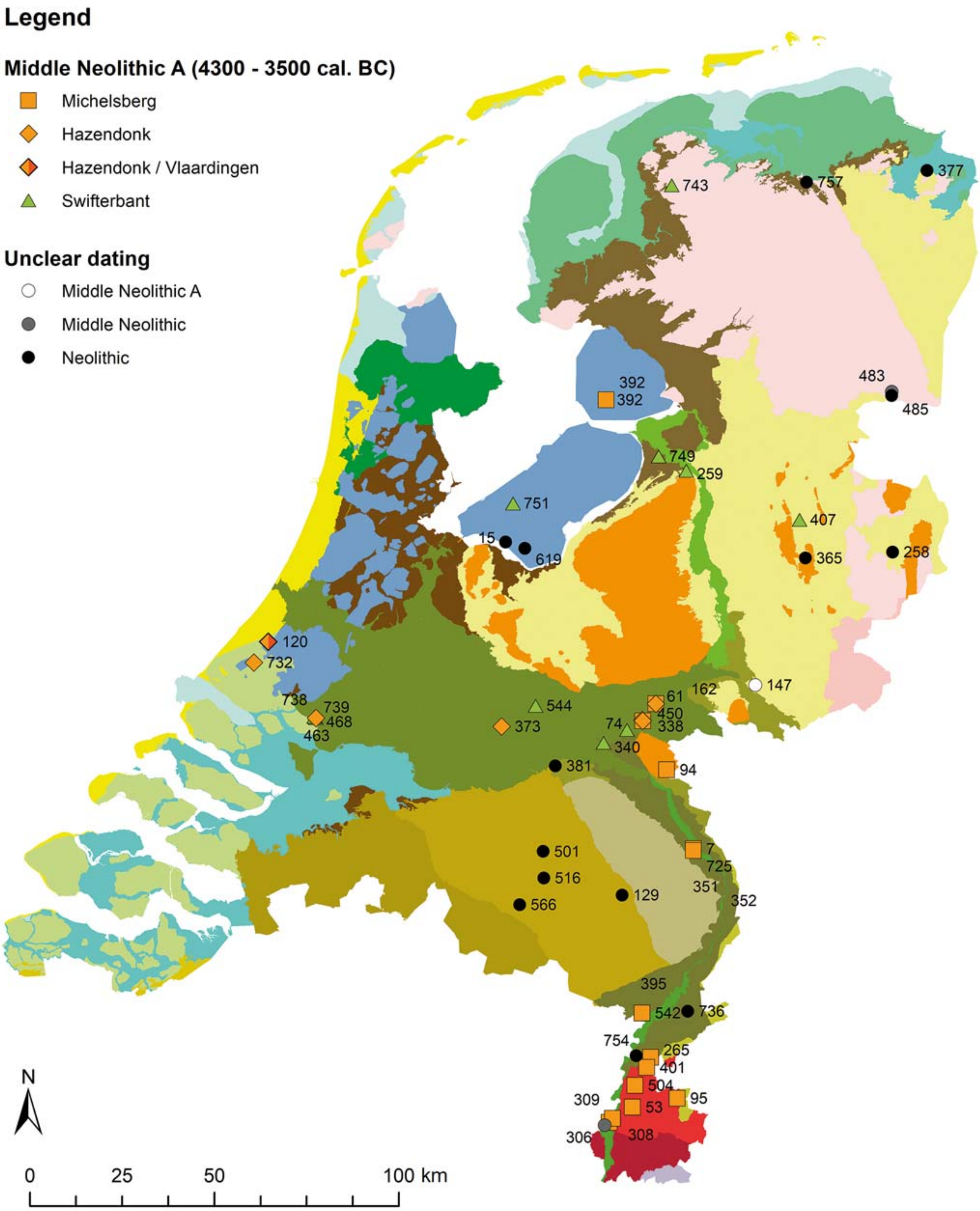


Fig 2.15 Continued.

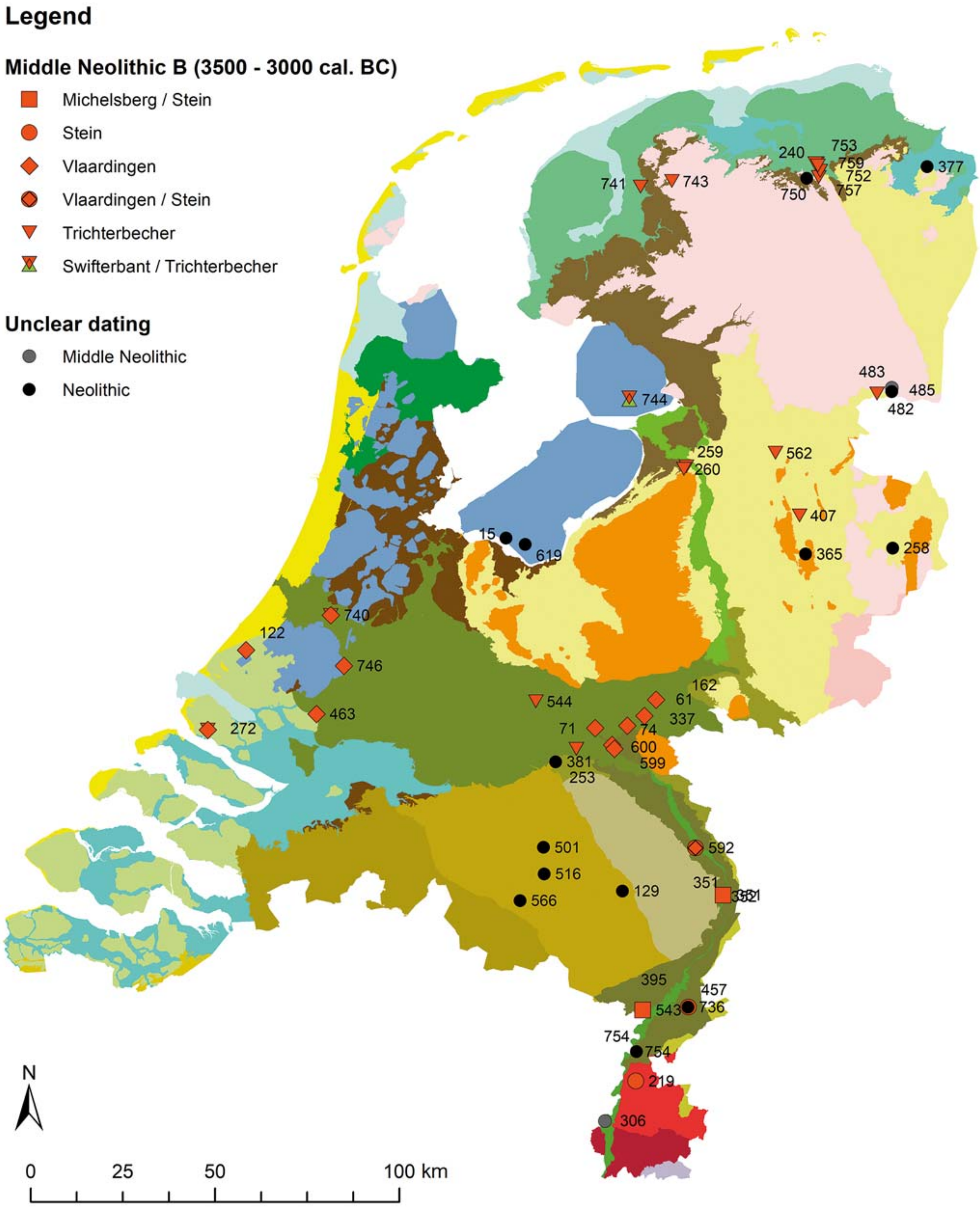


Fig 2.15 Continued.

assemblage, whereas the flint was considered at the level of the entire site. For both flint and ceramics, it is difficult to be certain about which data from different reports are comparable.

Another problem concerns the presentation of radiocarbon dates. It is not unusual to find only calibrated ^{14}C-age estimates, without mention of the measured radiocarbon age or the calibration software version used. Clearly, this is undesirable, as different calibration software versions may use different calibration curves, hence producing different dates; uncalibrated dates should always be presented according to accepted conventions.[54]

A final problem to be addressed here concerns the availability of primary data. For 72 out of the 139 projects, additional data, such as finds databases or additional maps could be found online (Archis, DANS-EASY). For the remaining 61 projects, only the written report was available online. This situation is in conflict with Dutch legislation, which includes the following requirements for excavating agencies (translation ours):

- During excavation, actions and archaeological finds are documented; the finds are conserved and a report is made that describes the results of the performed actions (Article 5.4).
- The finds, the report and additional documentation are to be presented to the government within two years after the excavation is completed (Article 5.6).
- Monuments, reports and independent observations are to be entered into the national information system, which should be accessible to anyone (emphasis in the original); however, the relevant agencies retain the rights of authorship and the database rights (Article 5.12).

In the context of our synthetic study of research results, we frequently wanted to turn to the original data. The unavailability of this data (in digital or printed form) frustrated any attempts to take further steps and increase the potential to build on research results from development-led projects. Publication of primary data and specialist databases would be more in line with Article 8 of the Valletta treaty.[55] In the present situation, data is not as easily accessible for interested parties and researchers as it should be, and this situation poses a risk to the archaeological resource.

Notwithstanding the problems and restrictions mentioned above, we were able to extract useful data from the set of selected reports. This required screening each individual report. It turned out that the majority of reports present data of limited use. The following chapters will demonstrate that the contribution that can be made to the various research questions under the umbrella of the themes and dimensions as defined in chapter 1 is highly variable and unbalanced.

54 Waterbolk 1983.
55 Article 8 of the Valletta Convention states that 'each party (country) undertakes to (i) facilitate the national and international exchange of elements of the archaeological heritage for professional scientific purposes, whilst taking appropriate steps to ensure that such circulation in no way prejudices the cultural and scientific value of those elements; and to (2) promote the pooling of information on archaeological research and excavations in progress and to contribute to the organisation of international research programmes.'

3 People and material

3.1 Introduction

As we briefly indicated in section 1.2.1, relationships between people and material are complex. The archaeological study of material culture has a long tradition and, indeed, goes back to the very early days of the discipline.[56] From a culture-historical perspective, material remains have been studied as a means to define and distinguish between ‘cultures’ and ‘traditions’ in the past, as well as to build evolutionary and chronological frameworks.[57] New questions and interpretations of material culture arose with the paradigm shift in the 1960s, when archaeologists became critical of the culture-historical approach.[58] To these processual archaeologists, variability and change in material culture should, first of all, be understood in terms of functionality and adaptation to different and changing environmental conditions. In the 1970s, new approaches, such as microscopic use-wear analysis and refitting, opened new windows, leading to re-interpretations of an otherwise inert source of information.[59] Soon after, and triggered by ethnographical studies,[60] fierce debates about how to distinguish between ‘function’ and ‘style’ made clear that the reality of what material culture actually involves is far more complex.[61] This discussion was paralleled by yet other perspectives on material culture. Structuralist approaches – mostly a French ‘school’ influenced by the work of Leroi-Gourhan[62] – developed anthropological perspectives on technology, where the concept of the *chaîne opératoire* (operational sequence) provides a connection between technological action, gesture and mind.[63] Post-processual archaeologists put more explicit emphasis on meaning and perception of material culture (‘materiality’), and they ascribe a central role to the human mind.[64] Building on the post-processual perspective on how material culture should be understood, phenomenological approaches seek to overcome problems of dualism (mind<>matter; material<>form), and emphasise the act of production arising from the interaction of person and material.[65] Yet another perspective on material culture, and particularly on the dynamics that underlie variability and (dis)continuities, emphasises the role of cultural transmission as a mechanism of hereditary socio-technological traditions.[66]

The broad range of approaches to material culture that developed over the years have found their way into Dutch archaeology. Generally speaking, traditional typo-technological culture-historical and processual perspectives are dominant. The study of artefacts and structural features predominantly serves as a means to interpret sites from a functional perspective – as part of a ‘settlement system’ –and to contextualise remains within established chronological and cultural frameworks. The typo-chronological analysis of material remains represents, without doubt, the overwhelming majority of studies, especially in the context of development-led research. As standard procedure, material remains are classified according to commonly used typologies. Particular aspects, such as the use of raw materials, and secondary attributes, such as completeness and burning, are taken in consideration. Technology is mostly approached from a techno-typological perspective, where objects are classified into technologically defined categories based on certain attributes. Use-wear analysis of lithics has become increasingly popular, also in development-led archaeology.[67] In connection with use-wear analysis of stone tools, studies into the meaning of material culture have also become an important line of research,[68] although maybe not as much in the context of development-led projects. The same holds for the study of ceramics.[69]

The study of material culture as it is conducted in the Netherlands, and to a variable extent echoed in development-led research, covers the following three main themes:

- Craft activities;
- Socio-cultural meaning;
- Frames of reference.

The first theme puts the object central; studies focus on the reconstruction of modes of production and the use and discard of items. The second theme is more concerned with the contextualisation of material culture; studies focus on the socio-cultural role of objects and on understanding culture change. The third theme aims at the establishment of frameworks for the characterisation of the archaeological record; studies focus on the classification of cultural remains and the development of chronologies.

56 Bordes 1968; Klejn 1982.
57 See, for example, Bordes 1968.
58 Binford & Binford 1968; Bordes & De Sonneville-Bordes 1970.
59 Van Noten & Cahen 1978.
60 Wiessner 1983.
61 Sackett 1982; Wiessner 1983.
62 Schlanger 1994.
63 Lemonnier 1992; Pétrequin & Pétrequin 1990.
64 Hodder 1986.
65 Ingold 2000; see Conneller 2011, p. 30.
66 Jordan 2015.
67 This is particularly so for projects with involvement of the Faculty of Archaeology at Leiden University, which hosts the Laboratory for Material Culture Studies (now Foundation LAB).
68 Van Gijn 2010; Wentink 2008.
69 Raemaekers, Kubiak-Martens & Oudemans 2013.

Below, we will evaluate what contribution development-led projects have, or could have, made to these lines of research.

3.2 Craft activities

Traditionally, objects are studied within categories that are defined on the basis of the raw materials used. In the context of early prehistory, lithics feature as the dominant category in the NOaA 1.0. Within this main category, a systematic distinction is made between flint and other rock.[70] Other categories are bone/horn/antler, wood, pottery, and miscellaneous materials, such as amber, ochre and wood tar. As appendix I shows, specific research questions as listed in the NOaA 1.0 are basic and can be summed up in more general terms. Most of these questions are included in project outlines (the PvE) in one form or another. Often, questions are specified according to the raw material categories that are expected to be (potentially) preserved on the site that is to be investigated. However, the way in which these research questions are approached in practice is variable and less straight forward than one might imagine. This is partly because certain lines of enquiry – the chronological resolution of certain material categories, for instance – necessitate contextualization beyond the site level and partly because conceptual issues of analysis – for example, the chaîne opératoire, as we will see below – are not necessarily shared or understood in similar ways by researchers. Although both these issues are probably inherent to archaeological research, these are issues to keep in mind in the context of the study we present here. In the following sections, we will focus on a number of topics that have received considerable attention in development-led projects, and we will evaluate how this attention has contributed to our understanding of craft activities in early prehistory.

3.2.1 Production, use and discard of lithic tools

The analysis of stone artefacts is strongly focused on flint and other rocks with comparable fracturing characteristics, such as phtanite and fine-grained quartzite. Artefacts made of other types of rock (sedimentary, metamorphous and igneous) have long received limited attention, and mostly it is only tools made of these rocks that have been analysed. However, it seems that this situation is gradually changing and that lithic artefacts made out of rock other than flint are increasingly attracting the attention of researchers. This is particularly the case with regard to use-wear analysis.

In general terms, the analysis of lithics is approached from a rather classificatory and descriptive perspective. In reference to the research question mentioned in the NOaA 1.0, artefacts are assigned to a pre-defined typo-morphological or technological category. Further characterisation of artefacts on the basis of particular attributes – for instance, length, width, thickness and completeness – is at the category level. Typically, this results in overview tables and graphs, which summarise the typological/technological composition of the assemblage or attributes of artefact categories. The results of use-wear analysis are mostly presented separately. In the end, this leads to a rather static picture of the assemblages studied, instead of a better understanding of the behavioural dynamics that underlay the formation of these assemblages. It appears that the analytical concept of the chaîne opératoire, which as an integrated approach permits the development of insight into just these dynamics,[71] has not been picked up by lithic specialists and consequently does not make it into the project outlines.

Below we take a closer look at what contribution development-led archaeology has made to NOaA 1.0 research questions concerning the production, use and discard of stone tools (flint and other types of rock). We will do so with another question in mind: What insight can (potentially) be gained into the behavioural dynamics that resulted in technological variability in craft activities?

Tool manufacture and raw materials

With some exceptions where Middle Palaeolithic finds are involved, development-led projects have produced assemblages dating to the Late Palaeolithic, Mesolithic and/or Neolithic. Other than the more sporadic production of core tools (e.g. axe blades), two conceptual modes of

70 Other rock is what is referred to as *"natuursteen"* in the Dutch text.

71 Pélegrin *et al.* 1988; Schlanger 1994, 2005.

production were applied for the crafting of most tools during these time periods. One involved the production of tool elements out of blades, the other, the production of tool elements out of flakes. These are very different technologies, which demand different knowledge and practical skills in their execution. To maintain such knowledge and skills, information had to be shared amongst group members, whilst skills had to be acquired though practice.[72] Of course, in reality things were probably not that black and white. During blade production, flakes are also detached, and were used as tools. But the deliberate choice of producing blades or flakes as a basis for tool manufacture involved different conceptualisations. Whereas blade technologies were dominant during the Late Palaeolithic through Early Neolithic, the relative importance of flake technologies seems to increase during the Middle Neolithic, when blades become more scarce.[73] This shift is probably related to changing socio-cultural contexts, where we start to see a distinction between 'domestic technologies' and 'specialist technologies'.[74] However, as yet, we have limited knowledge about how various technologies and the use of tools were embedded within early prehistoric socio-cultural traditions, and how and when change occurred.

The distinction between blade-based and flake-based technologies is systematically made in development-led studies. In this respect, it is important to take a look at what distinguishes a blade from a flake. As mentioned in connection with the study of the assemblages from Leeuwarden-Hempens, blades have a length:width ratio of at least 2:1, although it is acknowledged that many other attributional criteria (e.g. parallel edges, regularity of dorsal scars) can be added.[75] Indeed, the execution of a pre-conceived scheme of production to obtain relatively long and regular blanks is considered to be fundamental to this technology by specialists in flint knapping.[76] Yet, the simple, arbitrary metrical criterion is picked by most researchers for practical purposes, neglecting the problems this creates for technological analysis that aims to go beyond descriptive classification. But let us see what development-led studies contribute to our general understanding of lithic technology with regard to the selection of raw materials and manufacturing (methods and techniques) of blanks and tools.

Late Palaeolithic. Late Palaeolithic (Hamburgian, Creswellian, Federmesser Gruppen and Ahrensburgian) assemblages rarely feature in the reports in our database.[77] Artefacts that are considered to be of this age are attributed to a particular cultural tradition on the basis of typological arguments, or, more often, on the basis of technological characteristics, the presence of a particular type of raw material, or the geological context.

The few finds attributable to the Hamburgian come from the sites of Knooppunt Hattemerbroek and Epse-Olthof,[78] but only the latter produced enough material to draw inferences about stone tool manufacture.[79] In line with the current state of knowledge, we see the systematic production of slender, slightly curved blades out of fine-grained 'northern' flint – amongst which red Heligoland flint (see section 4.2.2) – through the application of direct soft percussion (fig. 3.1). Blades were detached from two opposite striking platforms and a single production surface. One core was originally prepared on a large flake, but the core was dramatically reduced in size due to a plunging blade that came off in the very first stage of core reduction; the remaining core was further used to produce small blades and was subsequently abandoned. A few scrapers and a fragment of an impact-damaged Havelte (?) point suggest maintenance activity and hide working.[80] Core reduction debris, some of which could be refitted, provides evidence for on-the-spot tool manufacture out of high-quality flint that was brought in from elsewhere (there is none available in the vicinity of the site). Although the Hamburgian assemblage from Epse-Olthof is fragmentary, it is likely the result of multiple short-lived visits by small groups of hunter-gatherers. The resulting picture fits the idea of a technological system that combines on-the-spot core reduction and tool manufacture/maintenance, the abandonment of blades and utilised tools that were brought in from elsewhere, and the transport of cores between encampments.[81]

72 Lemonnier 1992.
73 Van Gijn 2010.
74 De Grooth 1987.
75 Noens 2011, 118.
76 Tixier 1984; Tixier *et al.* 1980. It should be noted that, even when a technological definition is applied, production schemes are not always aimed at producing highly regular blanks or blades. Mesolithic Coincy-style production schemes are relatively irregular, but there is still a tendency to systematically produce elongated blanks (Walczak 1998).
77 Late Upper Palaeolithic (Magdalenian) finds which could be expected to be present in the south-eastern part of the Netherlands are absent.
78 Knooppunt Hattemerbroek covers a large area involving two projects (appendix II: PUBID 259, 260, 749), which made use of the same project outline. Epse-Olthof involves a series of projects conducted over more than ten years by the archaeological unit of the municipality of Deventer; the results on the early prehistoric occupation have been published in a single volume (appendix II: PUBID 733).
79 It should be noted that the first indications for the presence of Hamburgian artefacts were reported in the context of development-led research in which the Groningen Institute of Archaeology was involved (Peeters *et al.* 2015). At a later stage, fieldwork was continued in the context of the annual fieldschool for archaeology students of Saxion University of Applied Sciences in Deventer, which resulted in the recovery of more, undisputably Hamburgian, material, again through the involvement of the Groningen Institute of Archaeology (Hoebe 2015; Peeters & Rensink in prep.).
80 Since the tang is almost entirely missing, the attribution of the point to the Havelte type is uncertain.
81 Johansen & Stapert 2004.

Fig 3.1 Various types of flint from the Hamburgian assemblage of Epse-Olthof. Most of the flint is of the Senonian type (translucid without fossil inclusions); the red blade (with two refitted blade fragments) is made of red Heligoland flint (photo by P. Hoebe). Scale bar in centimetres.

Assemblages attributed to the Federmesser Gruppen are equally rare. In several cases (e.g. Hasselo, Almen-Het Asseler), we seem to be dealing with 'by-catch' of isolated objects, such as backed points (Tjonger points, Federmesser points), which are easily identifiable.[82] Several assemblages collected at Knooppunt Hattemerbroek can possibly be attributed to the Federmesser Gruppen,[83] but the spatio-temporal integrity of this material is mostly questionable due to the scattered distribution pattern and unclear stratigraphical context. Only one of these assemblages represents a clear concentration, said to have been found in a shallow 'pit'. It contained a group of 79 artefacts originating from the same nodule, some of

82 Appendix II: PUBID 645.
83 Appendix II: PUBID 259.

Fig 3.2 Blade production waste from the Late Palaeolithic concentration at Knooppunt Hattemerbroek (from appendix II: PUBID 749). The length of the core (top left) is 66 mm.

which could be refitted: flakes, blades and one blade core with two opposite striking platforms (fig. 3.2). Initially, this material was attributed to the Federmesser Gruppen.[84] The authors state that an attribution to the Hamburgian or even Ahrensburgian is possible in reference to the absence of hard hammer blade production, which is typical of the Federmesser Gruppen.[85] Since the description in the report is insufficiently detailed,[86] and since some drawings and a photograph published in the earlier evaluation report lack the detail that might permit the reader to establish the cultural affiliation,[87] the material should be looked at again. Whatever the cultural attribution and precise dating, we seem to be dealing with a Late Palaeolithic, short-lived flint-knapping workshop, where only the exhausted core, preparation flakes and rejected blades were left behind. Given the absence of raw material sources in the direct environs of the site, it is clear that the assemblage must be seen in the context of a technological system that involved transportation of larger nodules of flint.

Remains of short-lived encampments attributable to the Ahrensburgian have been documented at the sites of Wijchen-Kraanvogelstraat and Alverna (also in Wijchen). Although the lack of points at both of these sites makes it difficult to confirm an Ahrensburgian affiliation, such an affiliation is probable in view of the technological characteristics of the blades, the morphology of the burins and scrapers, as well as the use of high-quality flint. For Alverna, the presence of light grey Belgian flint was reported;[88] it concerns several blades and a scraper, but no knapping debris. This type of flint is known from well-documented Ahrensburgian sites in the southern Netherlands. Production debris and refitted artefacts indicate on-the-spot manufacture of blades at the Alverna site (fig. 3.3). Several blades and flakes could be refitted to the core. The absence of decortication flakes suggests that the initial preparation of the core, from a cobble, took place elsewhere. Blade production was executed from two opposite striking platforms and a single production surface; the morphology of the core was

84 Hamburg & Knippenberg 2005, 58.
85 Verbaas *et al.* 2011, p. 344.
86 Verbaas *et al.* 2011.
87 Hamburg & Knippenberg 2005, 55-58.
88 Appendix II: PUBID 742. The assemblage was studied by J. Deeben (Rijksdienst voor het Cultureel Erfgoed). Deeben (†) had a profound knowledge of the Late Palaeolithic and Mesolithic of north-west Europe.

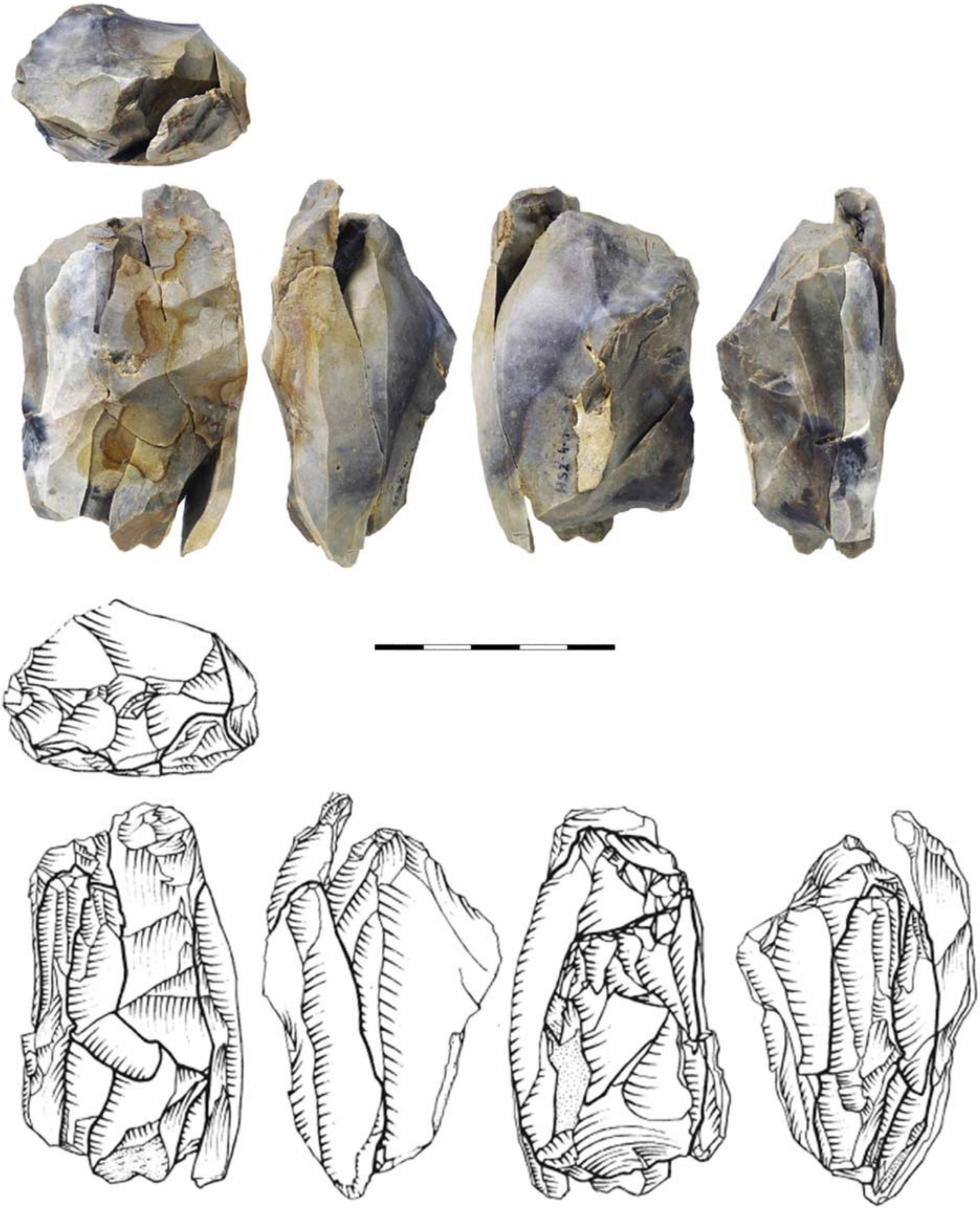


Fig 3.3 Core with refitted blades and flakes from the Ahrensburgian assemblage at Alverna (from appendix II: PUBID 742). Scale bar in centimetres.

Fig 3.4 Ochre-stained coversand at A2-Aalsterhut with some flint artefacts in situ (from appendix II: PUBID 216).

controlled by means of detachment of correction flakes. The few formal tools (n=8, c. 10% of the assemblage) – mostly scrapers and burins – indicate a narrow activity spectrum. The assemblage from Wijchen-Kraanvogelstraat contains a higher percentage of tools (n=39, c. 20% of the assemblage), but the range of tool types is comparable.[89] The presence of several tested nodules, cores and various core rejuvenation pieces, and of many artefacts with cortex, shows that here, in contrast to the Alverna assemblage, all steps of the production sequence are represented. As in the previously discussed Hamburgian and Federmesser contexts, these Ahrensburgian assemblages fit a technological system that involved transportation of nodules of flint, as well as of prepared cores, blanks and tools.

A third Ahrensburgian assemblage comes from the site of A2-Aalsterhut.[90] The site is part of a legally protected complex of Late Palaeolithic (Federmesser Gruppen, Ahrensburgian) and Mesolithic sites that has been (partly) excavated since the 1950s. More than 1500 artefacts were collected, amongst which 39 tools, such as points, scrapers, burins, and retouched/utilised flakes and blades. This is a rather broad spectrum, but because only a 2-3 m wide strip could be investigated, it is not clear how representative the lithic assemblage is of the total distribution. Both blades and flakes were used as blanks for the manufacture of tools. Bigger blades attest to a bidirectional core reduction scheme. Most of the production waste and tools are of Belgian flint (amongst which Haspengouw flint) and flint of south-eastern Dutch origin (Rijckholt, Rullen) collected from river deposits. However, some artefacts that bear relatively fresh cortex may have been collected at outcrops in the southern part of the province of Limburg.[91] The overall assemblage composition and the presence of some quartzite artefacts – including one showing abstract linear decoration – seems to point to a multipurpose encampment. As was the case at other Ahrensburgian sites in the vicinity, red ochre was part of the behavioural context of the activities conducted at the site (fig. 3.4).

Although restricted in number, the Late Palaeolithic assemblages described above provide evidence for technological systems within which (long-distance) transportation of raw materials and objects in various stages of exploitation and use was common. Differences in assemblage composition point to inter-site variability in stone tool production.

89 Heirbaut 2010, 136.
90 Appendix II: PUBID 216.
91 Vroomans *et al.* 2014.

Mesolithic. Lithic tool assemblages of Mesolithic age are frequently encountered in the context of development-led fieldwork. Both tools made of flint and tools made of other types of rock (e.g. quartzite, sandstone, granite) are encountered. The latter category will be discussed in the section on tool typology and function. With regard to flint and other types of rock with comparable fracture properties, Mesolithic technology is generally characterised by the manufacture of (micro)blades and flakes as blanks for tools. However, the modes of blade production have been shown to change over time. Early Mesolithic blades are, to some extent, produced in a Late Palaeolithic tradition, but they are nonetheless different from Ahrensburgian blades. Middle Mesolithic blade production is strikingly different, and shows a clear focus on microblades. In the northern Netherlands, microblades were possibly – but not exclusively – produced by means of the pressure technique;[92] no such indication exists for the central and southern Netherlands. The Late Mesolithic, in contrast, is characterised by the production of relatively long, regular blades by means of indirect percussion (the punch technique); this mode of production is continued into the Early Neolithic. Although this shift has been described in the literature for some time,[93] we think that it is worthwhile to see how assemblages excavated in the context of development-led projects fit this picture, and how these assemblages can inform us in greater detail about flint tool manufacture and associated use of raw materials. One problem we have to face is the palimpsest nature if the great majority of sites and the mixing of materials dating to more than one occupation phase. The most extensive Early to Middle Mesolithic assemblages come from the sites of Dronten-N23, Knooppunt Hattemerbroek, Rotterdam-Yangtze Harbour, Epse-Olthof and Ede-Kernhem.[94] Without exception, these sites were used on multiple occasions and, based on radiocarbon dates, over many centuries –and hence by many generations of hunter-gatherers. Nonetheless, several distinct clusters within some of the wider finds distributions have permitted the archaeologists to isolate relatively discrete chronological assemblages, which have been dated on the basis of ^{14}C-dates of associated charred hazelnut shell and microlith typology.

An Early Mesolithic assemblage is represented at Knooppunt Hattemerbroek. At this site, assemblage 6.12 comprises blade cores with uni- and bidirectional reduction schemes. The majority (75%; n=15) are flake cores (fig. 3.5). Maintenance of cores is attested by rejuvenation and correction flakes, whereas blades show evidence of platform edge preparation by means of retouch. Typically, about 60% of the blades (n=85) lack a clear bulb of percussion, c. 25% show a weakly developed percussion cone, and another 25% show a lip. These characteristics indicate the use of soft hammers (stone, antler), which supports the idea of continuity from Late Palaeolithic technological traditions.[95] An assemblage dated to the Early-Middle Mesolithic 'boundary' from Dronten-N23 (assemblage 5) shows an equal representation of flake and blade cores, but the latter are probably underrepresented due to their use for the production of flakes in the final stage of reduction. Bipolar cores reduced by the hammer-and-anvil technique, which occur in Middle and Late Mesolithic assemblages from the same site, are lacking in assemblage 5. On the other hand, assemblage 6 from Dronten-N23, also dated to the Early-Middle Mesolithic 'boundary', does comprise bipolar cores.[96] Middle Mesolithic assemblages 3, 7, 8 and 9 show a dominance (>70%) of flake cores. The remaining cores are blade cores and bipolar cores; the latter are reduced by means of the hammer-and-anvil technique. Further technological information is lacking in the report.

Late Mesolithic assemblages are represented at Dronten-N23 and Leeuwarden-Hempens.[97] Assemblages 1 and 2 from Dronten-N23 include more than 200 cores, of which 60% flake cores, 26% blade cores, and 14% bipolar cores. Flake cores have one or more platforms and are often irregularly shaped. Amongst the blade cores, unidirectional reduction schemes and single platform strategies are dominant. Bipolar cores have been reduced by means of the hammer-and-anvil technique. No further technological information is given with regard to flake and blade production, so it cannot be confirmed whether indirect percussion was used. The use of indirect percussion seems, however, to be likely – based on the drawings provided[98] – at Leeuwarden-Hempens, where long and regular blades were found (fig. 3.6). The ^{14}C-dates on charred hazelnut shell do, however,

92 Musch & Peeters 1993.
93 Pélegrin 2000; Tixier *et al.* 1980.
94 Appendix II: PUBID 259, 462, 538, 733, 745.
95 Verbaas *et al.* 2011, 364.
96 Niekus *et al.* 2012.
97 Noens 2011; Niekus *et al.* 2012.
98 Noens 2011, fig. 68-70 (120, 122-123), fig. 74 (130).

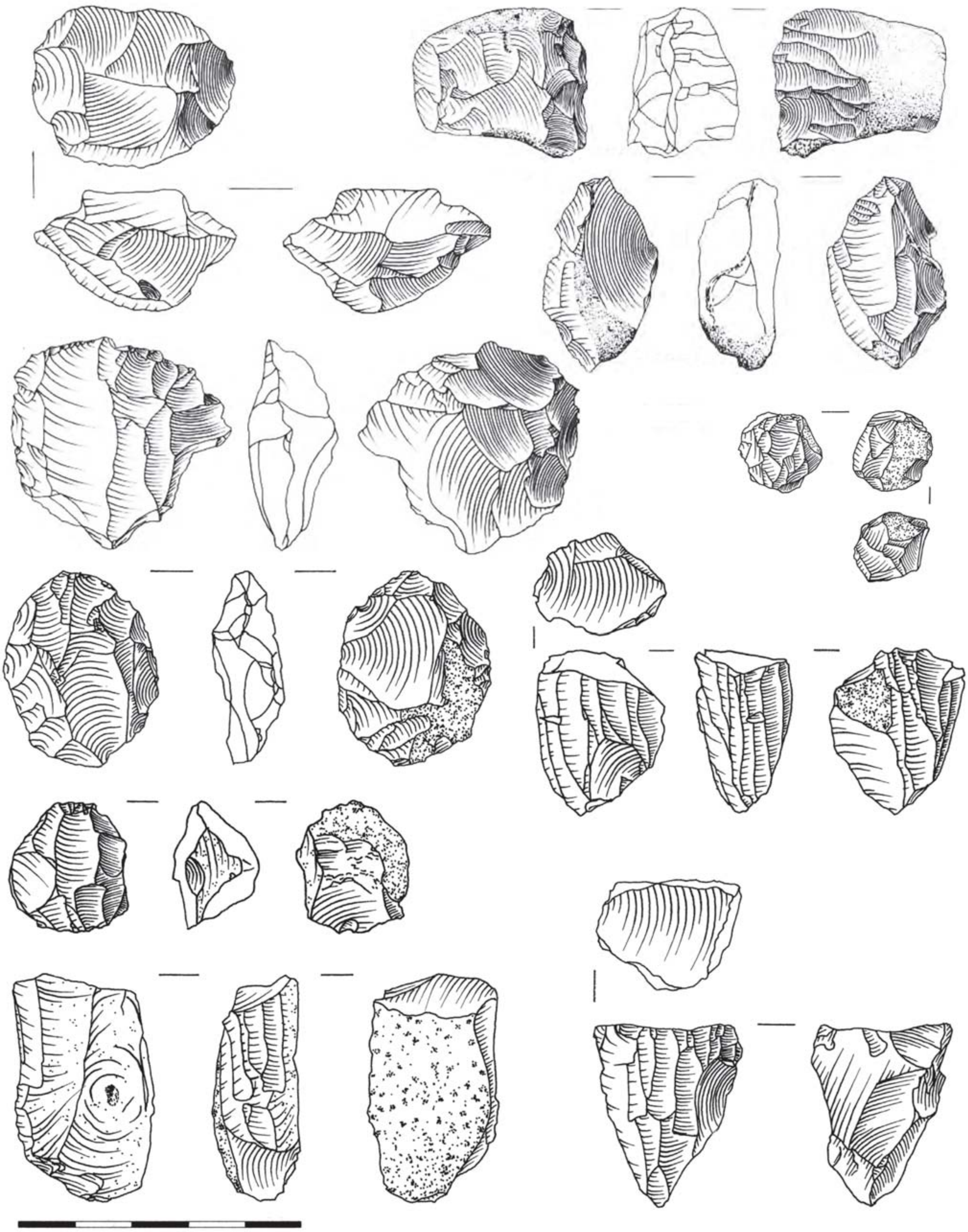


Fig 3.5 Mesolithic blade cores from Knooppunt Hattemerbroek and Dronten-N23 (from appendix II: PUBID 259, 538). Scale bar in centimetres.

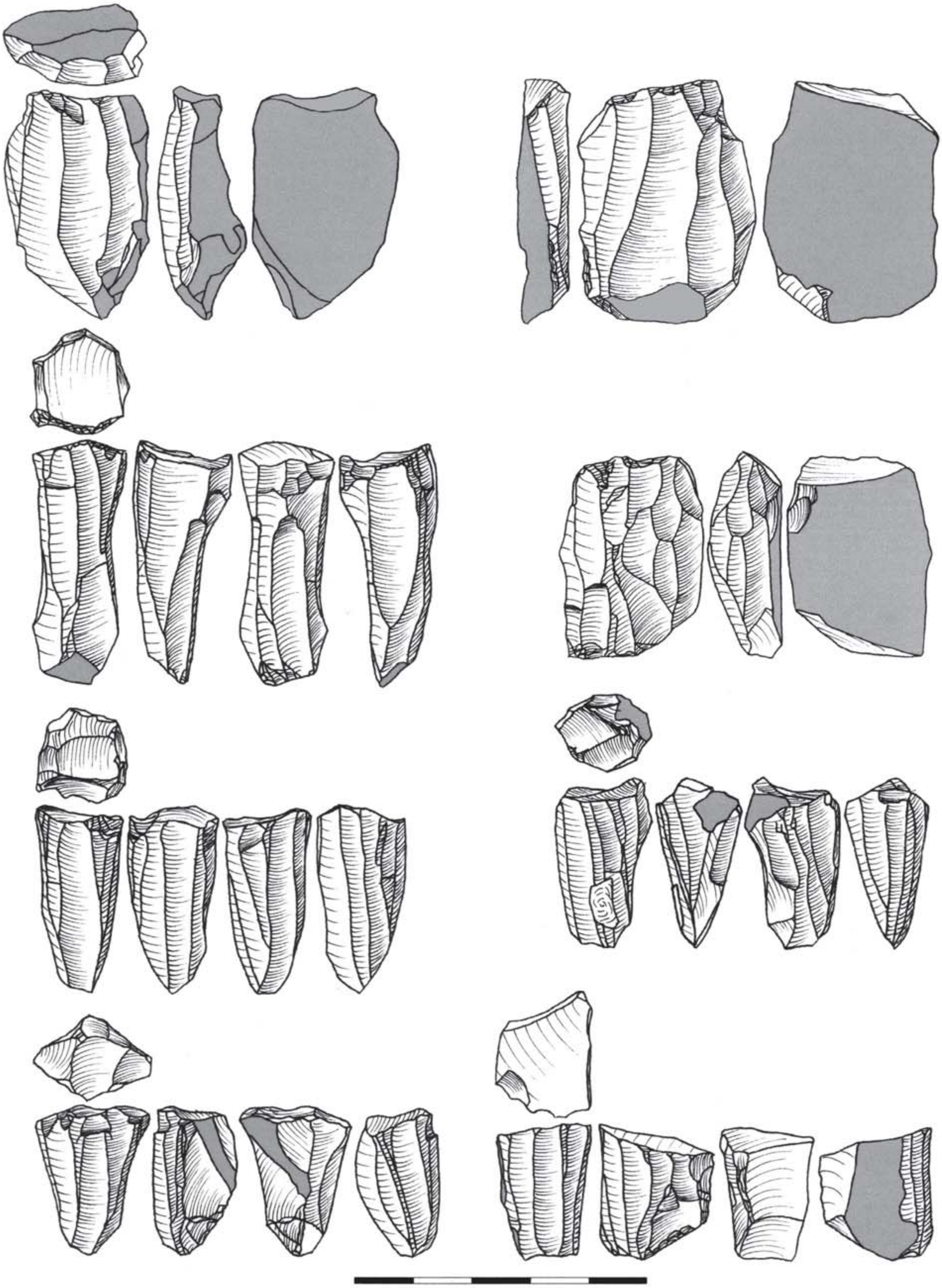


Fig 3.6 Mesolithic flake and blade cores and blades from Leeuwarden-Hempens (from Noens 2011). Scale bar in centimetres.

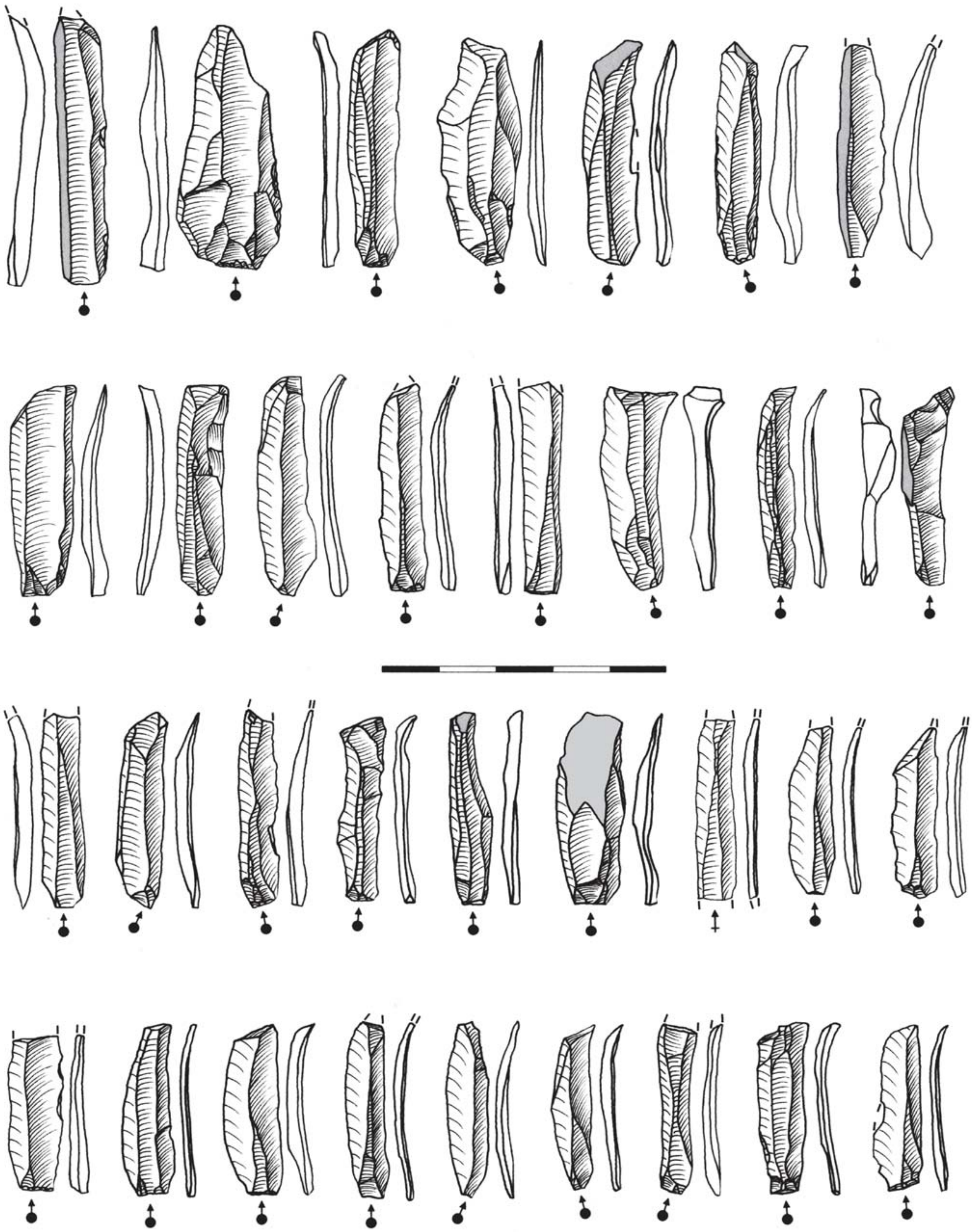


Fig 3.6 Continued.

indicate activity throughout the Middle and Late Mesolithic, which makes it difficult to confirm a Late Mesolithic age for these blades. Several notched blades (Montbani blades) and numerous trapezoid points made out of such regular blades suggest a Late Mesolithic age. The same site has produced regular microblades, as well as small prismatic cores showing regular blade negatives that may indicate pressure flaking. This is also the case for the 'handle cores' and 'bullet core' mentioned in the report. Again, it is difficult to establish their age, but triangular points and backed bladelets made out of regular microblades make a Middle Mesolithic age more probable (see section 3.4.1, on the typo-chronology of the Late Palaeolithic and the Mesolithic).

In general terms, the raw materials used in the Mesolithic seem to be of local origin. This means nothing more than that there is no concrete evidence for flint varieties collected in areas at considerable distance from the sites investigated. And what it does not mean is that the raw materials were collected at the sites themselves. Only in the case of Leeuwarden-Hempens can such an assumption be made – to some extent – because the locally occurring glacial till in the substrate contains nodules of flint. However, there is no evidence for local mining of these deposits, which did not reach the Mesolithic land surface.[99] Hence, 'local' seems to refer to the exploitation of secondary sources of flint, the source of which is unknown, indeed impossible to know. As an alternative, it has been proposed to use the term 'non-territorial' for materials originating from distant sources, which implies that local sources are located within a territory.[100] But what, specifically, is meant by this term? Does territory equate with home range or does it refer to the entire area exploited over a yearly cycle of mobility? And how big is a territory and how is a particular site positioned within it? Even if one can pinpoint a unique source area, for instance, in the case of Wommersom quartzite (see section 4.2.2), it does not follow that this source is to be considered non-territorial when artefacts of this material occur, for instance, at sites in Rotterdam. Depending on one's definition of territory, Wommersom (Belgium) might just as well be within the territory of the people who also exploited the Rotterdam area.

Neolithic. The Neolithic is generally considered to have been a period of technological change, including the appearance of new types of tools, new methods of tool manufacture, and methods of raw material acquisition. A considerable number of assemblages have been excavated in the context of development-led archaeology in almost all parts of the Netherlands. The chronological and cultural context of these assemblages is diverse, however, which makes it possible to potentially obtain deeper insight into variability in stone tool manufacturing technologies. Within the Early Neolithic of the Netherlands, several socio-cultural contexts are distinguished: LBK, Rössen and Swifterbant. The Middle Neolithic comprises Michelsberg, Stein, Vlaardingen, Hazendonk, and TRB.

Several sites have yielded assemblages with a considerable amount of material from LBK contexts: Sweikhuizen-Geverik, Beek-Kerkeveld, and Rijksweg A2-Stein Heidekampweg.[101] All derive from settlements characterised by typical LBK house plans and associated pits and ditches. From a technological perspective, the flint material fits the LBK picture (fig. 3.7). Tools mostly comprise scrapers, borers, and retouched and notched/denticulate pieces made out of blades and flakes. Points occur on all sites, but in low numbers. As far as can be judged from the published drawings and photographs – no quantified measurement data are provided – blades are relatively wide and regular, and have been detached from prismatic cores. The denticulate edge of a platform rejuvenation flake (tablet) from Beek-Kerkeveld indicates the application of indirect percussion for the production of blades, which is common for the LBK. At Rijksweg 2-Stein Heidekampweg, however, prismatic cores and tablets are rare in comparison with more opportunistically exploited flake cores. At all sites, the waste products represent the entire sequence of production, from initial core preparation, through full exploitation and maintenance, to discard. Several blade cores were used as hammer stones once they were not longer useful for blade production. The dominant raw material is flint of the Lanaye (Rijckholt) type, which could have been collected at outcrops in the region,

99 Noens 2011, 156.
100 Van Gijn & Houkes 2006.
101 Appendix II: PUBID 053, 528, 537.

Fig 3.7 Flint artefacts from various LBK sites. Beek-Kerkeveld: (a) blade core used as a hammer stone, (b) point, (c) blade with sickle gloss, (d) scraper; Stein-Heidekampweg: (e) production waste; Sweikhuizen-Geverik: (f) point, (g) scraper (from appendix II: PUBID 53, 528, 537).

e.g. in the vicinity of Banholt. The Banholt variant, which has been reported for both Beek-Kerkeveld and Rijksweg 2-Stein Heidekampweg, has a characteristic brown–red iron oxide infiltration band underneath the chalky cortex.[102] Other flint varieties – Rullen, Simpelveld and Valkenburg – from the Limburgian and Belgian chalk districts are less well represented in these three assemblages. None of the selected sites has produced evidence for specialised flint knappers;[103] stone tool manufacture was probably organised at the household level.

Few lithic assemblages attributable to the Swifterbant Culture have been studied since the major excavations at Hardinxveld-Giessendam and Hoge Vaart-A27, more than 15 years ago.[104] Rotterdam-Groenenhagen yielded an assemblage that shows technological affinities with the early stage of the Swifterbant Culture (fig. 3.8).[105] The manufacture of tools was based on regular blades, which provided blanks for the production of trapezoid points. Frequently, blades were used without any, or only limited, modification. Tools such as scrapers were produced out of flakes. Longer blades (length exceeding 5 cm, no dorsal cortex) were produced by application of indirect percussion on cores with a unidirectional production surface. The lack of voluminous cores in the excavated assemblage suggests that these blades may have been manufactured elsewhere. Small cores still bear cortex and mostly show negatives of flakes and smaller, less regular blades. The flint is mostly of northern origin; a limited number of artefacts are made of Rijckholt-type flint and possibly light grey Belgian flint, both of which can be found in Meuse gravel deposits. One artefact is made of white-speckled black flint, which is believed to originate from the Cap Blanc Nez (Calais, France) area. Another artefact – heavily burned – may be of Wommersom quartzite.

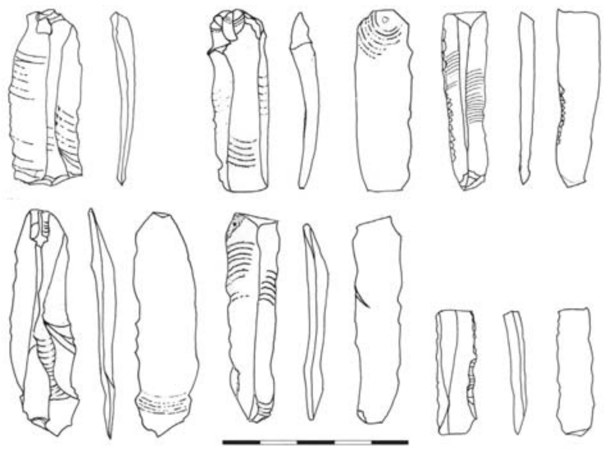


Fig 3.8 Blades from Rotterdam-Groenenhagen. The specimen in the lower right corner is retouched and slightly denticulate (from appendix II: PUBID 468). Scale bar in centimetres.

102 Brounen & Peeters 2009.
103 The recently excavated site of Maastricht-Cannerberg has produced evidence for supra-local production, which may indicate specialised knapping (Knippenberg 2016).
104 Peeters *et al.* 2001; Van Gijn, Beugnier & Lammers-Keijsers 2001; Van Gijn, Lammers-Keijsers & Houkes 2001.
105 Niekus & Machiels 2013. It should be noted that early Swifterbant Culture flint technology is in fact a continuity of Late Mesolithic technology and therefore cannot safely be distinguished from it without further contextualisation and dating evidence. In the case of Rotterdam-Groenenhagen, pottery attributable to the Swifterbant Culture was found in association with the flint assemblage (Bloo 2010).

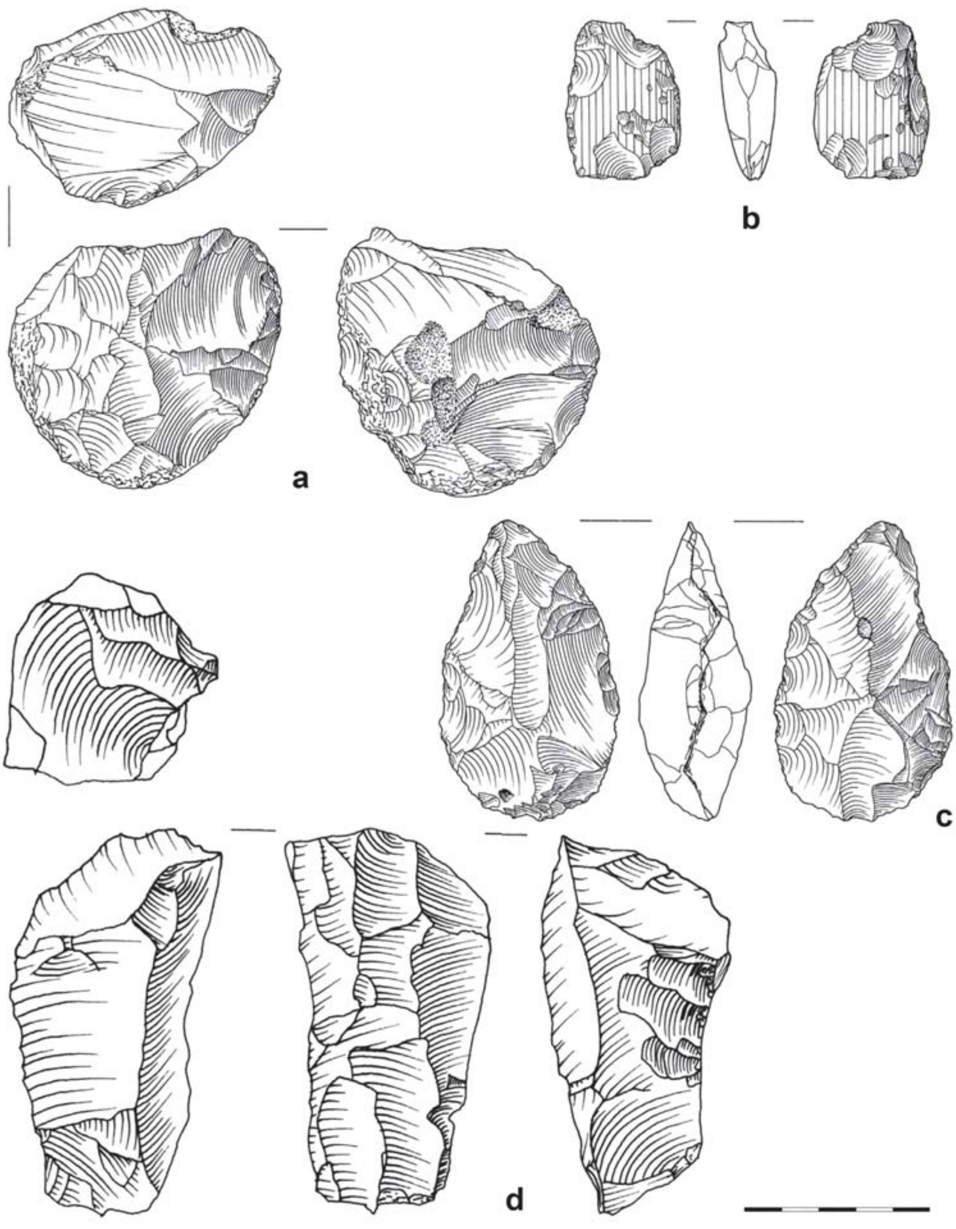


Fig 3.9 Flint cores of the Michelsberg Culture. Itteren-Voulwames: (a) core used as a hammer stone, (b) polished axe reused for flake production, (c) pick-shaped core; Brunssum-Molenbeek: (d) coarse blade core (from appendix II: PUBID 95, 309). Scale bar in centimetres.

Middle Neolithic assemblages come from a number of sites; they particularly provide insight into technological aspects of Michelsberg (Itteren-Voulwames and Brunssum-Molenbeek),[106] Hazendonk (Schipluiden, Rijswijk-Ypenburg and Nijmegen-Oosterhout),[107] Vlaardingen (Hazerswoude-Rijndijk, Hellevoetsluis-Ossenhoek, Rotterdam-Beverwaard),[108] Stein (Itteren-Hoeve Haertelstein, Hof van Limburg and Haren-Groenstraat),[109] and TRB (Knooppunt Hattemerbroek, Groningen-Europapark, Groningen-Helpermaar and Leeuwarden-Hempens).[110] Typically, these assemblages are dominated by the production of flakes. With the exception of Michelsberg assemblages, blades are rare. The Michelsberg assemblages still present a degree of standardised core reduction from a single platform for blade production, whilst flake cores are reduced from 1-3 platforms, yet not in an opportunistic or random fashion (fig. 3.9).

106 Appendix II: PUBID 95, 309.
107 Appendix II: PUBID 338, 463, 732.
108 Appendix II: PUBID 272, 463, 740.
109 Appendix II: PUBID 219, 253, 308.
110 Appendix II: PUBID 260, 741, 750, 752.

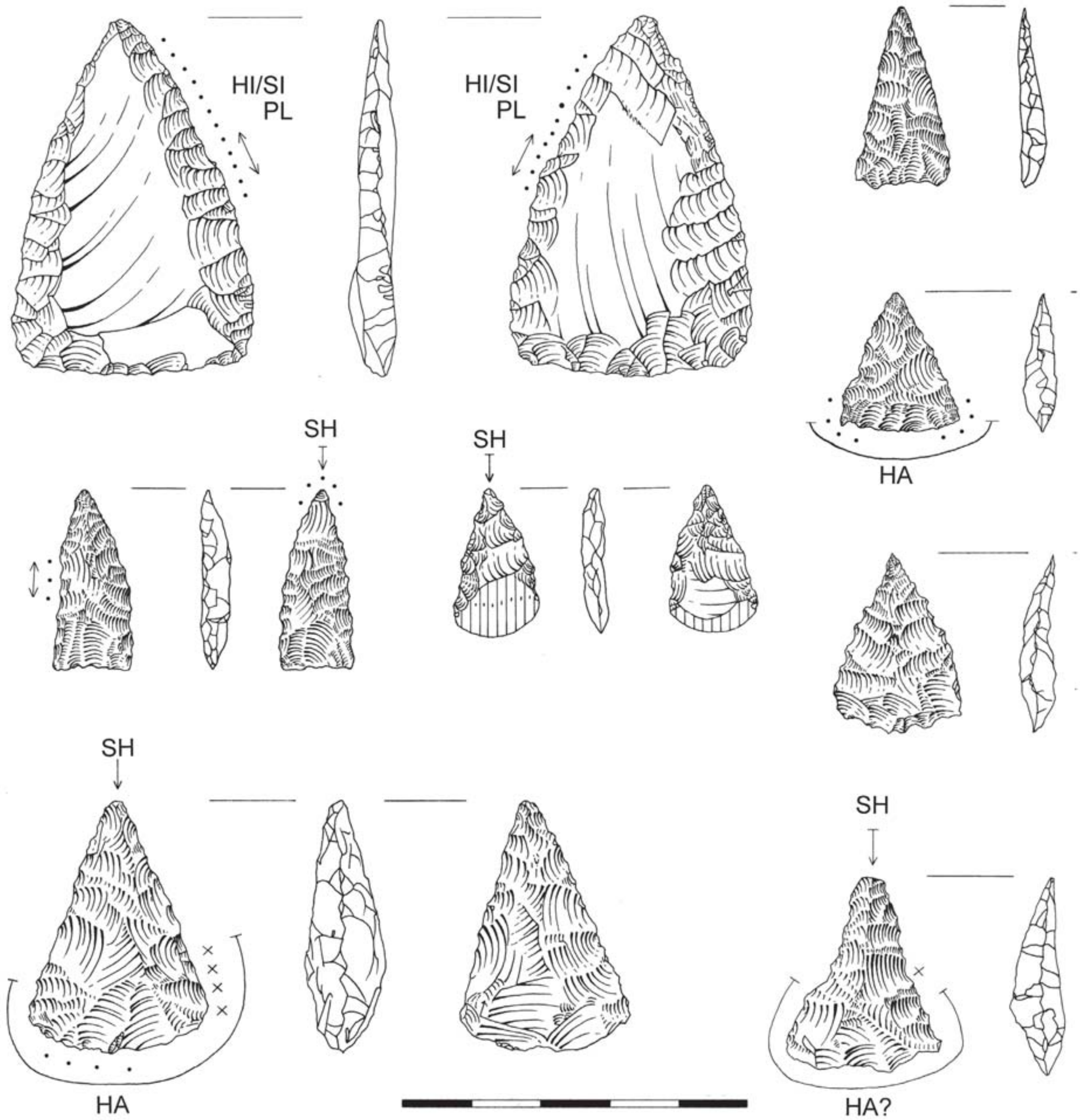


Fig 3.10a Points with invasive retouch from Schipluiden (from appendix II: PUBID 732). Scale bar in centimetres.

Retouched tools (pointed blades, scrapers) are often large (>5 cm) and produced from wide blades and flakes. A comparable picture emerges from the Hazendonk assemblages, which contain big retouched blades and flakes; other typical elements are short and elongated points with invasive retouch (fig. 3.10). These elements are mostly made out of what is described in the report as non-local flint, notably originating from sources in Belgium (Haspengouw?), southern Limburg and, possibly, northern France (Cap Blanc Nez).[111] However, the majority of lithics connect to a less standardised reduction of (beach-)rolled pebbles that may have been collected in the vicinity of the settlement locations. In the context of Stein, Vlaardingen and TRB, blades become scarcer, and normally these are small and not produced in a systematic manner; it would be better to describe these as long flakes or blade-like flakes. Evidence for blade production, however, is present in the Stein assemblage of Haren-Groenstraat (fig. 3.11), where several tools made out of blades were

[111] Van Gijn *et al.* 2006; Houkes 2008. See section 4.2.2 for further discussion.

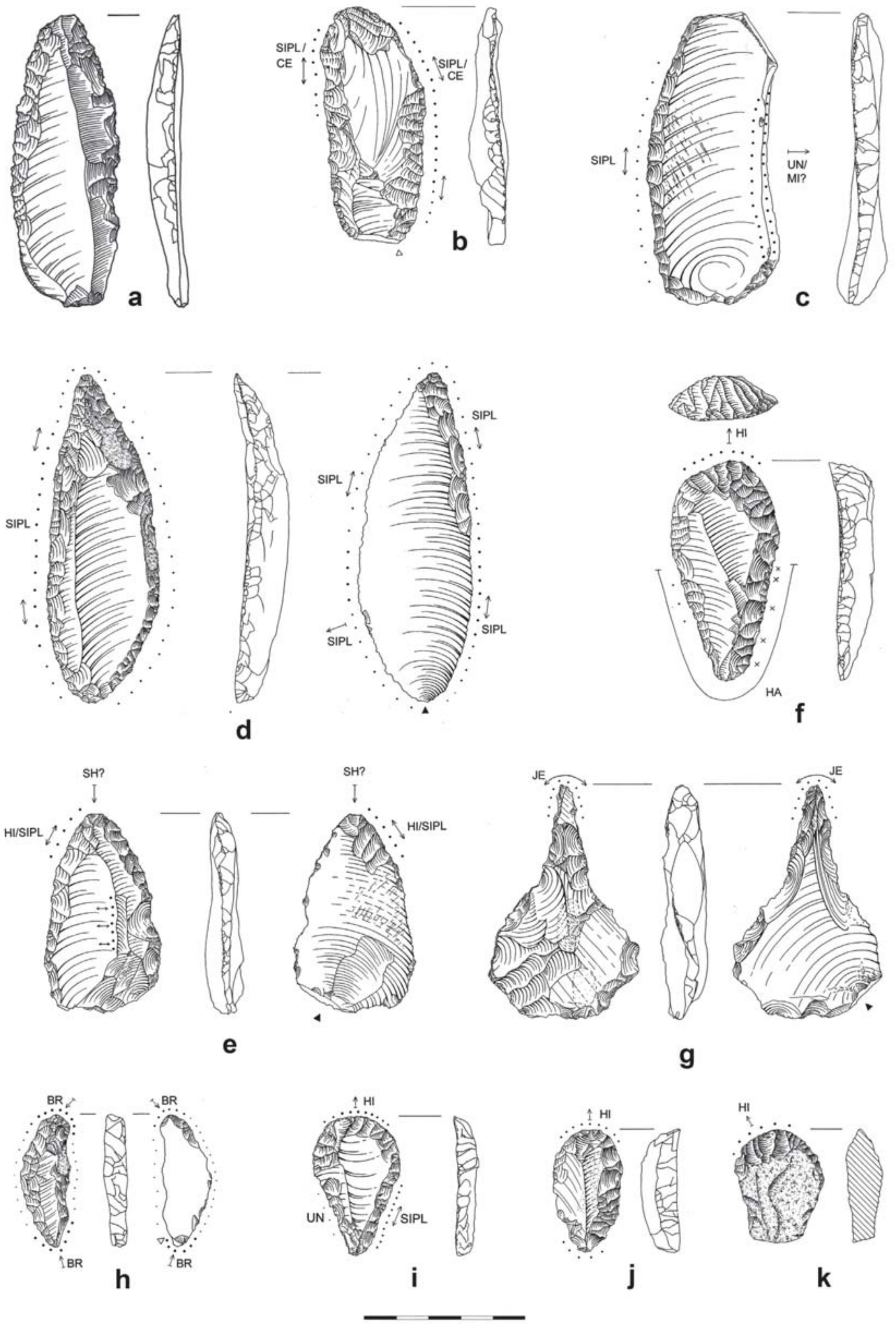


Fig 3.10b Macro-tools of the Michelsberg Culture (a) and Hazendonk group (b-j). Itteren Voulwames: (a) pointed blade; Schipluiden: (d) pointed blade, (b, c, e) pointed flakes, (f, i-k) scrapers, (g) borer, (h) retouched flake (from appendix II: PUBID 309, 732). Scale bar in centimetres.

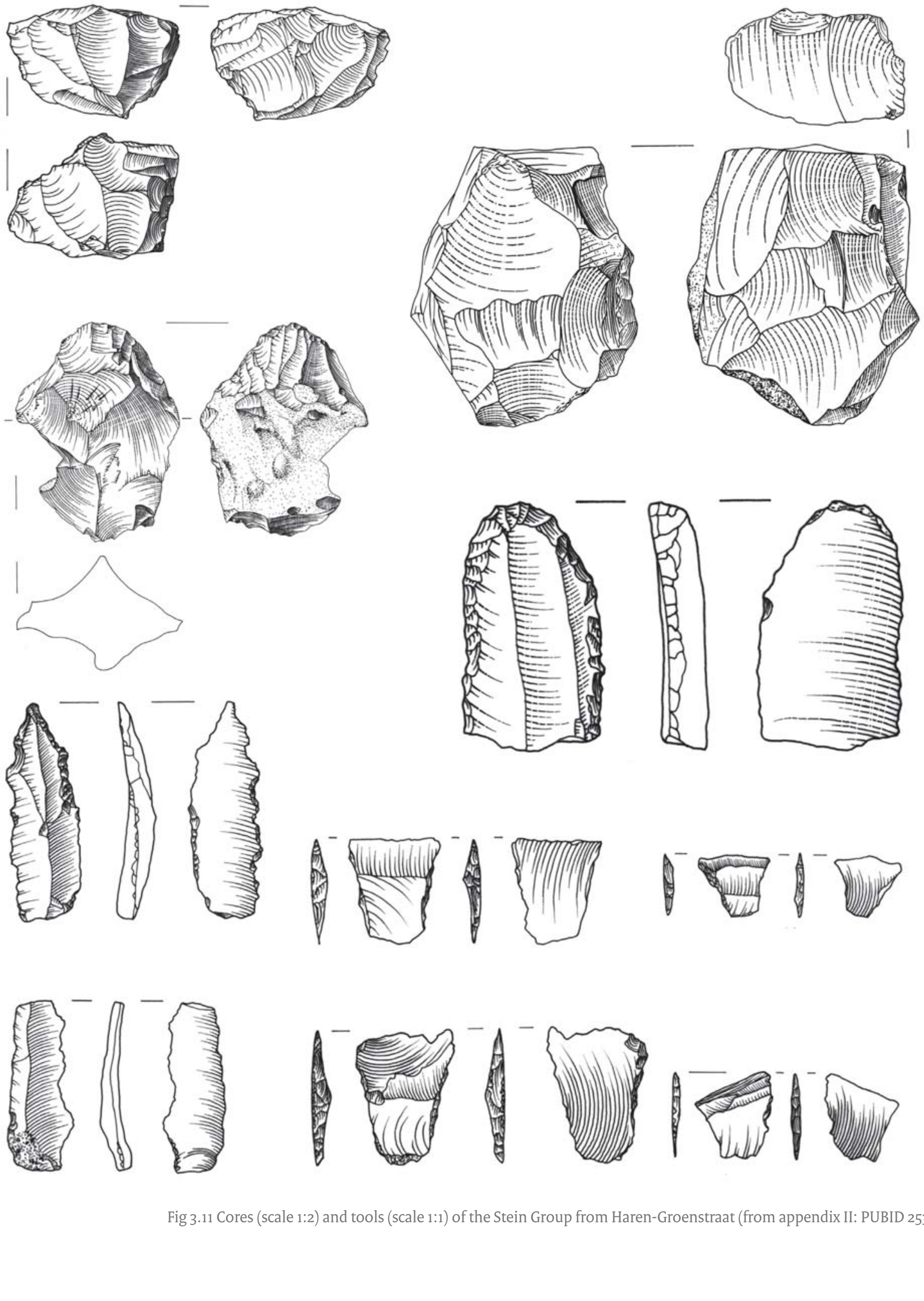


Fig 3.11 Cores (scale 1:2) and tools (scale 1:1) of the Stein Group from Haren-Groenstraat (from appendix II: PUBID 253).

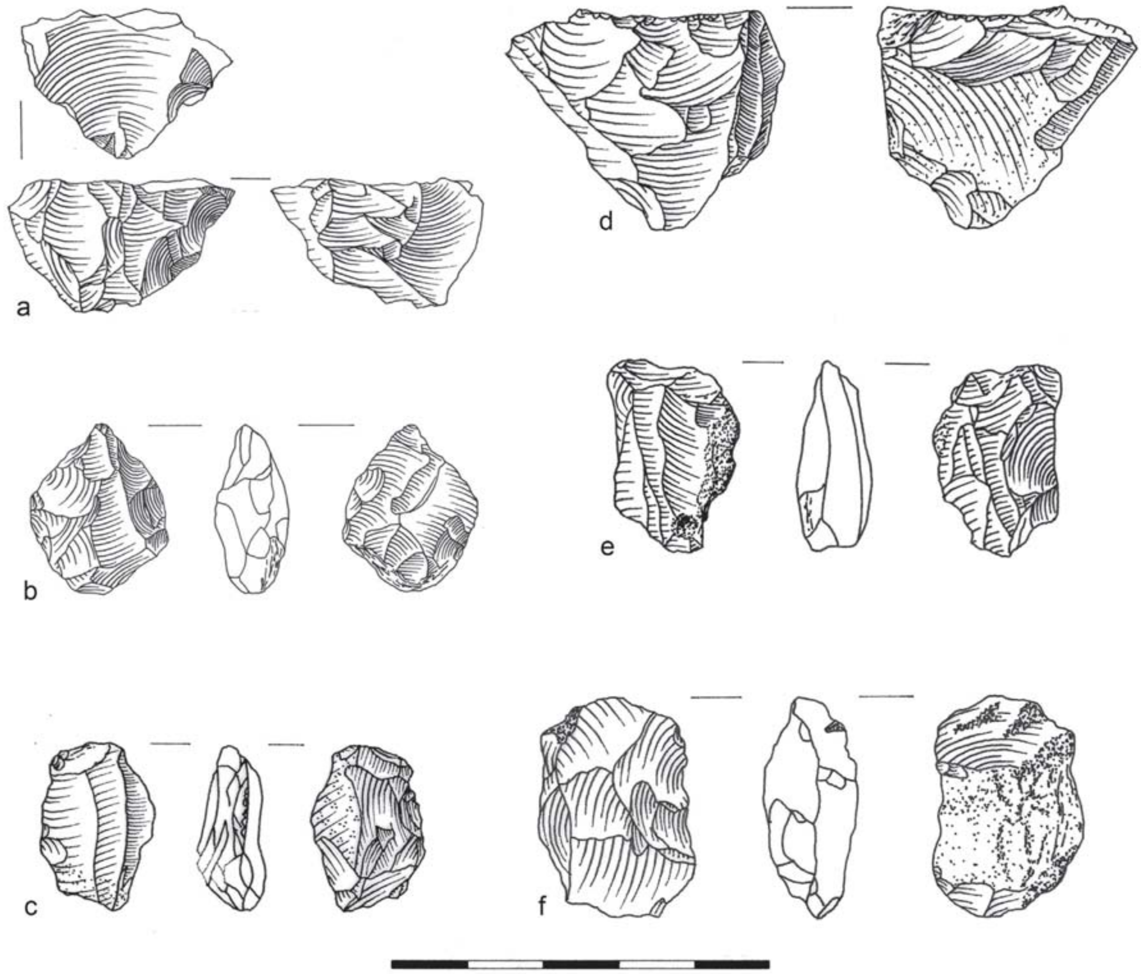


Fig 3.12 Cores from Vlaardingen and TRB assemblages: (a, b) Hellevoetsluis-Ossenhoek, (c-i) Knooppunt Hattemerbroek (from appendix II: PUBID 272, 260). Scale bar in centimetres.

found, notably transverse arrowheads (which were also produced on flakes). At this site, there is also evidence for the application of direct soft percussion. Vlaardingen and TRB assemblages appear to be dominated by opportunistic flake production from small erratic nodules – probably collected from outcrops in the vicinity – by means of direct hard hammer percussion, and sporadically by bipolar percussion (fig. 3.12). Typically, tools are not very standardised.

Tool typology and function

In the early days of development-led commercial archaeology, some 15 years ago, few lithic assemblages were subject to use-wear analysis of any reasonable intensity. These analyses came from the Late Mesolithic and Early Neolithic sites of Hoge Vaart-A27 and Hardinxveld-Giessendam Polderweg and De Bruin.[112] Owing to the positive results and the involvement of the national heritage agency, several subsequent projects have paid attention to use-wear analysis to obtain insight into craft activities within settlements. In many of the reports in our sample, typological classifications are used to draw conclusions about activities. But use-wear analysis has shown that the relationship between typology and tool function is not straightforward. Although use-wear analysis has not been executed as a standard within development-led projects, valuable insights have been obtained. This is not only the case for tools made out of flint, but also for tools made out of other types of rock. There is frequent cross-referencing to research results, but this is mainly due to the fact that nearly all

112 Peeters *et al.* 2001; Van Gijn, Beugnier & Lammers-Keijsers 2001; Van Gijn, Lammers-Keijsers & Houkes 2001.

use-wear analysis has been performed by one small group of researchers.[113] The obvious advantage thereof is analytical and interpretive coherency, as well as an increase of knowledge base upon which subsequent projects can build. Nonetheless, problems of representativeness may occur, owing to both sample size and sampling strategy.

Table 3.1 provides an overview of flint assemblages that have been subject to use-wear analysis. The relative importance of the sample size for the sites is difficult to compare, as the figures do not take into account differences in excavation strategy and site taphonomy. Dronten-N23, Ede-Kernhem, Leeuwarden-Hempens and Groningen-Europapark are maybe the most comparable, as they were excavated in more or less similar ways (sieving of 50 × 50 cm grid cells). Clearly, the percentage of analysed artefacts from these sites is low, with the most extreme case being Groningen-Europapark. The bigger samples, from Rotterdam-Yangtze Harbour and Schipluiden, are the result of the researchers making an explicit choice to pay more attention to use-wear as an important source of information. Furthermore, the sampling criteria differ amongst sites. With these differences, it is impossible to say to what extent the results obtained are representative of variability at both the intra- and the inter-site level.

Table 3.1 Sample size and selection criteria for use-wear analysis.

Site	N flint	N tools	Use-wear	Selection criteria; analyst
Rotterdam-Yangtze Harbour	2976	114	170 (5.7%)	• intentional retouch • straight working edge ≥ 5 mm • point prodruding far enough to be functional • straight, blunt working edge • absence of heavy post-depositional damage • analyst: Verbaas
Dronten-N23	25040	2216	243 (1.0%)	• selection based on assessment results • analyst: Verbaas
Leeuwarden-Hempens	19144	1729	354 (1.9%)	• representation of each typological category • sample of unretouched artefacts • equal spatial distribution • analyst: pilot study by Schreurs; expanded study by Beugnier
Ede-Kernhem	23292	769	50 (0.2%)	• selection of retouched artefacts with the *exclusion* of microlithic points • unretouched flakes and blades • analyst: Beugnier
Knooppunt Hattemer-broek section Hanze-lijn	10151	1187	236 (2.3%)	• representation of each typological category • sample of unretouched artefacts • exceptional objects • sample from each cluster complex • absence of heavy post-depositional damage • analyst: Verbaas
Knooppunt Hattemerbroek section Bedrijven-terrein (TRB context)	6925	645	203 (2.9%)	• representation of each typological category • sample of unretouched artefacts • exceptional objects • sample from each cluster complex • absence of heavy post-depositional damage • analyst: Verbaas
Schipluiden	2666	1123	373 (14.0%)	• representation of each typological category • preferential treatment of blades • analyst: Van Gijn, Van Betuw, Verbaas
Rijswijk-Ypenburg	15515	356	133 (0.9%)	• intentional retouch • regular edge morphology • representation of each typological category • sample of unretouched artefacts • analyst: Van Gijn, Verbaas
Hellevoetsluis-Ossenhoek	2823	214	81 (2.9%)	• retouched tools • analyst: Metaxas
Groningen-Europapark	10513	310	10 (0.1%)	• selection criteria unknown • analyst: Verbaas, Garcia-Diaz

[113] Most are connected to the Laboratory of Material Culture Studies at Leiden University (now Foundation LAB).

Typo-morphology and function. The typological classification of tools represents the basic exercise on which reports expand. Indeed, in many cases the 'analysis' is restricted to the presentation of a frequency count of tool types and brief comments on each of these types. In those cases where use-wear analysis has been performed, a more in-depth discussion is presented, including whether use-wear analysis confirms or repudiates a correlation between tool typology and function.

Confirmed correlations are particularly found for Mesolithic scrapers, which normally appear to have been used for working fresh or dry hides and are, indeed, found to have been used in a scraping motion (Knooppunt Hattemerbroek, Rotterdam-Yangtze Harbour, Epse-Olthof, Dronten-N23 and Ede-Kernhem).[114] Hide scraping also seems to have been the dominant function of Neolithic scrapers, yet there also is evidence for the working of bone or antler, plant material, and mineral or pottery – and even for their use as a strike-a-light (Schipluiden, Hellevoetsluis-Ossenhoek, Groningen-Europapark, Knooppunt Hattemerbroek).[115] Another positive correlation pertains to borers and piercers, which were indeed used for perforation of various materials, such as bone, bark, soft wood, mineral (pottery?) and occasionally shell and jet (Rotterdam-Yangtze Harbour, Dronten-N23, Ede-Kernhem, Groningen-Europapark).[116] More surprising is the less clear correlation between arrowheads and function. The broad and variable category of Mesolithic microlithic 'points' – thought to have functioned as projectiles (i.e. related to subsistence activity) – appears to include other functions, notably drilling and piercing, as well as cutting and scraping (Rotterdam-Yangtze Harbour, Dronten-N23, Knooppunt Hattemerbroek).[117] Neolithic arrowheads, in contrast, seem to have been used as projectile points only (Schipluiden, Hellevoetsluis-Ossenhoek and Knooppunt Hattemerbroek).[118]

Although it is possible that differences between the Mesolithic and Neolithic relate to sample size (representativeness), there is nothing to suggest that this is the case here. There seems to be a 'crossover' in functional range of Mesolithic and Neolithic scrapers and arrowheads, which may suggest differences in the formal relationship between particular functions and tool type. We have to bear in mind, however, that the typological categories are defined by archaeologists. Mesolithic microliths represent a broad category, mostly consisting of variably shaped 'insets' for compound projectile heads, whereas Neolithic arrowheads are single-element projectile heads (fig. 3.13). The categorisation of individual projectile elements can potentially lead to conflating similarly shaped items that had different functions. On the other hand, the chances that a scraper will be confused with a projectile point will be (close to) zero.

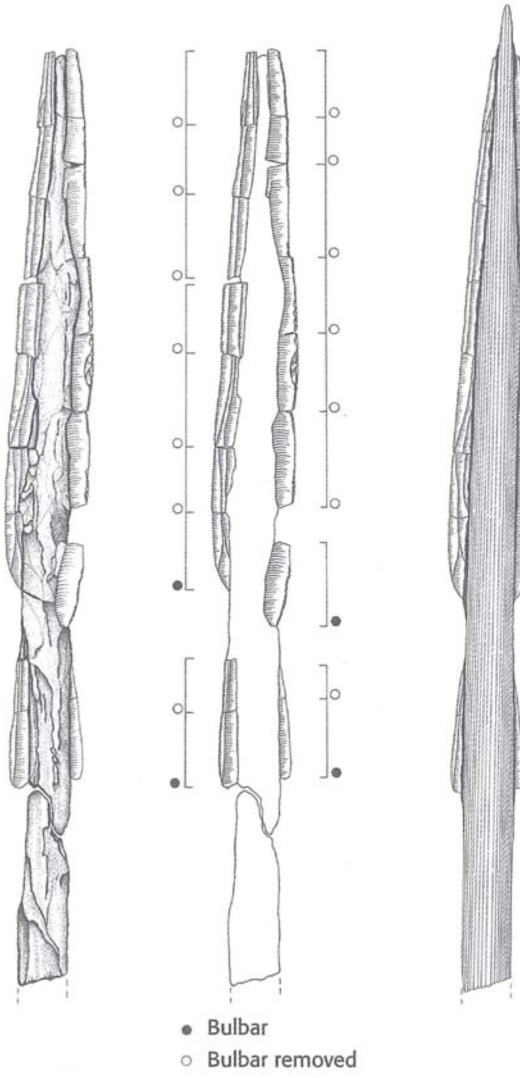


Fig 3.13 Example of a slotted point (17.5 cm in length) with hafted microliths from the Kongemose at Tågerup, Sweden (from Karsten & Knarrström 2003). Left: the object as it was found (in a grave), middle: the structure of microlithic inserts, right: reconstruction.

114 Appendix II: PUBID 259, 464, 538, 733, 745.
115 Appendix II: PUBID 259, 260, 272, 732, 752.
116 Appendix II: PUBID 259, 745, 752.
117 Appendix II: PUBID 259, 462, 538.
118 Appendix II: PUBID 259, 260, 272, 732.

Nonetheless, we have to remain aware of a degree of mismatch between typological categories and function, especially in the case of atypical tools.[119] To stick to the above examples, the fact that Mesolithic scrapers were predominantly used for scraping hides does not imply that this was also the case in the Neolithic. And elements we call 'arrowheads' may have served another function.

The correlation between typological categories and function amongst tools made out of rocks other than flint (or out of related siliceous rocks) has barely been investigated, for two reasons. First, for a long time, existing typologies were crude; they only became more differentiated over the past 15 years.[120] Second, use-wear analysis on non-flint tools is a relatively recent development. Although in general terms a correlation is found between tool type and function – hammer stones were used for pounding and crushing, grinding stones for grinding or polishing, querns for grinding – the results from development-led research point to variability within these functional groups (see the next section). Also, it has been observed that individual tools may have had multiple functions, for instance, pounding as well as grinding. The use of broad typological categories therefore comes at the risk of neglecting the potential functional variability represented within assemblages, which has implications for the interpretation of site function, or of even broader views on socio-cultural relationships between people and tools (or technology).

Tool use and activity. In view of the above, questions about the use of stone tool and the activities performed with them cannot be answered on the basis of typology alone. Use-wear analysis performed in the context of development-led projects provides important new insight. This work has focussed not only on 'formal' tool types – intentionally modified or shaped tools – but also on the use of unmodified artefacts, such as unretouched flakes and blades. Table 3.2 summarises the main findings for Mesolithic and Neolithic assemblages.

The uses to which unretouched and retouched flakes and blades were put not seem to have differed, which could imply that the activities involved did not require specific types of tools. However, to some extent people engaged in purpose-specific selection of particular blanks. In Mesolithic and Early Neolithic contexts, for instance, unretouched regular blades are frequently used for a specific way of plant working (Dronten-N23, Rotterdam-Yangtze Harbour, Ede-Kernhem, and

Table 3.2 Established functions and contact materials of flint tools from Mesolithic and Neolithic contexts.

Category	Mesolithic	Neolithic
Unretouched flakes	varied use (cutting, scraping, drilling) on plant material (incl. wood, bark, …) hide and even anorganic material and fish	varied use (cutting, scraping, splitting) on hide and plant material (incl. wood)
Retouched flakes	varied use (cutting, scraping) on hide, wood, bark and bone	varied use (cutting, scraping, wedge) on hide, plant material (incl. wood) and bone
Unretouched blades	varied use (cutting, scraping, drilling) on plant material (incl. wood, bark, …), hide and even anorganic material, bone/antler and fish	varied use (cutting, scraping) on hide and plant material
Retouched blades	varied use (scraping, drilling, butchering) on hide, plant material (incl. wood), fish and bone/antler	varied use (cutting, scraping) on hide and plant material (incl. wood)
Scrapers	hide working	hide working, working of bone, wood, plant material and mineral
Borers	perforating bone, wood and mineral	perforating bone, wood, plant material and mineral
Piercers	perforating and engraving bone and plant material	n.a.
Arrowheads	hunting, and working of organic material	hunting
Axes	n.a.	heavy and light duty wood working

119 It should be noted, however, that we may be dealing with a problem of researcher-related bias. Extensive use-wear analysis on microliths from the Belgian sites of Verrebroek-Dok and Aven Ackers by Valerie Beugnier only identified a projectile function. She excluded microliths from her subsequent analysis of the Ede-Kernhem assemblage from the Netherlands because she didn't expect to find anything new. The Dutch analyses that show a more diverse functional range amongst microliths have mostly been undertaken by Annemiek Verbaas.

120 See e.g. Van Gijn & Houkes 2006; Devriendt 2014.

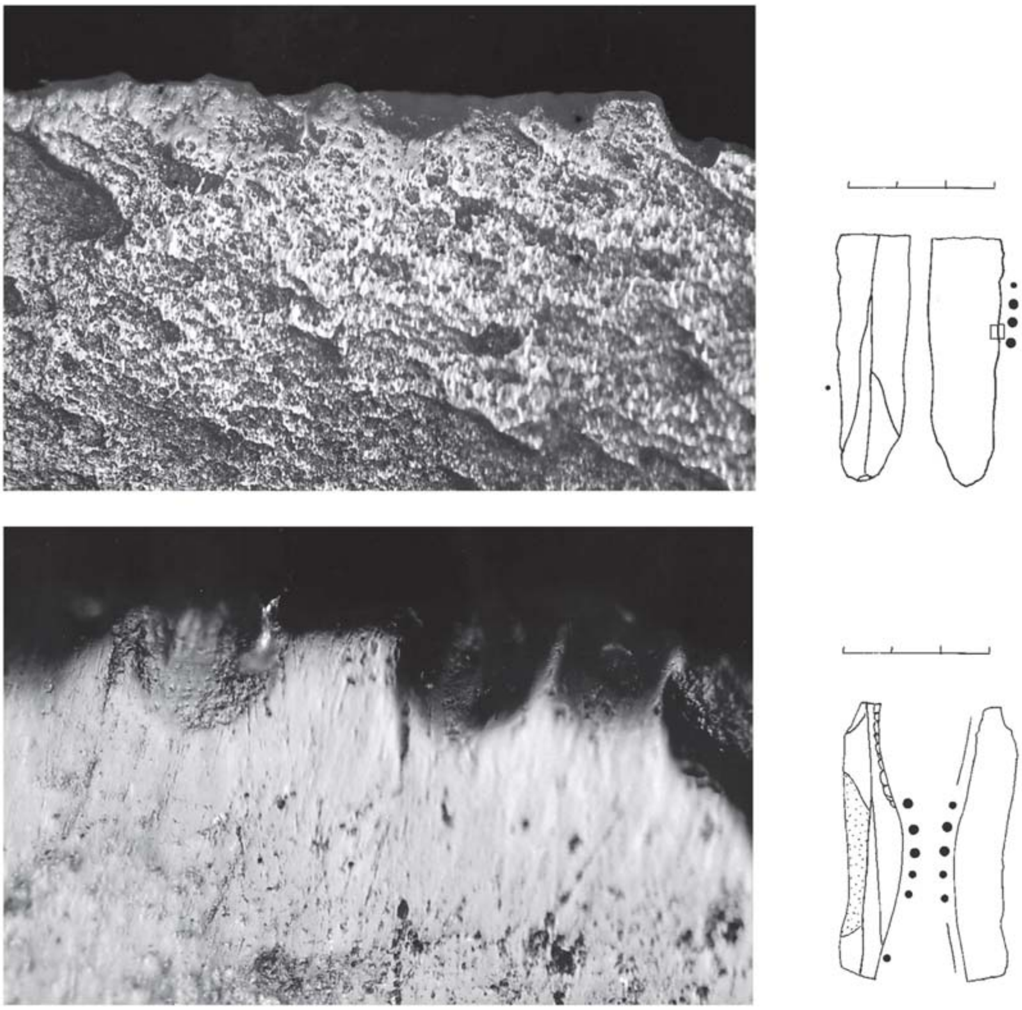


Fig 3.14 Examples from Hoge Vaart-A27 of highly reflective gloss caused by transverse working of a plant material of unknown nature (from Peeters, Schreurs & Verneau 2011). Scale bar in centimetres.

Leeuwarden-Hempens).[121] Although the distinctive wear traces have been identified by use-wear analysts for more than two decades,[122] it is still unclear what plant material was involved and how it was worked. It has been suggested that this particular function was related to wetland sites, but that it disappeared once crop cultivation became part of the wetland subsistence economy.[123] However, the occurrence of such use-wear traces on blades from Ede-Kernhem, which is a dryland site, and from Dronten-N23, which can also be considered a dryland site, shows that this suggestion may not be correct (fig. 3.14). But there are some difficulties here: many 'dry' sites are located next to or near river gullies/valleys, and stone tools from these sites may well bear signs of wetland exploitation. In other words, tools may have been discarded at other places than where they were used, and processing of – in this case – plant material, even material originating from wetland environments, may have occurred at some distance from the source area.

121 Appendix II: PUBID 462, 538, 745, 776.
122 Jensen 1994.
123 Van Gijn 2010, *pp.* 65-66.

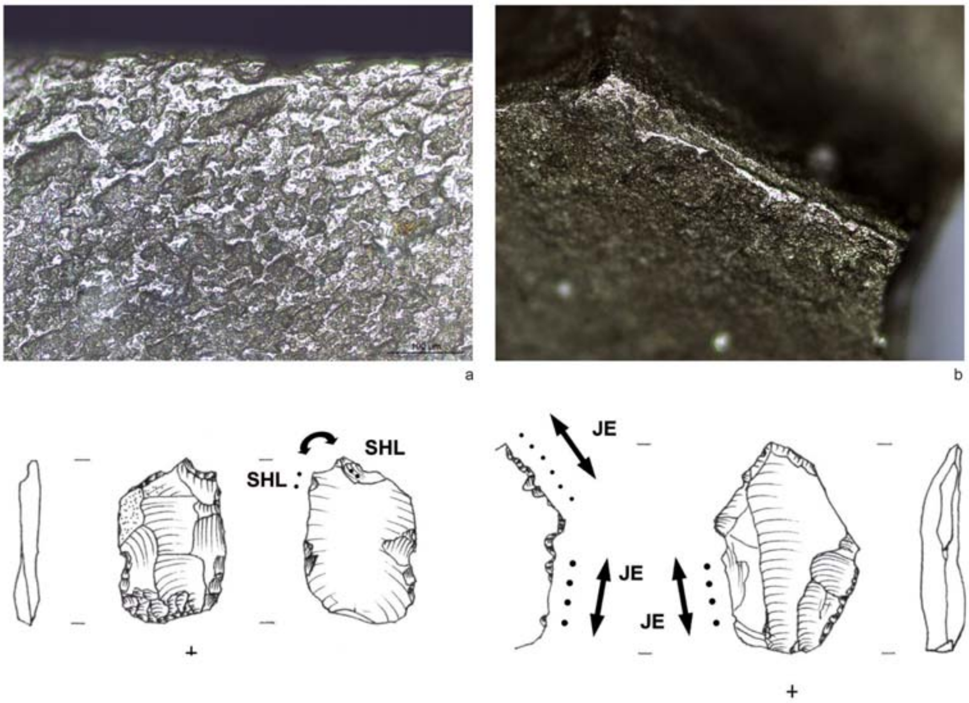


Fig 3.15 Use-wear traces of the working of shell (a) and jet (b) found on flint tools from Rotterdam-Yangtze Harbour (from appendix II: PUBID 462). Object drawings scale 1:1.

Whereas the above case shows that use-wear analysis can raise questions without providing answers, use-wear analysis can also offer insight into activities that otherwise would remain invisible. At Rotterdam-Yangtze Harbour, evidence was found for the Mesolithic working of shell and jet (fig. 3.15).[124] The working of shell involved piercing (using a borer), engraving, and scraping (using a burin–scraper combination tool), but no shell was found. The evidence for the working of jet in the Mesolithic is even more surprising. Cutting and scraping was executed with a retouched flake and the lateral side of a burin, but jet objects are absent in the Mesolithic record of the Netherlands and adjacent countries. In contrast, during the Neolithic, beads made out of jet are known from several sites (e.g. Swifterbant-S22, Schipluiden, Rijswijk-Ypenburg).[125] The absence of both shell and jet in the Mesolithic record of the Netherlands may, however, be the result of preservation conditions.[126] The dry and acidic sandy soils of the Netherlands are unfavourable; both materials do survive under waterlogged and alkaline conditions, but few waterlogged Mesolithic sites have been investigated to date. Use-wear analysis conducted in the context of development-led projects has opened an unexpected window on Mesolithic craft activities.

Along similar lines, use-wear analysis, combined with residue analysis, has shed light on activities that involve the use of non-flint tools (table 3.3). Little was known about the actual use of various tools that are described in a generic fashion as, for instance, 'hammer stone', '*retouchoir*', 'anvil', 'quern stone' or 'boiling stone'. In fact, artefacts made out of rock types other than flint – or other rocks with comparable fracture characteristics – have received hardly any attention whatsoever. This attitude is changing, and we can now refer to some good examples of what information can be drawn from this, to some, unexciting finds category. The majority of information concerns the Neolithic rather than the Palaeolithic and Mesolithic, for which functional interpretations are still based on intuition.

A few Late Palaeolithic sites (Geldrop-Aalsterhut, Knooppunt Hattemerbroek)[127] have produced non-flint tools, but the Mesolithic assemblages of Dronten-N23 and Ede-Kernhem account for most of the data to date, perhaps (partly) due to the extent of the excavations (fig. 3.16).[128] Hammer stones of variable shapes

124 Niekus *et al.* 2015.
125 Devriendt 2014; Van Gijn 2006, 2008. A recently excavated Swifterbant site at Utrecht-Nieuwegein yielded a big pendant made out of jet.
126 Some caution is perhaps advisable, as there may be a researcher-related bias.
127 Appendix II: PUBID 216, 259.
128 Appendix II: PUBID 538, 745.

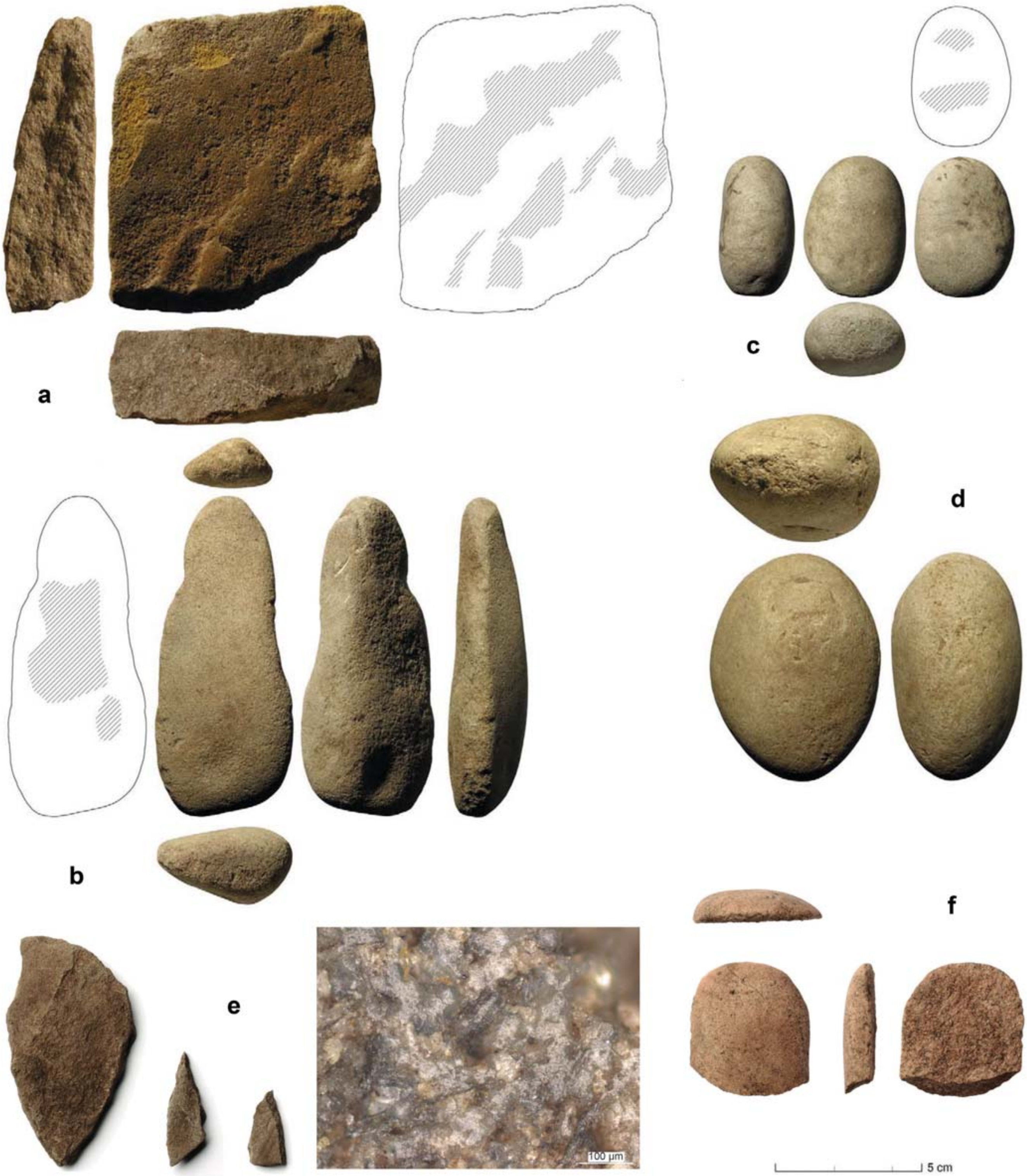


Fig 3.16 Mesolithic stone tools. Ede-Kernhem: (a) rubbing stone, (b, c) hammer-/rubbing stone, (d) hammer stone/anvil; Dronten-N23: (e) fragments of *plaquettes*, of which the smallest shows traces of woodworking, (f) fragment of a hammer stone used as a scraper (from appendix II: PUBID 538, 745).

and sizes were used for (flint) knapping as well as crushing (hazel-)nuts. The latter activity was also executed by means of so-called 'hand stones' and 'nether stones'.[129] Nether stones, however, were principally used for the polishing of soft materials, which was also done with *plaquettes*, used for wood polishing and processing of plant material. With the exception of plaquettes, which consist of thin sandstone slabs, the afore-mentioned tools consist of cobbles, mainly of quarzitic sandstone, quartz, and sandstone. Several sites in the northern Netherlands (Finsterwolde-Ganzedijk, Groningen-Meerstad) have produced hammer stones of granite.[130] It is likely that cobbles were selectively collected on the basis of size, shape and raw material so that they could be used in unaltered condition.

The presence of flakes and debitage at a number of Mesolithic sites (Dronten-N23, Ede-Kernhem, and Rotterdam-Yangtze Harbour)[131] indicate knapping of quartzite and quarzitic sandstone in particular, although it cannot be excluded that part of this material did not result from deliberate actions, since flakes and fragments are sometimes detached from hammer stones by accident. However, the presence of flake negatives on larger flakes attest to repeated actions, that is, serial detachment of flakes from a core. Some flakes show evidence of having been used, e.g. for scraping (Dronten-N23) or cutting (Schipluiden).[132] However, it remains unclear how systematic the knapping of these types of rock was. Deliberately shaped tools remain an exception in Mesolithic contexts: Knooppunt Hattemerbroek and Rotterdam-Beverwaard both yielded a complete mace head (known in German as a *Geröllkeule*),[133] which in both cases had broken in two.[134]

Non-flint stone tools seem to be more common on Neolithic sites.[135] These tools mostly concern querns and grinding stones, whetstones, polishing stones, hammer stones, anvils, adzes and axes (fig. 3.17).[136] In contrast to the situation in the Mesolithic, deliberate shaping of such tools was common, and was conducted by flaking and pecking – hence the frequent occurrence of flakes and debitage. There tools were predominantly made out of sandstone, quarzitic sandstone and quartzite. Gneiss, quartz and granite are less common, but they are well represented in the northern Netherlands, where they occur in moraine deposits.

Although use-wear and residue analysis is not often performed (see table 3.3), it has revealed the grinding of grain, peas and other plant materials on LBK saddle querns and other tools from Stein-Heidekampweg. One quern showed evidence for the grinding of cereal grains on the flat side, and is coated with red ochre on both sides. Since no traces of ochre grinding were found, it has been suggested that the ochre coating was deliberate.[137] Evidence for grinding of grain and other processing of plant materials was found on querns and grinding stones at the Middle Neolithic site of Schipluiden (Hazendonk 3), as well as on querns at the Middle Neolithic sites of Hazerswoude-Rijndijk (Vlaardingen) and Knooppunt Hattemerbroek (TRB).[138] Whetstones were used not only to grind or polish bone tools and flint axe blades, but also to polish soft materials, possibly for the production of (amber) ornaments (for a discussion of ornaments, see section 3.3.1). Woodworking was mainly done with axes and adzes, although some non-flint stone flakes were used as well. Only at Swifterbant Culture sites have non-flint stone flakes and blades been modified into retouched pieces and scrapers (Rotterdam-Groenenhagen, Swifterbant-S3).[139]

3.2.2 Organic resources for artefacts

Artefacts of other than lithic raw materials are likely underrepresented in the archaeological record due to differences in preservation. Uncharred objects made of bone, antler, wood and plant fibre, for instance, can only survive in wet contexts and particular dry sediments, such as calcareous loess; these kinds of matrix are almost absent in the Netherlands. Sites such as Hardinxveld-Giessendam (Polderweg and De Bruin), Hoge Vaart-A27, and Schipluiden demonstrate the rich spectrum of artefacts made out of such organic materials.[140] It is more than likely that the lithic component, which is overwhelmingly present in the archaeological record, in fact represents a relatively small portion of the full range of artefacts that was actually produced, used and discarded. Any possibility of expanding our knowledge about

129 Only for Dronten-N23 (Knippenberg & Verbaas 2012) was a clear distinction made between actively used tools (hand stones, grinding stones) and passively used tools (stationary stones/querns, whetstones).
130 Appendix II: PUBID 210, 255.
131 Appendix II: PUBID 462, 538, 745.
132 Appendix II: PUBID 538, 732.
133 This tool was used as a hammer stone on a medium-hard material. Traces of hafting were found inside the hourglass-shaped perforation.
134 Appendix II: PUBID 260, 732, 740.
135 A word of caution is nonetheless in order, as non-flint lithic artefacts seem to have been analysed superficially, if at all. Systematic analysis of such remains may lead to a different picture.
136 Depending on visible traces and use-wear analysis, but also on the researcher and which typology is being employed, either the more generic term 'grinding stone' is used, or specific terms are used to define more specialised tools (querns, whetstones).
137 Knippenberg & Verbaas 2012, 117
138 Appendix II: PUBID 260, 732, 740.
139 Appendix II: PUBID 732; Devriendt 2014.
140 Laarman 2001; Louwe Kooijmans, Oversteegen & Van Gijn 2001; Louwe Kooijmans, Vermeeren & Van Waveren 2001; Louwe Kooijmans, Hänninen & Vermeeren 2001; Van Gijn 2006; Louwe Kooijmans & Kooistra 2006.

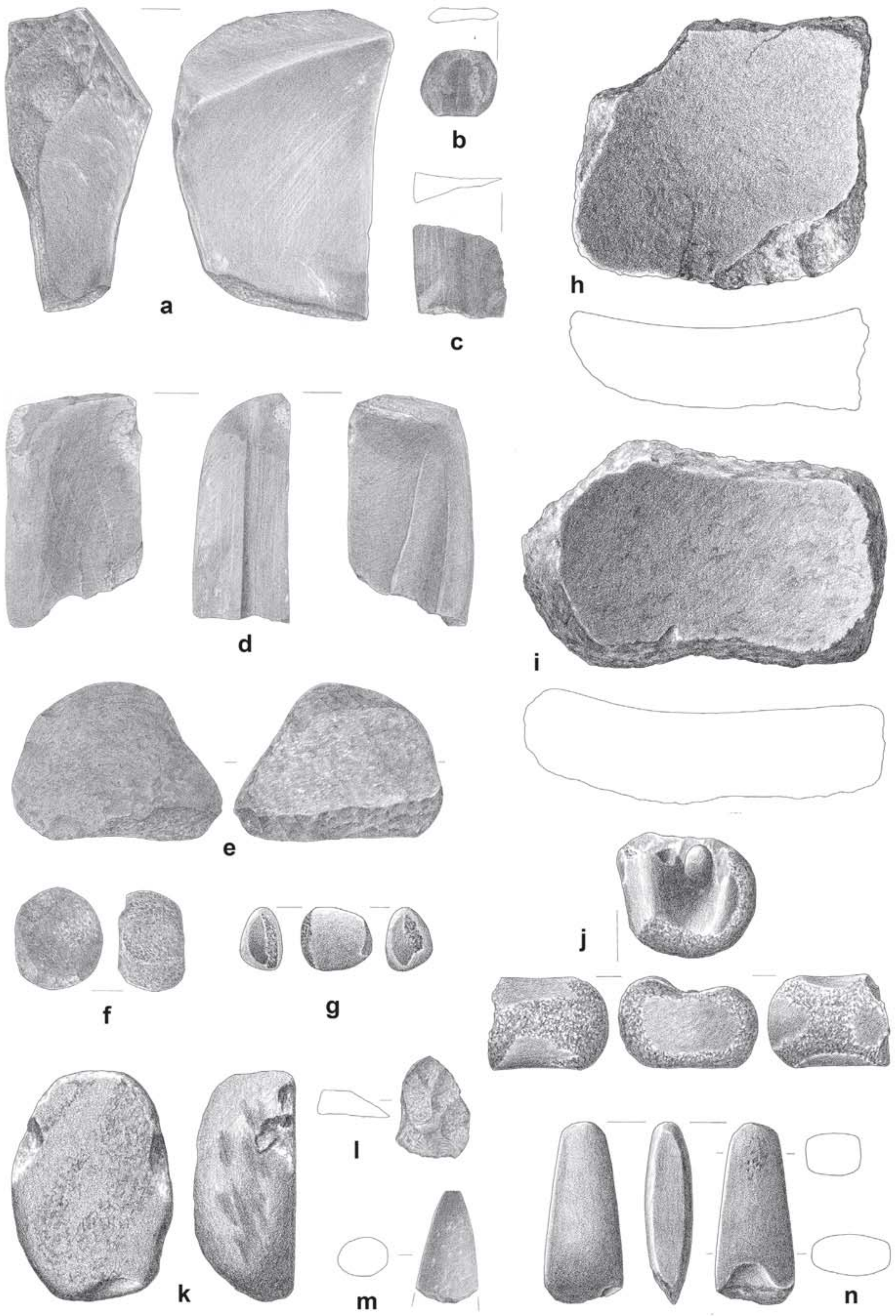


Fig 3.17 Neolithic stone tools: Schipluiden: (a-e) querns, (f) rubbing stone, (l) axe, (m) axe fragment; Knooppunt Hattemerbroek: (g) rubbing stone, (h, i, k) querns, (j) hammer-/rubbingstone, (n) axe (from appendix II: PUBID 260, 732). Scale 1:4.

Table 3.3 Established functions of non-flint stone tools.

Site	Context	Quern (*maalsteen*)	Grinding stone (*wrijfsteen*)	Plaquettes	Polishing stone (*polijststeen*)	Whetstone (*slijpsteen*)	Hammer stone (*klopsteen*)	Hammer stone / grinding stone	Anvil (*aambeeld*)	Axe / adze / chissel	Fire cracked rocks	Flakes / debitage
Geldrop-Aalsterhut	Ab						no analysis					no analysis
Knooppunt Hattemerbroek	LP						no analysis					no analysis
Dronten-N23	EM-MM	crushing middle hard material and (hazel) nuts	crushing (hazel) nuts	polishing / grinding[1] plant material (wood?)		polishing / grinding soft stone	pounding (middle) hard material					
Rotterdam-Yangtze Harbour	EM-MM		polishing / grinding wood, crushing plant material								(?) cooking stones	no analysis
Meerstad-Site 2a	MM					no analysis	no analysis				cooking / hearth stones	
Finsterwolde-Ganzedijk	M						no analysis		no analysis		cooking / hearth stones	
Ede-Kernhem	EM		no analysis		no analysis		no analysis		no analysis		cooking stones	no analysis
Hoogezand-Vosholen	MM-LM						no analysis				no analysis	
Olieveld Schoonebeek-Site 14	MM-LM						no analysis				hearth stones	no analysis
Casteren-Wagenbroeksloopje	LM											no analysis
Stein-Heidekampweg	LBK	processing of grain, coloured with red ochre	processing grain and other plant material		processing peas or similar plant material	middle hard plant material (wood?), stone (red ochre?)	no analysis	crushing plant material?		woodworking	(?) cooking stones	no analysis
Beek-Kerkeveld	LBK	no analysis				no analysis				no analysis		
Itteren-Voulwames	MC	(?) no analysis					(?) no analysis				(?) cooking stones	
Rotterdam-De Zwanen Rietpark	Sw		(?) no analysis					no analysis	no analysis			no analysis
Rotterdam-Groenenhagen	Sw											also scraper, yet no analysis
Nijmegen-Oosterhout	Hd3					no analysis	no analysis		no analysis		cooking / hearth stones	no analysis
Schipluiden	Hd3	processing of grain	pounding, plant processing			polishing flint and bone	pounding			wedge in woodworking	temper and cooking / hearth stones	cutting and scraping wood
Itteren-Hoeve Haertelstein	St	no analysis	no analysis				no analysis					no analysis
Hof van Limburg	St	(?) no analysis					(?) no analysis					
Haren-Groenstraat	St	(?) no analysis	(?) no analysis		(?) no analysis	(?) no analysis	no analysis				temper and cooking / hearth stones	
Beverwaard-Tramremise	Hd3								no analysis		temper	no analysis
Hellevoetsluis-Ossenhoek	Vl	no analysis				no analysis	no analysis					
Hazerswoude-Rijndijk	Vl	processing of grain				grinding bone, flint and wood	pounding hard material		used for middle hard material (nuts?)	no traces of use	temper and cooking stones	
Groningen-Europapark	TRB		no analysis			no analysis	no analysis	no analysis		no analysis	temper	no analysis
Helpermaar	TRB					no analysis	no analysis	no analysis		no analysis	temper	no analysis
Hattemerbroek-Bedrijventerrein	TRB	processing of grain	processing cereals, plant material and middle hard material		polishing soft stone (amber?)		pounding hard material	crushing or bruising plant material and (middle) hard material			cooking / hearth stones	
Leeuwarden-Hempens	TRB						no analysis					

[1] In Dutch the term *slijpen* is used.

the use of organic artefacts is therefore of major importance if we are to build a somewhat more representative record of early prehistoric socio-technological traditions at a geographical scale beyond the Netherlands. With a few exceptions of projects that have employed use-wear analysis, the contribution that development-led research has made in this respect is limited despite the potential.

Artefacts of organic material can be divided in various categories, ranging from construction material, to implements, to jewellery. Organic material represents material that was still alive or had 'recently' died at the moment of procurement. We therefore exclude amber and jet from the category organic material. Although both amber and jet have an organic origin, they represent fossilised forms of resin and carbonised (petrified) wood, respectively, that were collected in that form as a raw material for artefacts. Like petrified wood, we classify amber and jet as rock. Below we discuss the use of organic material for the production of implements and jewellery.

Implements of bone and antler

Bone and antler represent important raw materials for the production of a wide range of implements. Adzes, axes, chisels, points and awls are the main categories, and items from these categories have also been found in the context of development-led projects. Mesolithic tools remain exceptional, as few sites with well-preserved organic remains dating to this period have been investigated.[141] An example is a complete chisel made out of a metatarsus of an aurochs found at the site of Mildert-Tungelroyse Beek (fig. 3.18).[142] A fragment of an antler tool – an adze or chisel – is reported from the Early to Middle Mesolithic site of Rotterdam-Yangtze Harbour.[143] The remainder of bone and antler tools comes from the Middle Neolithic Hazendonk Culture sites of Schipluiden and Rijswijk-Ypenburg[144] and the Vlaardingen Culture site of Hellevoetsluis-Ossenhoek,[145] mostly chisels and awls. The latter site also produced two hollow tubes of unknown function made of goose long bone.[146] Production waste points to local production. Compared with the rich Late Mesolithic and Early Neolithic assemblages of Hardinxveld-Giessendam (Polderweg and De Bruin) and Hoge Vaart-A27,[147] the Middle Neolithic assemblages mentioned above are rather impoverished with regard to the range of tool types. Their earlier, wetland counterparts show more variety with the inclusion of mattocks, adzes, axe shafts, and other implements for which no clear definitions exist. This contrast cannot be explained by structural differences in preservation. At the same time, it does not signify a trend of decreasing importance of bone and antler tools. An extremely rich and varied assemblage from Emmeloord-J97, which may date from the Middle to Late Neolithic/Bronze Age, suggests otherwise.[148] Here a variety of needles, fishhooks, spatulas, mattocks and a possible dagger were found, in addition to chisels and awls.

Whilst these artefacts are generally described in detail and often illustrated in the reports, interpretation of their function is often limited. Use-wear analysis of tools from Schipluiden suggests that awls may have been used in the production of basketry/fabrics and in hide working; bone chisels were used for woodworking.[149] Indeed, it is suggested that bone and antler tools should be considered a structural part of toolkits that also included stone tools.[150] Furthermore, in consideration of production waste and other traces of tool manufacturing, it would seem that the technology involved is a continuation of a Mesolithic tradition.[151]

Artefacts of wood and other plant material

The number of sites that have produced artefacts of wood and other plant material is also limited.[152] Small fragments of rope consisting of twisted plant fibre – plant species undetermined, due to the small size of the fragment – of Late Mesolithic age were found in an auger sample at Rotterdam-Emplacement CS.[153] These fragments possibly belong to a fishnet or fish trap, as has also been suggested for fragments of rope found at the Late Mesolithic site of Hardinxveld-Giessendam Polderweg.[154] Fish traps made out of shoots and rope are not unusual in wetland contexts, and well-preserved examples are known from Neolithic sites such as Hoge Vaart-A27 (early Swifterbant), Bergschenhoek (Swifterbant), and Emmeloord-J97 (TRB, also Late Neolithic).[155] It is

141 Increasing numbers of bone and antler tools dating to the Mesolithic are being collected on Dutch beaches. These originate from offshore sand extraction zones. The sand is used for beach replenishment. As yet, there is little archaeological monitoring of this commercial extraction activity.
142 The report claims a Late Mesolithic age for this object based on a ^{14}C-date (appendix II: PUBID 395, p. 37), but the date itself is not provided.
143 Zeiler & Brinkhuizen 2015.
144 De Vries 2008; Van Gijn 2006.
145 Van Dijk 2009.
146 Van Dijk 2009.
147 Laarman 2001; Louwe Kooijmans, Hänninen & Vermeeren 2001; Louwe Kooijmans, Overstegen & Van Gijn 2001; Louwe Kooijmans, Vermeeren & Van Waveren 2001.
148 Bulten *et al.* 2002.
149 Van Gijn 2006.
150 Van Gijn 2006.
151 Van Gijn 2006.
152 For a recent overview, see Lange 2017.
153 Brinkkemper 2007.
154 Louwe Kooijmans, Vermeeren & Van Waveren 2001.
155 Bulten *et al.* 2009; Hamburg *et al.* 2001; Louwe Kooijmans 1986.

Fig 3.18 Bone and antler artefacts from Mesolithic and Neolithic sites. Rotterdam-Yangtze Harbour: (a-b) fragments of antler adzes; Schipluiden: (c) cut-off distal end of red deer metatarsal, (d, h) antler waste products originating from tool production, (e) bone awls produced out of metapodia, (f) fragment of an antler perforated base axe, (g) bifacially worked proximal part of an antler beam and adhering pedicle(from appendix II: PUBID 462, 732). Objects a, b and e scale 1:2; objects c, d, f, g and h scale 1:4.

unclear how to interpret nine strips of bark deriving from Pomoideae (which includes hawthorn and apple) that were found in a well at Schipluiden.[156]

Wooden implements were found at the Hazendonk group sites of Schipluiden and Rijswijk-Ypenburg (table 3.4).[157] The bow fragment found at Schipluiden is made out of juniper wood; this is rather surprising, because Mesolithic and Neolithic bows from the Netherlands are usually made out of elm and yew.[158] It has been suggested that the latter two types of wood were not locally available, and that juniper wood should be considered a second-best option: people did not see the need to go to a whole lot of trouble in order to acquire other, more suitable wood types. This is all the more remarkable, since paddles made out of ash wood were found at the same site. Again, there is no evidence for local stands of ash, which suggests that the wood or maybe even the paddles were been brought in from elsewhere. In contrast, the axe hafts from both sites are made out of various types of wood, but not ash, although ash is known to have been preferentially used for axe hafts. Typically, the Schipluiden axe hafts are made of branches instead of sturdier trunk wood.[159] As stated in the report, this may point to local – and ad hoc (?) – production of wooden implements and technological choices that did not involve external contacts or long-distance forays, with the exception of paddles. One crescent-shaped plank of ash wood whose function has not been determined possibly represents a canoe partition (fig. 3.19).[160] If correct, this suggests that waterborne technology involved selective use of wood.

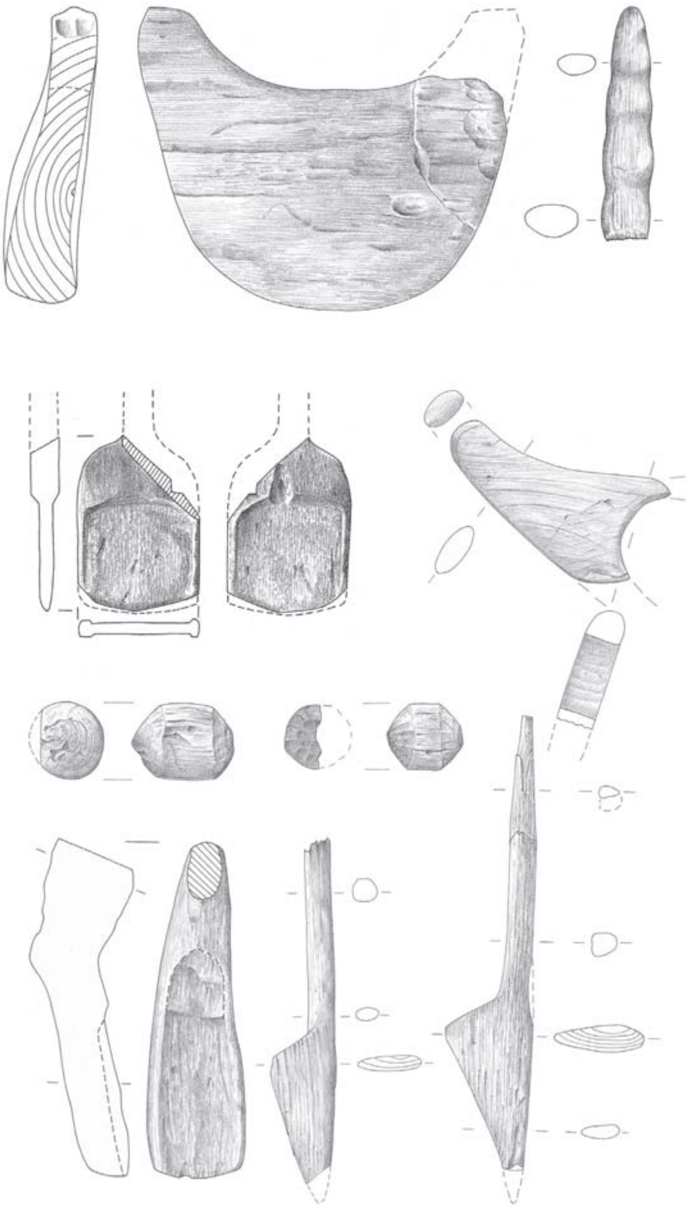


Fig 3.19 Functionally unidentified wooden artefacts from Schipluiden (from appendix II: PUBID 732). Scale 1:4.

Table 3.4 Wooden implements and used wood.

Implement/tool	Schipluiden		Rijswijk-Ypenburg	
Bow	1	juniper	-	
Paddle	2	ash	-	
Axe haft	8	spindle; hazel; alder; willow; Pomoideae	1?	willow
Sickle haft?	-		1	oak
Pointed object	11	buckthorn; spindle; hazel; juniper; honeysuckle; Pomoideae	2	juniper*; buckthorn
Functionally not interpretable	10	ash; sloe; alder; Pomoideae; cherry/plum?	-	

* This object somewhat resembles a leister prong, also known from Bergschenhoek and numerous sites in southern Scandinavia.

156 Louwe Kooimans & Kooistra 2006.
157 Kooistra 2008; Louwe Kooimans & Kooistra 2006.
158 Louwe Kooijmans & Kooistra 2006, 228.
159 Louwe Kooijmans & Kooistra 2006, 234.
160 Louwe Kooijmans & Kooistra 2006, 235.

Jewellery/ornaments
Items that have been interpreted as jewellery or ornaments made out of organic material are rare. Only one example of a (calcined) single tubular bead made out of a hollow long bone of a bird has been reported from the Early to Middle Mesolithic site of Rotterdam-Yangtze Harbour (fig. 3.20).[161] As mentioned in section 3.2.1, this site also yielded evidence of the processing of shell, notably piercing, engraving and scraping. This activity was most likely related to the production of ornaments. The site itself has not produced any shell ornaments; nor has any other Mesolithic site in the Netherlands. Shell ornaments are, however, known from several Mesolithic sites elsewhere in north-west Europe.

Middle Neolithic ornaments made out of organic material were retrieved from the Hazendonk Culture sites of Schipluiden and Rijswijk-Ypenburg.[162] Schipluiden yielded two beads similar to the one from Rotterdam-Yangtze Harbour; both beads come from a child's grave. At Rijswijk-Ypenburg, a bone finger ring was found in a child's grave, and a fragment of a not fully perforated tusk of wild boar from the occupation layer may represent an unfinished pendant. At the Vlaardingen Culture site of Hellevoetsluis-Ossenhoek, three perforated teeth, of wild boar, otter and dog, were found.[163] The finds from these sites show that ornaments are not exclusively encountered in graves. This is not only the case for late Early Neolithic and Middle Neolithic contexts, but also for earlier phases. Perforated tusks of wild boar, as well as perforated incisors of horse, cattle, otter and canines of dogs, are known from Swifterbant contexts.[164] Interestingly, finds from the early Swifterbant Culture context of Hoge Vaart-A27 suggest that tusks of wild boar seem to have been systematically extracted from the mandibles,[165] possibly in order to make pendants out of them.

Despite the fact that few ornaments made out of organic materials are known, the above examples demonstrate that there is a potential for them to be found. Ornaments from burial contexts obviously have a better chance of being recognised. Small items and fragments from finds/cultural layers may, however, not easily be detected. An eye-opener is the discovery of a pierced plum stone in a screened archaeobotanical sample from the site of Swifterbant-S4, which is interpreted as a bead.[166] Although this find falls in the category 'lucky shot', it shows that an eye for detail pays off.

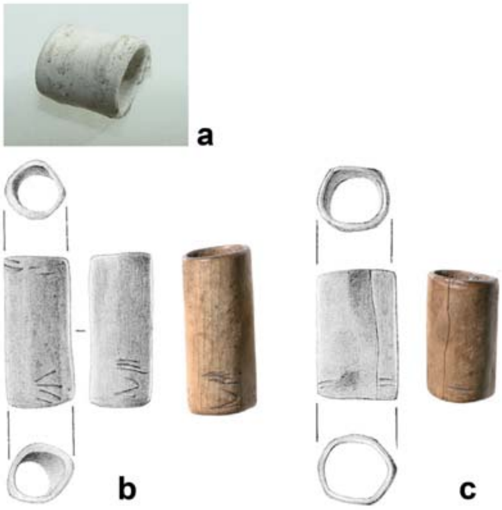


Fig 3.20 Mesolithic and Neolithic bone beads: (a) Rotterdam-Yangtze Harbour; (b, c) Schipluiden (from appendix II: PUBID 462, 732). The broken bead from Rotterdam-Yangtze Harbour measures 6.7 mm in diameter; the beads from Schipluiden are scale 1:1.

3.3 Socio-cultural meaning

The second theme to be addressed concerns the meaning of materials in their socio-cultural context. Objects made out of various sorts of materials had particular 'utilitarian' functions within specific behavioural settings, and involved a myriad of craft activities. Traditionally, archaeologists tend to connect this 'utilitarian' dimension of materials to the domestic and subsistence domains. However, objects also had 'non-utilitarian' functions, of a more symbolic nature. For certain objects, such as flint axes of Scandinavian origin, this may seem more obvious than for objects that do not stand out from the 'average'. Nonetheless, such objects could very well have had other intrinsic meaning to the people who used them, meaning which is simply difficult to recognise archaeologically. Part of the problem is us archaeologists: in trying to understand the archaeological record, we break it down into entities that are comprehensible to us. However, our interpretive framework need not have any connection whatsoever with the prehistoric perceptive frameworks within which these objects functioned. Another part of the problem concerns the manifestation of the socio-cultural meaning of materials. As this is an issue

161 Zeiler & Brinkhuizen 2015.
162 Van Gijn 2006, 2008.
163 Van Dijk 2009.
164 Prummel 2016.
165 Laarman 2001.
166 Personal communication Dr Mans Schepers, 4 September 2017.

Table 3.5 Summary of early prehistoric depositions.

Site	Socio-cultural context	Object(s)	Depositional context
Dronten-N23	Late Mesolithic (?)	A total of 41 artefacts; nodules, cores and tested blocks. Splinters (n=16), flakes and blades (n=9) and two tool fragments are considered to represent 'settlement noise'.	At the limits of a flint scatter
Siddeburen-Foxhol	Mesolithic	A total of c. 500 flint artefacts; mainly knapping debris (splinters, flakes, blades, rejuvenation pieces; no cores) and some retouched pieces.	Two pits; separated c. 2m from each other
Beek-Kerkeveld	LBK	Complete grinding set; traces of haematite only present on the grinding surface.	Pit
Leur-Hernense Meer	Swifterbant	115 fragments of a single (?) pot.	Pit
Haren-Groenstraat	Stein/Vlaardingen	Two voluminous flint cores (eluvial Lanaye flint).	Possibly in a pit
Knooppunt Hattemerbroek	TRB	large part of a pot (rim, neck, and body); part of a baking plate	Posthole
Lomm-Hoogwatergeul	Middle Neolithic?	Complete polished flint axe (*dünnackige Flintovalbeile*).	Transitional zone: river terrace to gully
Rijswijk-Ypenburg	Middle Neolithic	Complete pot + granite grinding stone	Pot found in a pit; grinding stone on top of the pit

of context, the difficulty is to determine which criteria should be met.

The NOaA 1.0 draws attention to 'non-utilitarian' functions of materials and phenomena, in particular in connection with burial practices. Other non-utilitarian aspects concern 'ritual' or 'cultic' depositions of objects, such as stone axe blades, ceramic vessels and skeletal remains. Context is primarily considered in reference to the localisation of such items in particular landscape zones – brook valleys or wetland environments – or their occurrence outside settlements. From this perspective, the NOaA 1.0 states that "*'anomalous' features should be treated with considerable care: in a later stage of research it could turn out that it concerns burials or cultic depositions*" (translation ours).[167] However, no explicit research questions concerning these aspects are included.

In the next few sections, we will consider several manifestations of behaviour that shed (some) light on the socio-cultural meaning of materials. For this purpose, we will not limit ourselves to the more obvious, cosmology-induced aspects of burial and ritual. Cultural transmission of craft traditions and the act of exchange of materials and knowledge, for instance, contribute just as much to an establishment of socio-cultural relationship between people and materials.

3.3.1 Materiality: the meaning of objects

Finds of single, isolated objects and hoards of objects have long been interpreted as lost items or caches. Of course, neither of these suggestions can be excluded: people do lose things, and people do cache items, for instance, for future use or to protect valuables from looting. However, the contextualisation of such finds, which are mostly known from low-lying zones in the landscape (often wetlands), has shed new light on the nature of these phenomena. Hierarchic patterns in the nature of objects and their occurrence in the landscape or specific features (e.g. burials) suggests underlying principles of structuration that seem to be related to cosmological or ideological considerations.[168] From this perspective, depositions of single or multiple objects are frequently interpreted as manifestations of ritual activity.

Depositions represent a rather problematic category in development-led research. First, such depositions are not easily noticed due to their particularly localised occurrence, as an isolated object or a grouping of several objects. Second, the often 'secular' or 'ordinary' nature – simple knapping waste, a piece of bone, a wooden stick – of objects frequently obstructs interpretations outside the utilitarian domain. Third, most fieldwork is conducted on settlement sites: depositions of objects need to be distinguished from 'plain settlement waste'. Finally, locations or landscape zones where depositions are likely to occur – e.g. brook valleys, peatlands – are less often investigated. Despite these problems, several reports make explicit mention of such finds (table 3.5). The nature of the depositions fits the known variability, but merits some further discussion.

167 Deeben *et al.* 2006, 32.
168 Cf. Fontijn 2002.

Fig 3.21 Possible ritual depositions of LBK quern stones with traces of red ochre from Beek-Kerkeveld and Stein-Heidekampweg (from appendix II: PUBID 53, 528).

The two depositions dated to the Mesolithic consist of flint-knapping waste. Although the Dronten-N23 deposition has been described as such, the lack of detailed information concerning the exact circumstances of this find makes it difficult to establish the behavioural context. The small concentration of flints will certainly have been deposited deliberately, but it remains unclear whether we are dealing with a cache – read, storage of flints for future use – or a dump of waste material (fig. 3.21). In the case of Siddeburen-Foxhol we are clearly dealing with simple knapping debris, but here we see deliberate deposition in two small pits. One wonders why a 'random' collection of production waste was put in a pit, whilst considerable quantities of such waste were found scattered over the surface. A similar situation was encountered at the previously mentioned site of Hoge Vaart-A27, where a random collection of knapping waste (100 flakes) was deposited in a small pit. Two other depositions at this site consist of several exhausted cores and conjoining large flakes, in one case, and tested nodules, in the other. All three depositions occurred in a swampy environment, at some distance from the sandy ridge on which vast quantities of settlement waste were left during an early Swifterbant phase of repeated occupation.[169] Another example comes from the Mesolithic site of Nieuwe Pekela 3, where burnt flint cores were found in a pit.[170] This context has been interpreted as a cache, but this seems an unlikely option to us, as burnt flint – in contrast to that subjected to deliberate heat treatment (thermo-preparation) – is no longer usable. Yet another example has been described from Uddel-Uddelermeer, where a deposition of Late Mesolithic or Early Neolithic flint cores and blocks was found.[171] In this case, the cores conform to the 'rules' of systematic punched-blade production, but the flint is of such bad quality that any flint knapper could have anticipated failure.

The deposition by Mesolithic and Early Neolithic hunter-gatherers of 'production waste' in small pits seems to somehow be connected with the process of flint tool production.[172] The Middle Neolithic deposition from Haren-Groenstraat can also be fit into such a context, and could be seen as a continuity of a tradition that had started much earlier. The essence is

169 Hogestijn & Peeters 2001; Peeters 2007.
170 Groenendijk 2004.
171 Groenewoudt *et al.* 2006.
172 It should be repeated here that we use the terms Mesolithic and Neolithic in a purely chronological sense. If one were to use the terms in connection with particular behavioural (socio-economic, ideological) settings, the early Swifterbant phase could just as well be termed the 'ceramic Mesolithic' (see e.g. Peeters 2010).

Fig 3.21 Continued.

maybe caught in the act of 'extracting' tools out of a block of raw material. Simple flakes, blades, unusable cores and chunky blocks are materialisations thereof. They are the remains of a process of material transformation in which deliberate 'destruction' – for example, of the burnt cores from Nieuwe Pekela 3 and maybe also of the Mesolithic pierced mace heads discussed in section 3.2.1 – may have played a part.[173] However, complete objects are also represented, for instance, at Beek-Kerkeveld and Lomm-Hoogwatergeul. Whether the deposition of pots is part of the same ritual is difficult to say. The possible deposition of a pot at Leur-Hernense Meer, whilst rare, is not an exception. Other examples from Swifterbant contexts come from Hardinxveld-Giessendam De Bruin, Urk-E4 and Bronneger.[174] The large fragments of a pot and baking plate at Knooppunt Hattemerbroek can maybe be interpreted as a construction offering, which is another setting again.

From a broader perspective, the deposition of both pots and stone tools, such as complete and fragmented axe blades and querns, are a common practice in Neolithic north-west Europe. To what extent ritual deposition of objects can be understood as an expression of a single belief system is difficult to say.
Did deposition of deliberately – or even accidentally – fragmented objects have the same meaning as deposition of complete objects? And how are depositional practices connected with places in the landscape? The recognition of (potential) ritual depositions in a settlement context is important, as it extends the archaeological insights into the diversity of the depositional landscape, which is, as yet, mostly known from 'off-site' (non-settlement) contexts. As the majority of development-led projects are concerned with settlement contexts, there is an important potential to be tapped.

173 In this context, further reference can be made to the suggested deliberate destruction of flint axes through burning in southern Scandinavia (Larsson 2000) and the deliberate fragmentation of quern stones (Devriendt 2014).

174 Kroezenga *et al.* 1991; Peters & Peeters 2001; Raemaekers 2001.

3.3.2 Death and ritual

The treatment of the dead offers an explicit perspective on cosmological belief systems in early prehistory. Development-led fieldwork has yielded a considerable number of sites with evidence for mortuary practices (table 3.6). Because these sites tend to draw the attention of archaeologists, synthetic analysis has already integrated most of the data over the past few years, notably in two papers published in 2007.[175] However, more recent discoveries permit us to enlarge the body of data, and deepen insights.

As to the Mesolithic, the dataset remains limited. After the discovery of inhumations at the sites of Hardinxveld-Giessendam Polderweg and De Bruin, evidence for mortuary practices was found at two additional sites, Rotterdam Beverwaard, Dronten-N23. At Rotterdam-Beverwaard, three Middle Mesolithic pits with cremated human remains were discovered (fig. 3.22).[176] Hitherto, Mesolithic human 'cremation' in the Netherlands was only known from Oirschot V and, possibly, Dalfsen.[177] Amongst the cremation remains at Rotterdam-Beverwaard are also some fragments belonging to animals. Each pit also contained small amounts of flint artefacts and points made out of Wommersom quartzite. One pit yielded a broken yet complete perforated mace head and a slab (grindstone?), both made out of quarzitic sandstone. The presence of a perforated mace head reminds us of a Middle/Late Mesolithic pit hearth at Knooppunt Hattemerbroek, which also yielded a portion of such a tool; a second, conjoining part was found outside the pit.[178] No cremated bone was found in the pit, and unburnt bone would not have survived. The same is true for a Late Mesolithic pit at Swifterbant-S22, which also contained a fragment of a perforated mace head, and which could also be fitted to a fragment from the finds layer.[179]

Although in the case of both Knooppunt Hattemerbroek and Swifterbant-S22 it is impossible to tell whether the pits are related to mortuary practice, it is important to consider the situation at the Mesolithic site of Mariënberg.[180] Here, a group of six cylindrical pits containing a bright red, ochre-like compound were interpreted as burial pits.[181] Again, no bone was preserved, but particular soil patterns support the suggestion that bodies buried in a sitting (flexed or crouched and upright) position were originally present. Apart from small numbers of flint artefacts (relatively many punched blades, which are of Late Mesolithic age), two burial pits yielded sandstone shaft polishers. It would seem that objects like these, as well as perforated mace heads, formed part of the mortuary ritual. Possibly, such objects were explicit individual belongings and bound to one's personhood in life and in death. It cannot be excluded that other pits containing such items, but not containing remains of human bone, also represent graves.

Table 3.6 Sites with graves and loose skeletal remains.

Site	Archaeological period	Age (yrs)	Gender	Type	PUBID
Beverwaard	Middle Mesolithic	10-40	Unknown	Cremation	463
		12-40	Female?	Cremation	
		10-34	Unknown	Cremation	
Dronten-N23	Late Mesolithic	35-45	Female	Inhumation	538
Schipluiden	Hazendonk group	38-45	Male	Inhumation	732
		59-65	Male	Inhumation	
		46-49	Male	Inhumation	
		41-50	Male	Inhumation	
		25-40	Male	Inhumation	
		8	Infant	Inhumation	
		2	Infant	Inhumation	

175 Louwe Kooijmans 2007; Raemaekers *et al.* 2007.
176 Appendix II: PUBID 463a; Niekus *et al.* 2016.
177 Arts & Hoogland 1987; Verlinde 1974. Mesolithic cremations are a rare phenomenon in the Low Countries altogether (see Niekus *et al.* 2016); other sites are Heffingen-Loschbour in Luxemburg and La Chaussée-Tirancourt in northern France (Ducroq, Bridault & Munaut 1991; Toussaint *et al.* 2009).
178 The two parts together form a complete mace head.
179 Devriendt 2014; Drenth & Niekus 2009; Price 1981.
180 Verlinde & Newell 2006, 2013. Louwe Kooijmans (2012) questioned several aspects – e.g. the nature of 'ochre' colouring (but see Huisman & Van Os 2013) – of the interpretations made by Verlinde and Newell (2006), but nonetheless concluded that the features must be interpreted as burial pits.
181 Huisman & Van Os 2013.

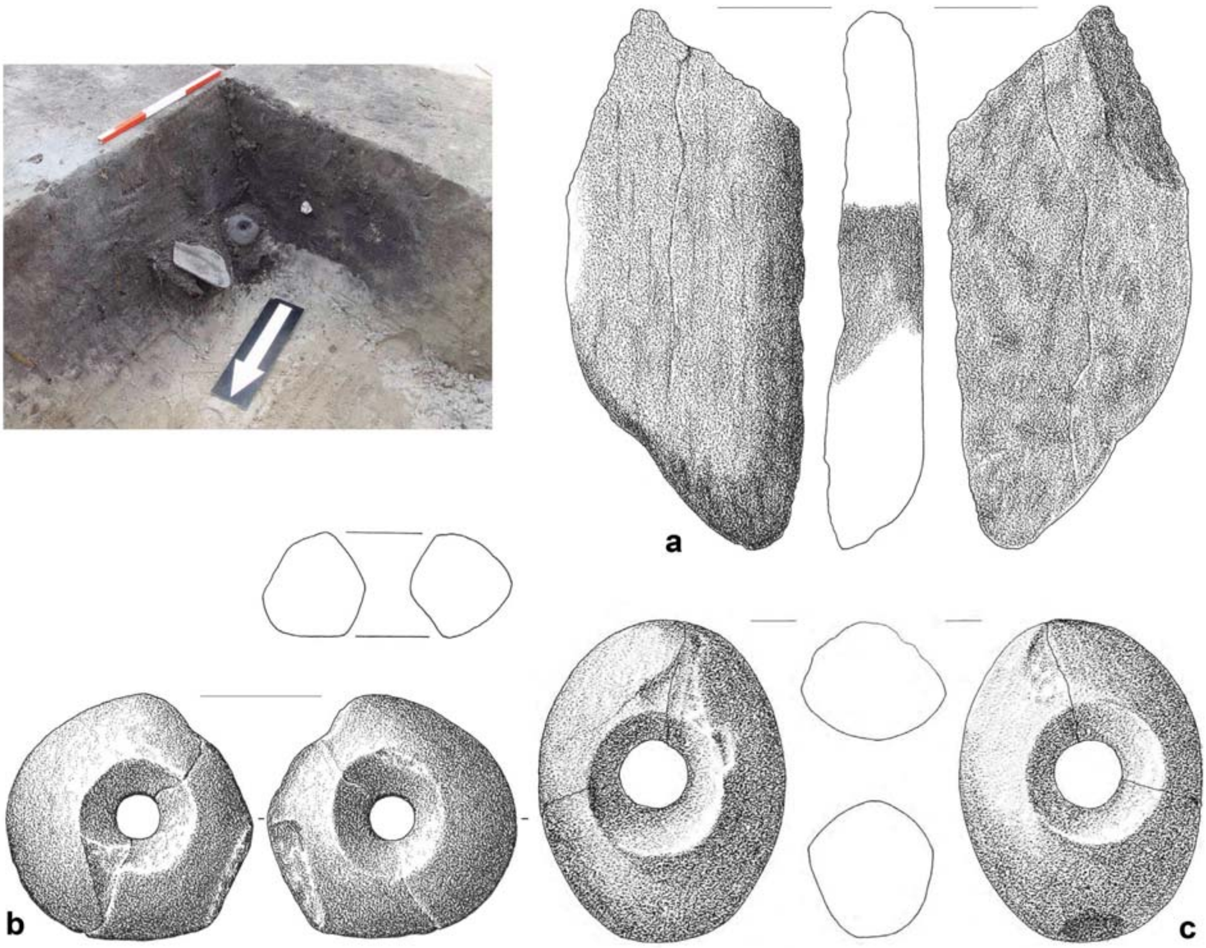


Fig 3.22 The Mesolithic grave at Rotterdam-Beverwaard with the stone mace head (b) and slab (a), and the mace head (c) from Knooppunt Hattemerbroek (from appendix II: PUBID 259, 463). Object drawings scale 1:2.

Grave goods are, however, scarce in the Dutch Mesolithic. Indeed, the Late Mesolithic inhumation graves at Hardinxveld-Giessendam Polderweg and De Bruin contained no grave goods at all, but there was some red ochre in one burial at Polderweg. And absence of grave goods – at least those made of non-perishable materials – is also noted at Dronten-N23, where a single inhumation grave was found on top of a river dune (fig. 3.23). The grave, which contained the poorly preserved remains of a woman buried in supine position, marks the final use of the location, which had previously been visited by many generations of Mesolithic hunter-gatherers, over the course of three millennia (see section 5.3.1). During this long time span, the environment became increasingly wet due to the structural rising of the groundwater table, and developed into freshwater swamp and marsh. It is in this context that the grave had been dug, possibly several centuries after the last visit, when the location served other purposes. The exact timing is, however, difficult to determine, as no secure date can be given for the burial; it may be of Late Mesolithic age, but could also be of Early Neolithic (Swifterbant) age.

The situation at Dronten-N23 seems to be comparable to that at other river dune sites in Flevoland. At Swifterbant-S21, S22 and S23, as well as at Urk-E4, burials with (poorly) preserved bone were found on top of the dunes.[182] These dunes were used for dwelling and subsistence purposes during the Mesolithic, but evidence for occupational continuity in the earliest part of the Neolithic – the early phase of the Swifterbant Culture – is lacking. The burials, however, seem

182 Raemaekers *et al.* 2007.

Fig 3.23 The inhumation grave at Dronten-N23 (from appendix II: PUBID 538). Top left: excavation plan showing the burial pit that intersects several Mesolithic pit hearths. Top right: preserved molars in situ. Middle: overview of the burial. Bottom: the burial pit in various stages of excavation.

to date to the classic phase of the Swifterbant Culture, post-dating the last Mesolithic activity by several centuries. If the available dates reflect prehistoric reality to a reasonable extent, this suggests the re-use of locations in a context wherein mortuary practices played an explicit role. This could be seen as a means to historically connect people to the landscape, whereby ancient settlement ground is used for burial of the dead.[183]

The finds from Rotterdam-Beverwaard and Dronten-N23 demonstrate how development-led research can make a valuable contribution to our understanding of mortuary practices. Considering the small number of Mesolithic graves known from the Netherlands, the variability in treatment of the dead is considerable: inhumation and cremation, extended and sitting position, isolated bones mixed with settlement waste, graves with and without grave goods, bowl-shaped and cylindrical pits, and graves with and without ochre. In Swifterbant contexts, inhumation and burial in extended position of single and, sometimes, multiple individuals seems to be the rule, followed by the occurrence of isolated bones mixed with settlement waste, an occasional skull burial, and a sitting grave.[184] This picture changes with the Middle Neolithic, when burial in flexed position in rectangular or oval pits is frequently seen, in addition to burial in extended position and the occurrence of isolated bones mixed with settlement waste.[185] Mostly, graves contain the remains of a single individual. At Schipluiden, one grave contained two individuals (males) buried in opposed orientation, one of whom seems to have suffered a violent death.[186]

Although differences in the treatment of the dead are apparent from the archaeological record, it is also becoming clear that grave goods remain rather scarce in the Dutch Middle Neolithic. When they are present, they tend to consist of personal ornaments (beads and pendants, mostly of amber, and sometimes jet) or implements (e.g. strike-a-lights with a pyrite nodule in grave 2 at Schipluiden).[187]
Although amber preserves relatively well, these remain rather exceptional. A recently excavated TRB cemetery near Dalfsen (province of Overijssel) has, however, produced a grave with a complete necklace consisting of tens of amber beads.[188] The use of amber for personal ornamentation continues in the Late Neolithic, notably in the Corded Ware and Bell Beaker graves discovered at Knooppunt Hattemerbroek.[189]

We must bear in mind that our knowledge about Mesolithic and Neolithic burial practices may be heavily biased due to the research focus on settlement sites. The possibility of burial outside settlements, or in locations other than former settlement sites, must be kept in mind. Indeed, considering the fact that only limited numbers of burials and 'isolated' human remains are known in the first place, and that there is considerable variability in mortuary practices within that relatively small 'sample', we can but wonder what we are missing. Certainly there is a problem with regard to differences in preservation conditions, but this cannot account for all of the patterning observed thus far. From this perspective, it is important that we archaeologists keep our eyes open, and all the more so whenever we have an opportunity to investigate off-settlement contexts.

3.4 Frames of reference

Although material culture can be considered to have a mediating role in the context of socio-cultural dynamics, material culture has traditionally received a lot of attention to characterise spatio-temporal patterns in the archaeological record. This is also the case in the NOaA 1.0, which addresses questions concerning the typo-chronology of artefact categories, flint tools and ceramics in particular (see appendix I).

3.4.1 Typo-chronology of the Final Palaeolithic and the Mesolithic

Whereas chronologies of the Palaeolithic and the Neolithic are usually characterised in terms of successions of 'well-defined' cultures or technological traditions,[190] the Mesolithic has always been somewhat problematic, not only because chronologies are traditionally based on microliths – small parts of composite tools – with limited stylistic resolution (fig. 3.24), but also because of problems of independent chronological anchoring of flint tool assemblages. The latter problems are related to

183 Amkreutz 2013; Peeters 2007, 232.
184 Louwe Kooijmans 2007; Raemaekers *et al.* 2007.
185 Louwe Kooijmans 2007.
186 Smits & Louwe Kooijmans 2006.
187 Smits & Louwe Kooijmans 2006; Van Gijn *et al.* 2006.
188 Van der Velde & Bouma 2016.
189 Appendix II: PUBID 2059, 260. The Late Neolithic falls outside the scope of the present study.
190 This is not to say that no problems exist with regard to the definition and chronological anchoring of these 'cultures' and 'traditions'. In many cases, these 'cultures' and 'traditions' have inherited from culture-historical classifications the assumption of spatial and chronological interrelationships, which often lack underpinning with reliable context and dating. The 'clear' picture that the Palaeolithic and Neolithic successions seemingly exhibit is, without doubt, more complicated and problematic than is thought by many.

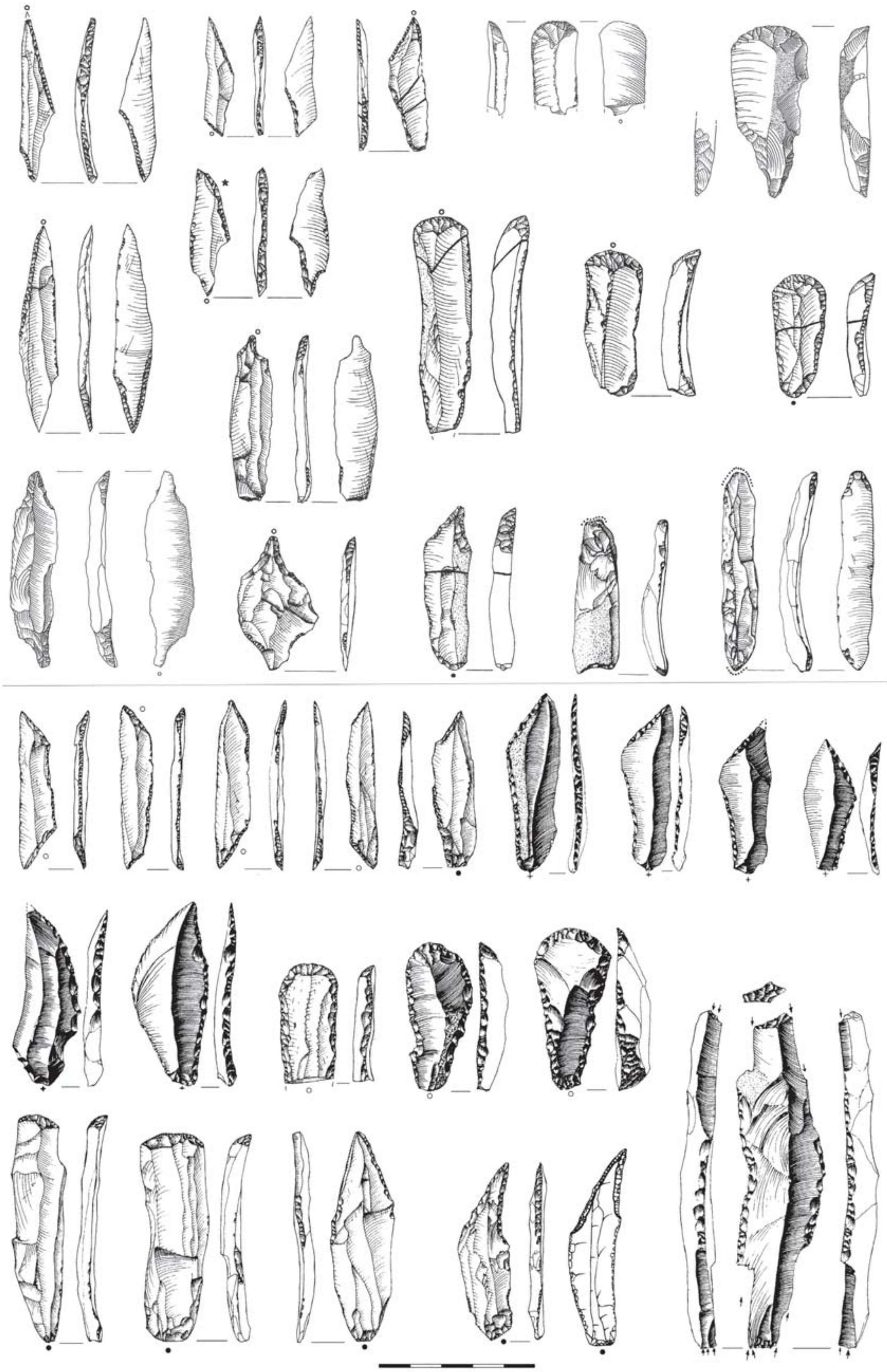


Fig 3.24 Overview of the most important typochronological tool categories for the Late Palaeolithic through Middle Neolithic (adapted from Amkreutz, Verhart & Van Gijn 2016; Brounen 2016; Deeben & Niekus 2016a, 2016b, 2016c; De Grooth 2016; Houkes 2016; Niekus, Kramer & Deeben 2016; Peeters 2016; Peeters & Devriendt 2016; Rensink & Niekus 2016; Schreurs 2016). Scale bars in centimetres.
Hamburgian (top) and Creswellian (bottom).

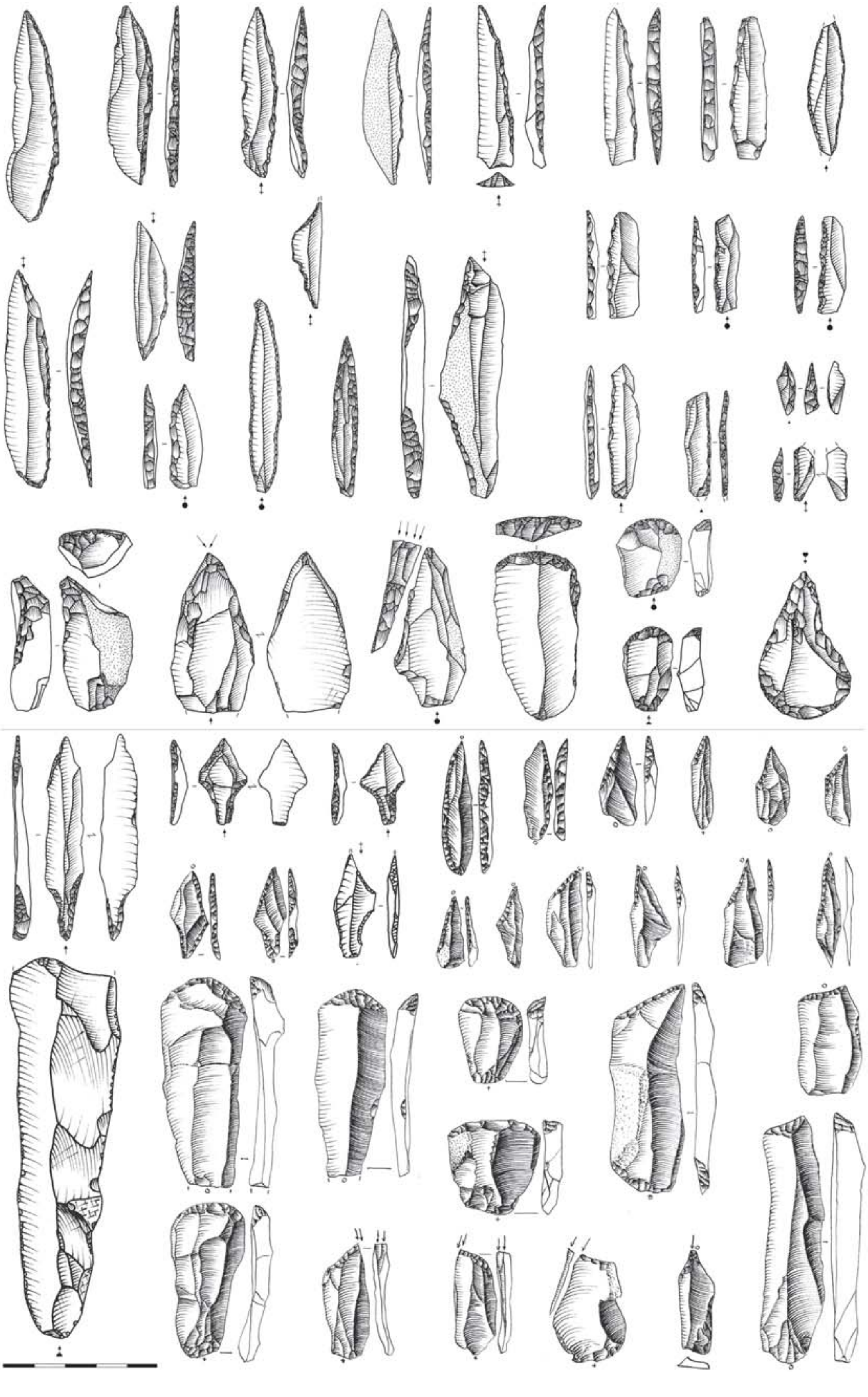


Fig 3.24 Continued.
Federmesser Gruppen (top) and Ahrensburgian (bottom).

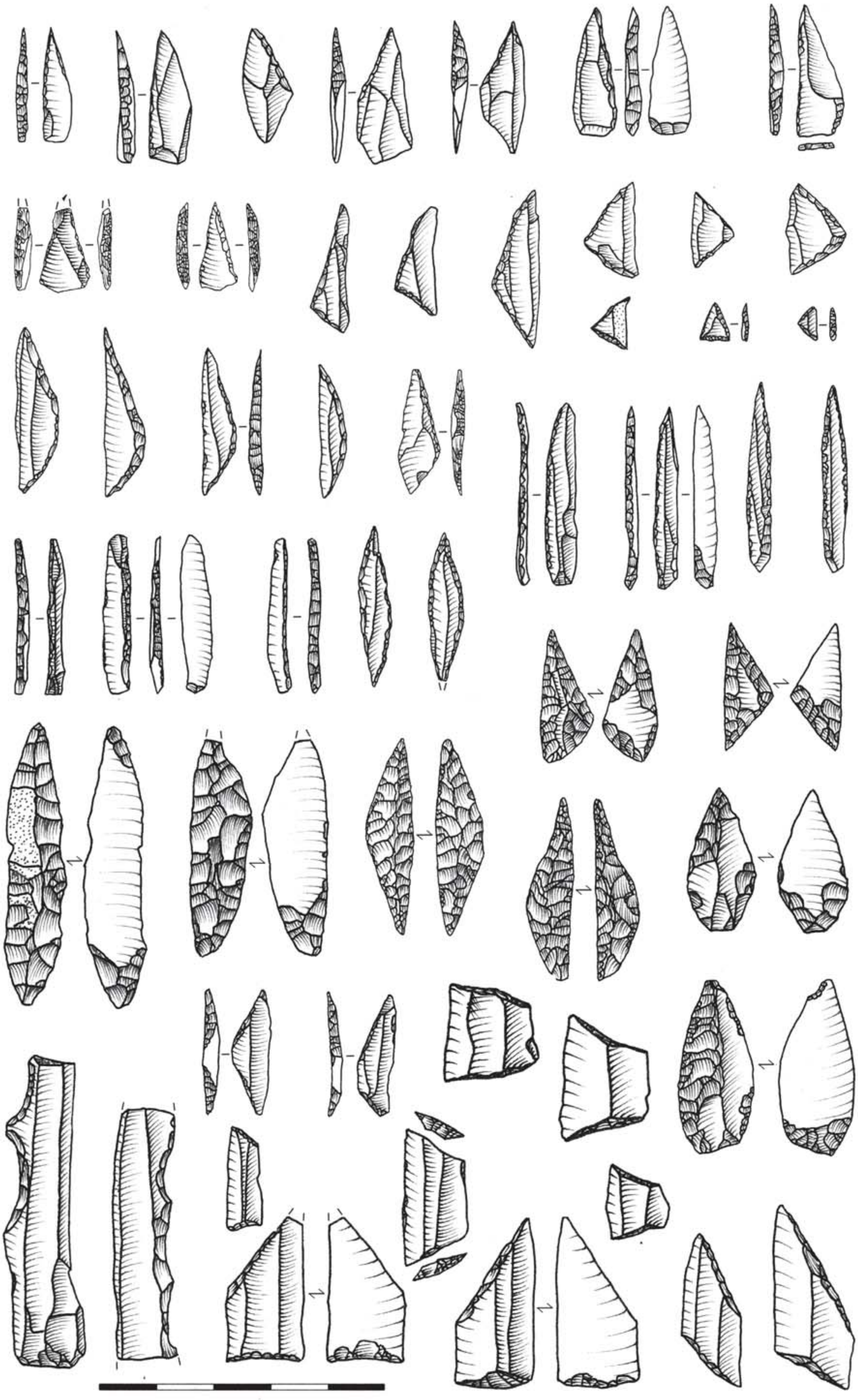


Fig 3.24 Continued.
Mesolithic.

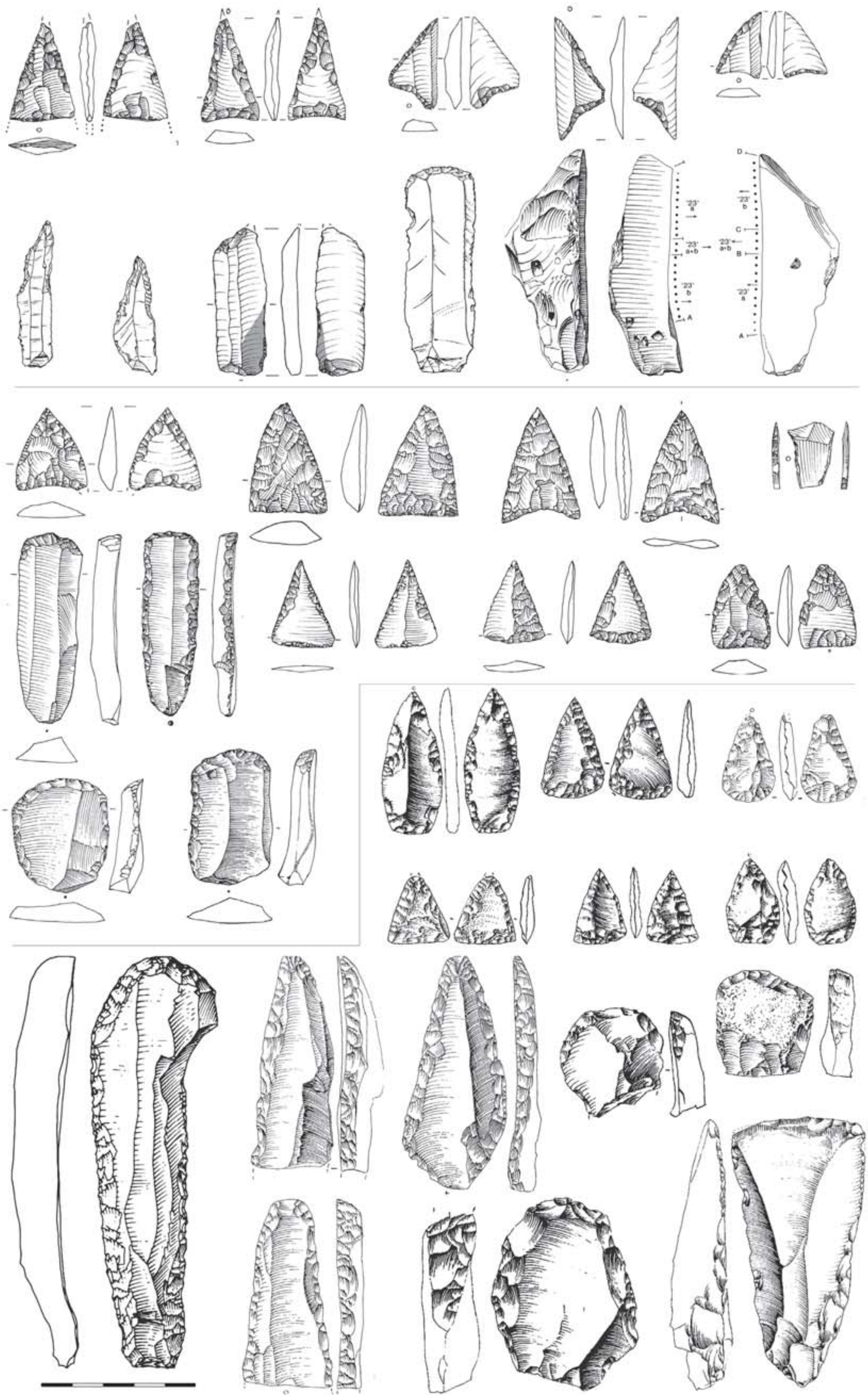


Fig 3.24 Continued.
LBK (top), Rössen (middle) and Michelsberg (bottom).

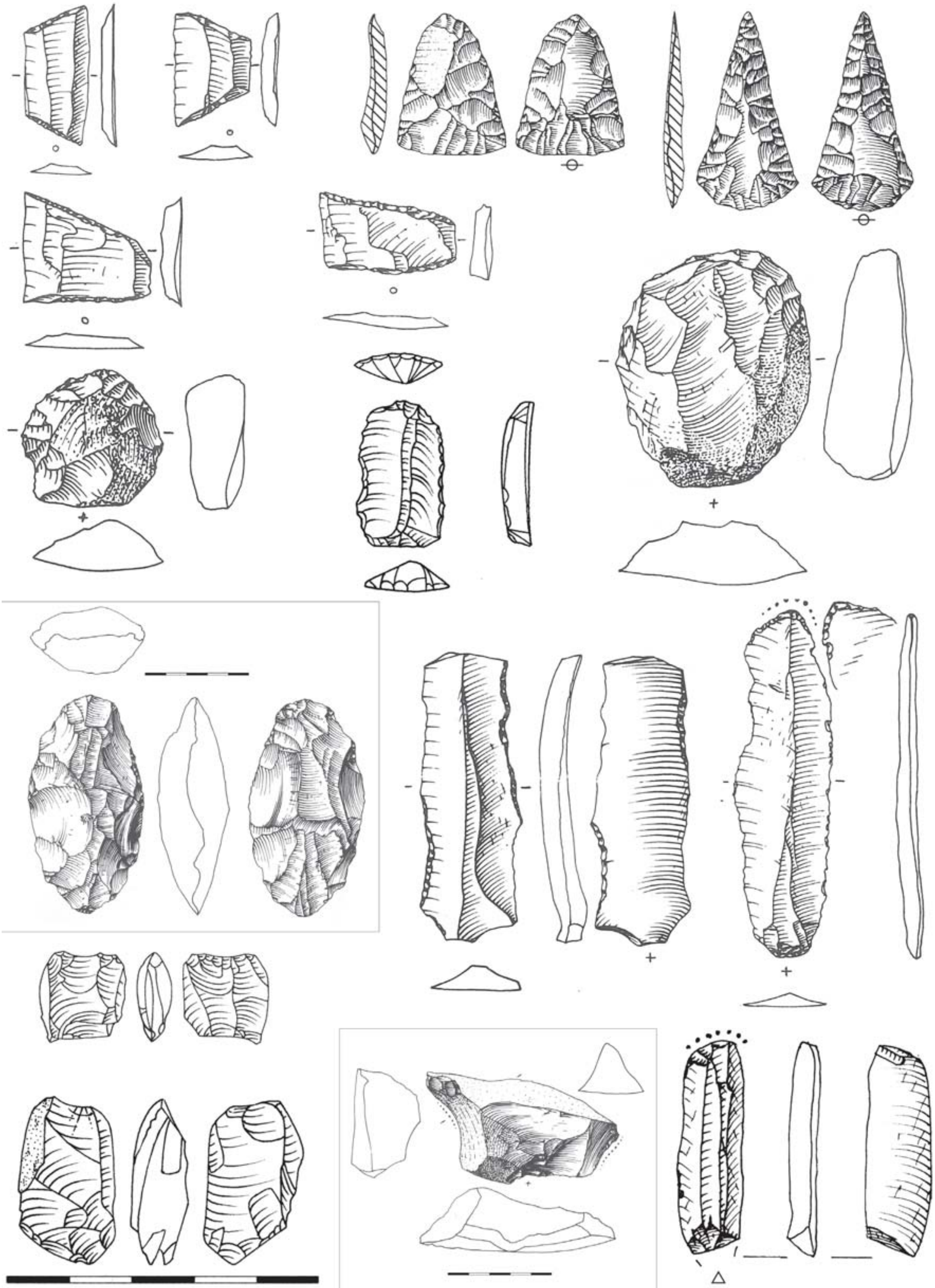


Fig 3.24 Continued.
Swifterbant.

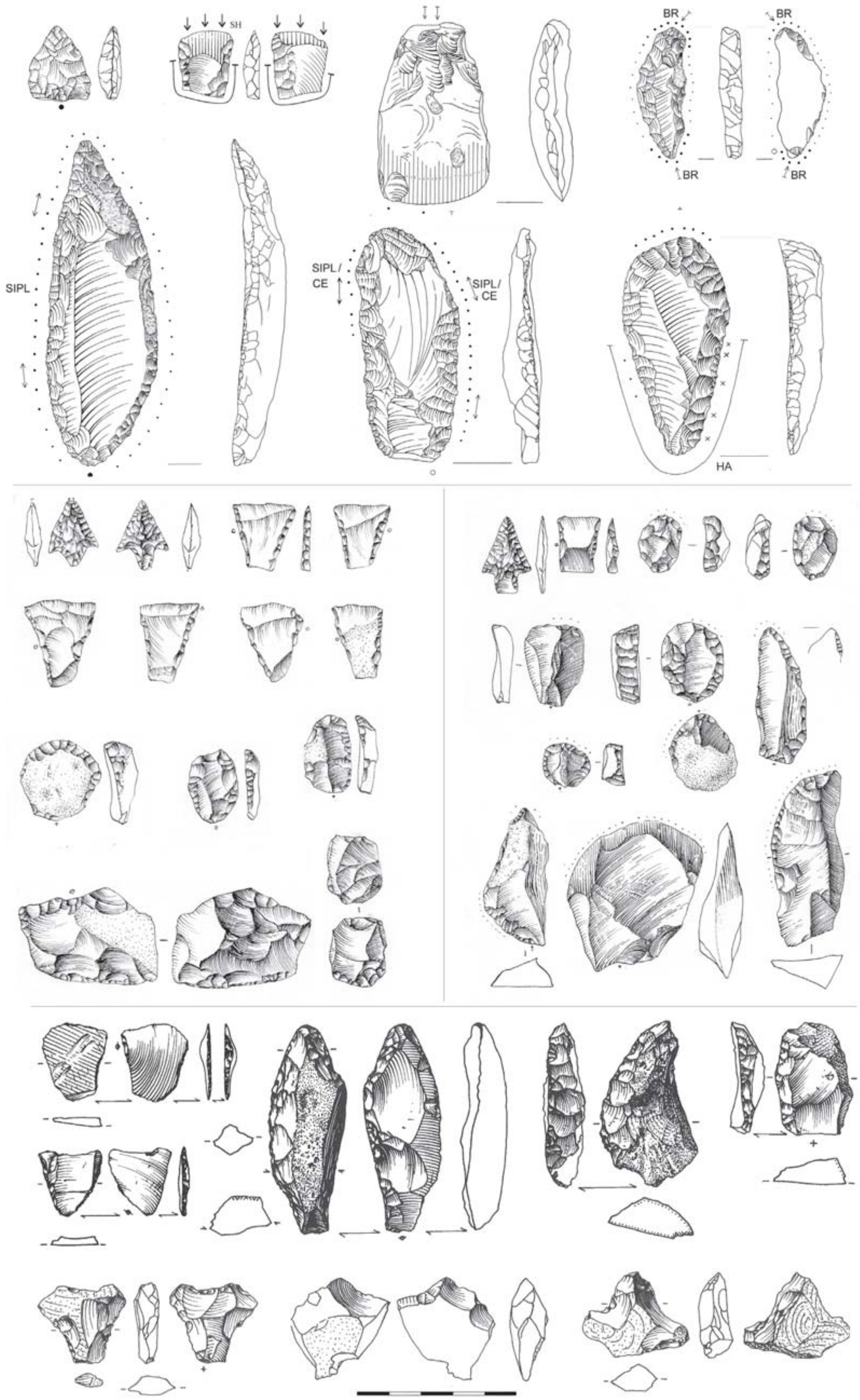


Fig 3.24 Continued.
Hazendonk (top), Vlaardingen (middle left), Stein (middle right), and TRB (bottom).

the problem of palimpsest formation and the assumed, but unestablished, chronological association of lithic assemblages and dated features (mostly pit hearths).[191] Especially the frequently used typo-chronology developed by Newell suffers from this problem,[192] although other classifications share similar shortcomings.[193] The use of different typo-chronologies potentially leads to difficulties in comparing reported research results. In the northern Netherlands, reference is particularly made to Newell's scheme and to additional considerations by others regarding its viability.[194] In the southern Netherlands, reference is made to Arts and an adapted scheme published by Newell, as well as Belgian classifications.[195]

One way to solve problems of chronological resolution of Mesolithic typology is to focus on finds occurrences that resulted from single, short-lived activity phases, comparable to those excavated in Verrebroek-Dok (Belgium).[196] This will lead not only to more fine-grained chronologies, but also to deeper insight into (sub-)regional variability. In the context of development-led projects, a restricted number of such chronologically discrete assemblages have been excavated, for instance, at Zutphen-Ooijerhoek, Dronten-N23, Ede-Kernhem and Well-Aijen. Some other assemblages have been recorded more recently, at Soest, Sumar and Kampen-Reevediep, but these have not yet been published and therefore fall outside the scope of the present study. Despite the availability of such valuable assemblages, the full potential cannot always be exploited, mostly due to a lack of ^{14}C-dates. At Hoogezand-De Vosholen, for instance, datable charred hazelnut shell and charred bone were found, but these have not been dated; in this case several clusters of lithics have been dated on the basis of microlith typology and the tree taxa (which are assumed to have chronological meaning) represented in the wood charcoal.[197] In other cases assemblages have been dated on the basis of radiocarbon dates on charcoal from pit hearths,[198] but here too, as above, is the problem of assumed contemporaneity. At Meerstad, ^{14}C-dates on wood charcoal and hazelnut shell sampled from the same pit hearth gave slightly divergent yet close results, which both seem to match the expected age of the lithic assemblage.[199] In view of the fact that charred hazelnut shell is generally associated with surface hearths and flint scatters,[200] it is likely that the date on the hazelnut shell provides a reliable age for the lithic assemblage of Meerstad. Pit hearths represent other behavioural contexts, which may not be related to that of surface hearths and lithic scatters.

A final problem that needs to be mentioned here concerns the definition of types of microliths, and the reliability of type assignment by analysts. Indeed, it is not always generally clear, for instance, what constitutes the difference between a lancet point and D point, what defines a needle-shaped point, and where to draw the line between C points and triangular points. This ambiguity leads to noise, or fuzziness, in classifications and increases the risk of erroneous typological assignments. At the same time, however, we must bear in mind that any archaeological typology is intrinsically fuzzy, as there is no such thing as fully mutually exclusive types within a class of closely related items. After all, it is the observer – the archaeologist – who decides which characteristics need to be taken in account, and what degree of overlap between types is acceptable. Hence, the concern should, first of all, be to establish to what extent the defined types have meaning, be it socio-cultural or chronological.

Based on previous insights and new information derived from development-led projects, a more variegated typo-chronological framework is gradually taking form (table 3.7). This framework is built not only on sites from the Netherlands, but also on key sites in Germany and Belgium. The typo-chronological framework is, however, not one of diachronic succession, but, rather, an increasingly complex pattern of spatio-temporal tendencies.

191 Lanting & Van der Plicht 1998.
192 Newell 1973.
193 Arts 1988. See Peeters and Niekus (2005) and Verhart and Groenendijk (2005) for a discussion.
194 Lanting & Van der Plicht 1998; Newell 1973; Peeters & Niekus 2005; Verhart & Groenendijk 2005.
195 Newell 1975; Arts 1988; Crombé, Van Strydonck & Boudin, 2009.
196 Crombé, Van Strydonck & Boudin, 2009.
197 Appendix II: PUBID 737.
198 Appendix II: PUBID 524, 617.
199 Arnoldussen *et al.* 2012.
200 Compare Crombé, Groenendijk & Van Strydonck 1999 ;Crombé *et al.* 2013; Sergant *et al.* 2006.

Final Palaeolithic to Mesolithic transition

For the Ahrensburgian, which is normally considered to represent the final Palaeolithic tradition, it is clear that tanged points were gradually replaced by B points and trapezoidal points. The latter are in fact B points with basal retouch, and they are sometimes (erroneously) called Zonhoven points. Although tanged points are more frequent in the early Ahrensburgian, they do not necessarily have to be present in sites belonging to this stage, e.g. as a result of differences in site function. The late Ahrensburgian sporadically comprises other types, such as Tjonger points or Federmesser and A points.[201]

The 'transitional' phase from Ahrensburgian to Early Mesolithic, between c. 9250-8400 cal. BC, is rather obscure.[202] One of the few sites known to date, Zwolle-Oude Deventerstraatweg, has a date on calcined bone of c. 9000 cal. BC.[203] The assemblage is incomplete due to partial destruction of the site, but comprises several Late Palaeolithic elements, such as large burins and scrapers, as well as fragmentary backed points (Tjongerian), a tanged or trapezoidal point, and a B point. Several blades show splintered bulbs of percussion (*esquillements de bulbe*), a feature that is often observed in Ahrensburgian assemblages and possibly indicates the use of soft stone hammers.[204] Securely dated lithic assemblages from the period 9000-8400 cal. BC are lacking, with the exception of a small assemblage – mostly debitage – recovered from alluvial deposits at Zutphen-Ooijerhoekse Laak.[205] One cluster of lithics at Knooppunt Hattemerbroek most probably dates between c. 8900 and 8400 cal. BC based on the assemblage of points.[206] It is composed of B points, elongated trapeze or trapezoidal points, one isosceles and one scalene triangle, and one crescent. The assemblage shows clear resemblance with Duvensee 2 (c. 8600 cal. BC) and Haverbeck (c. 8950-8700 cal. BC) in Germany.[207] It is possible that elongated trapeze points are characteristic of the Early Mesolithic in the northern Netherlands; other sites where these have been found are Slochteren-Hooilandspolder (c. 8100 cal. BC) and Nieuwe Pekela 9 (c. 7850 cal. BC). They are lacking in the lithic assemblages of Zutphen (c. 8300-8000 cal. BC) and Ede-Kernhem (c. 7850-7700 cal. BC) farther south.[208] Possibly this indicates regional differentiation.

Early Mesolithic

Within the Belgian Early Mesolithic, a number of 'groups' have been defined on the basis of the relative importance of microlith types;[209] these typological groups may also be of relevance for the Netherlands. The so-called Neerharen Group, dated c. 8550-8100 cal. BC, is dominated by points without a retouched base (A and B points, >50%), followed by isosceles and scalene triangles, and smaller numbers of crescents and other points. The Verrebroek Group, dated c. 8350-8000 cal. BC, is dominated by points without a retouched base (A and B points), followed by scalene triangles, and smaller numbers of crescents and points with a retouched base (C points). Finally, the Ourlaine Group – although mostly present in Belgium and northern France – dated between c. 8500-7550 cal. BC, is characterised by crescents (35-45%) in combination with points without a retouched base; other microliths, such as points with a retouched base and triangular points, occur incidentally.

As yet, the Neerharen Group is potentially only represented in the Netherlands at Posterholt.[210] Cluster 5 at Dronten-N23 has been dated at c. 8350 cal. BC and has been attributed to the Verrebroek Group on the basis of the microlith spectrum, although the presence of both some isosceles and scalene triangles would permit an attribution to the Neerharen Group.[211] The assemblage of Haelen-Broekweg, with dates between c. 8350-8250 cal. BC, compares well with the Dronten-N23 cluster.[212] Several clusters at Zutphen-Ooijerhoek, with dates between c. 8350-8000 cal. BC, have been attributed to the Verrebroek Group.[213] The assemblage of Slochteren-Hooilandspolder falls within the same age range,[214] but compares better with Duvensee because of a clear presence of elongated trapeze points.

Late Early Mesolithic

Slightly younger are clusters 7a, 7b and 9 at Ede-Kernhem, with dates of c. 7850-7700 cal. BC; the majority of microliths are triangular points (>70%) with additional points with and without retouched bases, as well as crescents.[215] Hence, the Ede-Kernhem assemblages differ from both the Neerharen Group and the Verrebroek Group. Although the dominance of triangular points corresponds to the characteristics of the Chinru Group, which is

201 Niekus *et al.* in prep.
202 Also see Crombé, Deeben & Van Strydonck 2014.
203 Niekus *et al.* in prep.
204 Compare Weber (2012), who described similar features for the Hamburgian.
205 Groenewoudt *et al.* 2001. However, this research falls outside the scope of the present study.
206 Cluster 6.12 (Niekus *et al.* 2012) has been partly excavated and has not been dated directly.
207 Bokelmann 1971, 1991; Holst 2007; Tolksdorf *et al.* 2009.
208 Kortekaas & Niekus 1994; Nieuwe Pekela is largely unpublished (Groenendijk 2004).
209 Crombé Van Strydonck & Boudin 2009.
210 This site has been investigated within an academic context (Verhart 2000).
211 Niekus *et al.* 2012.
212 Bats *et al.* 2010.
213 The site was excavated by the Rijksdienst voor het Oudheidkundig Bodemonderzoek (now Rijksdienst voor het Cultureel Erfgoed) in 1999, but it has not yet been published.
214 Appendix II: PUBID 773.
215 Devriendt 2015.

Table 3.7 Typochronological table for the Late Palaeolithic to Neolithic (from Amkreutz *et al.* 2016).

	Magdalenian	Early Hamburgian	Late Hamburgian (Havelte phase)	Creswellian	Federmesser-Gruppen	Early Ahrensburgian	Late or Epi Ahrensburgian
Tjonger point / *Federmesser* / curved backed piece	-	-	+	+	++++	+	+
Gravette point	-	-	+	-	++	+	-
Kremser point	-	-	-		+	-	-
Azilian point	-	-	-	-	+	+	-
Creswell point	-	-	+	++++	+	+	-
Cheddar point	-	-	-	+	?	-	-
Penknife point	-	-	-	-	+	-	-
Malaurie point	-	-	-	-	+	-	-
Ahrensburgian (tanged) point	-	-	-	-	-	++++	+
Shouldered point	-	++++	+	-	+	-	-
Havelte (tanged) point	-	+	++++	-	-	-	-
A point / Unilaterally retouched point / point w. unretouched base	-	-	-	-	+	+	++
B point / Obliquely truncated point / point w. unretouched base	-	-	-	-	+	++++	++++
Long B point	-	-	-	+	+	-	-
Small asymmetric trapeze	-	-	-	-	-	-	-
Broad asymmetric trapeze	-	-	-	-	-	-	-
Rhombic trapeze	-	-	-	+	-	+	+
Elongated trapeze	-	-	-	-	-	+	++
(Asymmetric) right-angled trapeze	-	-	-	-	+	+	+
Isosceles triangle	-	-	-	-	-	+	+
Scalene triangle	-	-	-	-	-	+	-
Backed bladelet	-	-	-	-	++++	++	-
Unilaterally retouched backed bladelet	+++	-	-	-			
Bilaterally retouched backed bladelet	+	-	-	-			
Triangular backed bladelet	-	-	-	-			
Lacan burin	+	-	-	-	?	-	-
Borer / *Zinke*	-	+++	+++	-	-	-	-

Legend

++++	frequent
+++	fairly common
++	present
+	rare
-	absent
	unknown
?	unclear

Table 3.7 Continued.

	Early Mesolithic southern Netherlands	Early Mesolithic northern Netherlands	Middle Mesolithic southern Netherlands	Middle Mesolithic northern Netherlands	Late Mesolithic southern Netherlands	Late Mesolithic northern Netherlands
Tjonger point / *Federmesser* / curved backed piece	+		-		-	
A point / Unilaterally retouched point / point w. unretouched base	+++	-	++	+	++	++
B point / Obliquely truncated point / point w. unretouched base	++++	++++	++	+	+++	+
C point / Tardenois point / point w. retouched base	+++	-	++	+	+	++
D point / Bilaterally retouched point / point w. unretouched base	++	-	++	++	+	+
Crescent	+++	++	-	+	+	-
Isosceles triangle	+++	++	++	+++	+	+
Scalene triangle	+++	++	+++	++++	++	++
Lancette point	-		+	-	-	-
Needle-shaped point				+		+
Symmetric trapeze	+	-	-		++	+
Asymmetric trapeze	+	++++	-		++++	+++
Rhombic trapeze	-		-		+++	+
“Mistletoe leaf” point	+	-	+++	+	++	-
Invasively retouched triangle	-		+++	-	+	-
Invasively retouched point w. rounded base	+	-	+++	-	++	+
Broken point w. surface retouch	-		+++	+	+	-
Transverse point	-		-		+	+
Sauveterre point			+		?	
Backed bladelet	+++	-	++++	++++	+++	++++
“Montbani-style” blade / denticulated blade					++	
(Perforated) macehead / *Geröllkeule*	+	+	+	+	+	+

Legend

++++	frequent
+++	fairly common
++	present
+	rare
-	absent
	unknown
?	unclear

N.B. Late Mesolithic asymmetric trapezes in the southern Netherlands include LBK points (exchange)

Table 3.7 Continued.

	Linear Pottery culture	Rössen culture	Swifterbant culture	Michelsberg culture	Hazendonk group	Funnelbeaker culture	Vlaardingen culture	Stein group	Corded Ware / Single Grave culture	(Bell) Beaker culture
Small symmetric trapeze			+							
Small asymmetric trapeze			+							
Broad symmetric trapeze			+							
Broad asymmetric trapeze			+							
Elongated trapeze			+							
(Asymmetric) right-angled trapeze			+							
Asymmetric trapeze w. hollow base and invasive retouch or *retouche inverse plate* (RIP) (= LBK point)	++									
Asymmetric trapeze w. different kind of base	+									
Transverse point		+	+		++	+	+++	+++	+	
Triangular (equilateral) arrowhead with edge retouch		?								+
Triangular (equilateral) arrowhead with semi-covering (surface) retouch		+	+	?	++					+++
Triangular (equilateral) arrowhead with covering (surface) retouch		+	+	?						+++
Asymmetric triangle w. concave base and invasive retouch or *retouche inverse plate* (RIP) (= LBK point)	+++									
Asymmetric triangle w. different kind of base	+++				+					
Triangular (isosceles) arrowhead w. straight base and edge retouch	++++	+		++						+
Triangular (isosceles) arrowhead w. straight base and semi-covering (surface) retouch		+++	+	++++	++++					+++
Triangular (isosceles) arrowhead w. straight base and covering (surface) retouch		+	+		+					+++
Triangular (isosceles) arrowhead w. rounded base and edge retouch				++						+
Triangular (isosceles) arrowhead w. rounded base and semi-covering (surface) retouch			+	++	++++					+++
Triangular (isosceles) arrowhead w. rounded base and covering (surface) retouch			+	?	+					+++
Triangular (isosceles) arrowhead w. concave base and edge retouch		+								+
Triangular (isosceles) arrowhead w. concave base and semi-covering (surface) retouch		+++			++					++
Triangular (isosceles) arrowhead w. concave base and covering (surface) retouch		+								+++
Leaf-shaped arrowhead w. edge retouch				++++						
Leaf-shaped arrowhead w. semi-covering (surface) retouch				++	?			+		
Leaf-shaped arrowhead w. covering (surface) retouch				?						+
Leaf- or droplet-shaped arrowhead w. covering (surface) retouch			+		?					
Tanged arrowhead w. surface retouch							+	++		
Barbed arrowhead w. a longer tang									+++	+
Barbed arrowhead w. a tang									++	+++
Lozenge-shaped arrowhead w. covering (surface) retouch								+		
Core axe			+	+	?					
Flake axe		+	+	++	++					
Stone axe w. round cross-section		+		+			+	+		
Stone axe w. rectangular cross-section				?	?	+			+++	++
Stone axe w. oval cross-section		+	+	+	+++		+	+		
Stone palstave									+	?
Flint axe w. rectangular cross-section						+			+++	++
Flint axe w. oval cross-section		+	+	++++	++++		+++	+++	+++	++
Unpolished axe				+			+	+		
Adze	+++	+++								
Plano-convex perforated adze	+	+								
Perforated shoe-last celt	+	+++								

Table 3.7 Continued.

	Linear Pottery culture	Rössen culture	Swifterbant culture	Michelsberg culture	Hazendonk group	Funnelbeaker culture	Vlaardingen culture	Stein group	Corded Ware / Single Grave culture	(Bell) Beaker culture
Perforated broad wedge		+++	+							
Knob-butted battle axe						+	+	+		
Battle axe types A, B, C, P1, P2, D, E, H, R/S									+++	
Battle axe types B/A									++	
Battle axe types F, G									+	
Facetted battle axe type 1									+++	
Facetted battle axe types 2a, 2b									++	
Battle axe type Emmen										+++
Battle axe type Zuidvelde										++
Battle axe type Epe										+
Battle axe type K										+
Heavy duty axe										+
Disc-shaped perforated macehead	+			?						
(Perforated) macehead / *Geröllkeule*									+	
Chisel w. oval cross-section (cigar-shaped)							++	++		
Chisel w. rectangular cross-section						+			+	
Chisel on blade								+	++	
Pick				+				?		
Notched hoe				+				+++		
Pointed retouched blade				+++	++			+	+	
Grand-Pressigny dagger									+++	
Pseudo Grand-Pressigny dagger									+++	
Scandinavian-type flint dagger										+++
Sickle-blade (w. gloss)	+++	+		?						
Bifacially retouched sickle										?
Sickle type "Schipluiden/Ypenburg"					++					
Planoconvex knife / knife w. surface retouch									+	+++
Quartier d'orange	+									
Flint w. rounded end(s) / strike-a-light						+				
Short blade scraper w. straight scraper edge	++++	+++								
Flake scraper > 5 cm				+++						
Blade scraper > 8 cm				+++						
Tanged scraper					++					
Blade > 8 cm				+++						
Blade > 6 cm									+++	

Legend
++++ frequent
+++ fairly common
++ present
+ rare
? unclear

Legend Swifterbant and Funnelbeaker
+ present
absent

dated between c. 8000-7500 cal. BC, the low number of C points contradicts such an attribution. The presence of lancet points in the Ede-Kernhem 7b and 9 assemblages corresponds better to the assemblages of Duvensee 6a (c. 8300 cal. BC BP), Duvensee 6b (c. 8000 cal. BC) and possibly Duvensee 13 (c. 7650 cal. BC).[216] The Duvensee assemblages, however, also contain trapezoidal and needle (Sauveterre) points, which are absent in the Ede-Kernhem assemblages. The latter, therefore, partially share characteristics of both the Belgian and the Duvensee sites.

Clusters 3, 9 and 10 from Dronten-N23,[217] dated c. 7650-7550 cal. BC, are slightly younger than the assemblages from Ede-Kernhem. About 50% of the microliths consists of triangular points, followed by points without retouched base (30%) and points with a retouched base, crescents, lancet and needle points (for a total of 20%). To some extent, the assemblage composition compares with the Verrebroek Group, which is, however, older. The Dronten-N23 assemblages also show some similarities with the Chinru Group in terms of dating and the importance of triangular points, yet they differ in the low number of points with retouched bases. As yet, the Chinru Group seems to be regionally connected with eastern France and (south-) western Germany.

The clusters from Ede-Kernhem and Dronten-N23 are quite comparable in terms of microlith spectrum.[218] The relative importance of lancet points at Dronten-N23 Cluster 3 possibly indicates a stronger northern affinity (i.e. Duvensee). A second possibility, which does not exclude the first, is that lancet points, as well as needle points, belong to the relatively younger phase. However, trapezoidal points are lacking in the Dutch assemblages, in contrast to Duvensee, where these are nonetheless relatively sparse. The assemblages of Meerstad (c. 7550 cal. BC) and possibly Ede-Kernhem Cluster 3 (c. 7400 cal. BC) have yielded relatively few points, but other than that, they fit the other assemblages well.[219] Comparable assemblages were retrieved from Rotsterhaule, Warns and Almere-Zwaanpad, with dates between c. 7100-6850 cal. BC.[220]

Middle Mesolithic

In the northern Netherlands, triangle points (mostly scalene, and sometimes very small) become dominant in assemblages until the appearance of Late Mesolithic trapezoid points (c. 6450-6400 cal. BC). There does not seem to have been a marked break with the late Early Mesolithic. In contrast, in the southern and central Netherlands, the appearance of points with invasive surface retouch – triangular, but mostly *feuille de gui* (mistletoe-leaf-shaped) and leaf points – marks the start of the middle phase of the Mesolithic, c. 7500-7400 cal. BC. Examples come from Rotterdam-Beverwaard, Epse-Olthof and Ede-Kernhem;[221] the most northern occurrence is Dronten-N23 Cluster 2, with a date between c. 6400-6350 cal. BC.[222] The contrast between the northern and south-central regions probably reflects differences in socio-cultural development in these two regions. Whether the relative importance of points with surface retouch in particular has any significance in this respect is not clear. The distinction between the so-called Sonnisse Heide Group and Gelderhorsten Group in Belgium is based on the relative frequency of such points in relation to dominant quantities of backed bladelets.[223] In the Netherlands, again, assemblages do not easily conform to these group descriptions, although one can see similarities. In the case of Haaksbergen-Hassinkbrink, dated c. 7100 cal. BC, the microlith spectrum is composed of points with and without retouched base, lancet points, triangular points and leaf points with surface retouch, as well as a trapezoidal point, a possible needle point, and a Svaerdborg point.[224] There are few backed bladelets. Interestingly, apart from the leaf points, the other points also show rather 'flat' retouch. Does this betray a 'southern' affinity in an otherwise 'northern' assemblage? On the other hand, backed bladelets are dominant in the assemblages from Groningen-Meerstad; Scheemderzwaag-Scheemda; and Dronten-N23 clusters 2, 3, and 5-9.[225] Broadly speaking, backed bladelets seem to be a common element in the Dutch Middle Mesolithic, without any geographical distinction.

Late Mesolithic

The Late Mesolithic phase is characterised by the presence of trapezoid points made on regular blades. These points have abrupt distal and proximal retouch and vary in shape, forming symmetric (oblique distal and proximal ends) and asymmetric (one straight-angled end, sometimes referred to as straight-angled)

216 Holst 2007.
217 Niekus *et al.* 2012.
218 Devriendt 2015; Niekus *et al.* 2012.
219 Appendix II: PUBID 255; Devriendt 2015.
220 Lanting & Van der Plicht 1998; Niekus & Smit 2006; Niekus *et al.* 2012.
221 Appendix II: PUBID 463, 733, 758.
222 Niekus *et al.* 2012. Recent excavations at Soest-Staringlaan (by BAAC) and Kampen-Reevediep (by ADC) have yielded important assemblages containing points with surface retouch.
223 Crombé 1999.
224 Appendix II: PUBID 206.
225 Appendix II: PUBID 255, 475; Niekus *et al.* 2012.

trapezes, as well as rhombic trapezes. In reference to production direction of the blade, both long and narrow and short and broad specimens are found, whereby the latter are considered to be the more recent form.[226] Assuming that this chronological shift is 'real', it does, however, only represent a general trend that continues well into the Neolithic. Other types of microliths continue to be used in parallel with trapezoid points. As far as can be seen from the few discrete clusters of lithics excavated, it has been suggested that trapezoid points appear c. 6400 cal. BC in the southern Netherlands,[227] and somewhat earlier in the northern part of the country.[228] Several clusters at Dronten-N23 indicate the appearance of trapeze points between c. 6450-6400 cal. BC.[229] Trapezoid points dominate the assemblage of Cluster 3, whereas Cluster 2 shows a broader spectrum of microliths. It is assumed that Cluster 3 is younger than Cluster 2, which has a date close to 6400 cal. BC. It is important to note that the Late Mesolithic is not simply characterised by trapezoid points. An important feature is the production of regular and relatively long blades by means of indirect percussion (punch technique) as blanks for trapezoid points, but also Montbani notched blades. This technological emphasis is one that is found all over Europe, with the exception of the British Isles.[230] This tradition of blade production and emphasis on trapezoid points, which explicitly differs from the Middle and Early Mesolithic traditions, continues well into the Neolithic. Indeed, it is widely represented in the Swifterbant contexts.[231]

Concluding remarks

In summary, the period between the Late Ahrensburgian and c. 8400 cal. BC is poorly represented in general. A handful of (incomplete) assemblages and few dates are, as yet, all we have. For the Early Mesolithic post-dating c. 8400 cal. BC, more assemblages and dates are available from development-led projects for the period under review. To some extent, the assemblages are comparable to groups defined in Belgium and Germany. Assemblages from the northern part of the Netherlands show more affinity with the German (Duvensee) groups, whereas those from the southern Netherlands connect better to the Belgian groups. This suggests the development of distinct traditions in the northern and southern Netherlands. After c. 7850 cal. BC, the picture becomes more blurred: mostly we seem to be dealing with assemblages with 'mixed' characteristics. In the north, defining elements for a Middle Mesolithic stage are lacking or uncertain (e.g. lancet and needle points, backed bladelets); we note a continuity of development in assemblages with triangular points, until the appearance of trapezoid points. In the southern and central Netherlands, points with invasive surface retouch define the Middle Mesolithic and can be linked to a clear shift in tradition. Between c. 7700-6950 cal. BC, backed bladelets are well represented in assemblages anywhere in the Netherlands. A further shift involved the appearance of trapezoid points and punched blade technology, which characterises the Late Mesolithic (and Early Neolithic). As a final remark, we note that it is important to bear in mind that the further development of a typo-chronological framework can benefit from a more systematic study of technology. If geographically distinct 'microlith traditions' existed during (part of) the Mesolithic, 'technological traditions' also may have been different. Indeed, such differences seem to be present in the production of bladelets (microblades).[232]

From the above, it follows that the typo-chronological framework for the Final Palaeolithic and Mesolithic still comes with many problems. The results from development-led projects have certainly shed light on some geographical and chronological trends, but, nonetheless, there is lack of discrete and well-dated clusters of lithics that can serve as solid chronological anchoring points. As a result, the overall picture remains complex. It is, however, clear that the group definitions of assemblages as developed in Belgium are only partly applicable in reference to particular phases and regions. In fact, this is also the case for the reference to German assemblages. This suggests that a nation-wide or broad regionally valid typo-chronological framework will be difficult to maintain, and that the definition of assemblages with varying characteristics yet partly overlapping chronology will be difficult to avoid. The question is, however, to what extent such typological division reflects differences in functional and technological traditions. This question harks back to the discussions about the

226 Niekus 2009.
227 Robinson *et al.* 2013.
228 Verhart & Groenendijk 2005; also see Deeben & Niekus (2016c) for a discussion.
229 Niekus *et al.* 2012.
230 Tolan-Smith 2008.
231 Peeters *et al.* 2001; Devriendt 2014; Peeters & Devriendt 2016. Recent evidence from the eastern Baltic suggests the presence of regular blade and microblade technologies in the 9th-8th Millennium BC (Hartz *et al.* 2010; Sørensen *et al.* 2013).
232 This aspect is currently being investigated in greater detail at the Groningen Institute of Archaeology.

interpretation of (dis)similarities in stone tool assemblages in the culture-historical and processual paradigms in the 1970s. In order to obtain better insight into the socio-cultural meaning of spatio-temporal variability in lithic assemblages, it remains important to keep an eye out for discrete low-density clusters, and to adapt field methods, project outlines and the involvement of specialists accordingly.

3.4.2 Chronological and regional trends in pottery production and use

In the Netherlands, early prehistoric pottery assemblages are by definition confined to the Neolithic, following the chronological framework presented in chapter 1,[233] but one could just as well argue for a 'ceramic phase' of the Mesolithic when considering the wider economic and technological context of, for instance, the early Swifterbant Culture.[234] But in our view, whether one considers it a Mesolithic or a Neolithic element is not that important; for this reason we use the terms in a purely chronological sense (see chapter 1). Of greater significance here is the fact that ceramics play a central role as frames of reference for Neolithic chronology and for the cultural assignment of assemblages. Pottery has become the structuring material category for the analysis of cultural developments (see fig. 2.11), and as such it plays a significant – but maybe somewhat underestimated – role in heritage management decision making. Significance assessment of newly discovered sites does take into account (potential) cultural assignment, for instance, to determine rarity. But of course there is more to ceramics. As yet, relatively little is known about regional variability, fabric and sourcing of compounds (clay, temper), or function.

Research topics like these are also echoed in the NOaA 1.0; so to what extent has development-led work made a contribution to increasing our knowledge about ceramics? Table 3.8 lists sites that have yielded early prehistoric pottery remains. The reports make clear that assemblage size is highly variable, ranging from over 10,000 fragments at Hazerswoude-Rijndijk to a single fragment at Emmeloord-Ens. Also, cultural groups that have largely escaped our attention in the twentieth century – notably Rössen and Michelsberg – are not represented in our sample of reports. Apparently, the pottery-based typo-chronological subdivision of the Dutch Neolithic does not suit the 'on the ground' situation, which makes it difficult to be certain about true absence (or presence) of cultural groups at a local or (sub-)regional scale.

Whilst it is clear that ceramic analysis at the site level may provide input for typo-chronological analysis and the study of regional variation, it is equally clear that development-led research often lacks specified research questions or a research budget to address these issues. Furthermore, re-analysis of assemblages such as those listed in table 3.8 is seriously hampered by the unavailability of datasets in the national digital repository DANS-EASY: only seven relatively small datasets appear to have been uploaded (also see section 2.4).[235]

Developments in typo-chronology

Two projects in Limburg provided 'Neolithic' pottery that could be used to build a new regional chronology, namely, Ittervoort and Well-Aijen. The reports indicate that it is difficult to interpret these assemblages using the current typo-chronological scheme. Attempts to build a new, more regional scheme have not been made. Moreover, whilst the Ittervoort assemblage of 114 sherds comes from a feature that also included wood charcoal suitable for ^{14}C-analysis, no date is available. Hence, despite its potential to build a new regional typo-chronology, this assemblage is, as yet, of no use. The Well-Aijen assemblage originates from test trenches[236] and involves a large feature that yielded 204 fragments of pottery, alongside stone and flint artefacts. A ^{14}C-date situates the assemblage around 4300 cal. BC.[237] The pottery sherds bear characteristics that are reminiscent of Rössen ceramics, notably the presence of perforated lugs (fig. 3.25). There are, however, also differences, like the absence of *Furchenstich* and *Doppelstich* decoration.[238] We consider it desirable that the final report, which incorporates results from the test trenches and subsequent excavation, contain a full analysis, including a wide geographical comparison that should include contemporary Swifterbant sites, especially Schokland-P14. The excavator has made convincing arguments for a model that proposes that Swifterbant pottery morphology was inspired by the Danubian tradition, but that the typical Swifterbant decorative schemes and

[233] Van de Broeke, Fokkens & Van Gijn 2005.
[234] Peeters *et al.* in prep.
[235] Appendix II: PUBID 74, 122, 340, 373, 407, 463, 744.
[236] The results of the subsequent excavations are not yet available.
[237] Appendix II: PUBID 725b.
[238] Ten Anscher 2012, 134-142.

Table 3.8 Overview of sites with early prehistoric pottery and number of pottery sherds.

PUBID	Project	Culture	N
53	Beek Kerkeveld	LBK	3089
194	Elsloo	LBK	3100
528	Rijksweg A2 Stein-Heidekampweg	LBK	2704
537	Sweikhuizen Geverik	LBK	310
651	Beek Bourgognestraat	LBK	43
340	Leur Hernense Meer	Swifterbant	115
463	Rotterdam Beverwaard Tramremise	Swifterbant	40
468	Rotterdam Groenhagen Tuinhoven De Zwanen Rietpark	Swifterbant	415
739	Groenenhagen Tuinenhoven	Swifterbant	212
61	Bergerden Geranium	Hazendonk	30
338	Nijmegen Oosterhout t Klumke	Hazendonk	186
373	Meteren de Plantage	Hazendonk	184
732	Schipluiden	Hazendonk	c. 8000
542	Ittervoort Thorn	Neolithicum	114
725	Well Aijen werkvak 2	Neolithicum	580
74	Beuningen	Vlaardingen-Stein	65
122	Den Haag Steynhof	Vlaardingen-Stein	7
219	Sittard Geleen Hof van Limburg	Vlaardingen-Stein	528
253	Haren Groenstraat (n BR)	Vlaardingen-Stein	219
259	Hanzelijn Hattemerbroek	Vlaardingen-Stein	?
272	Hellevoetsluis Ossenhoek	Vlaardingen-Stein	c. 2260
463	Rotterdam Beverwaard Tramremise	Vlaardingen-Stein	22
600	Wijchen Oosterweg	Vlaardingen-Stein	2200
740	Hazerswoude Rijndijk	Vlaardingen-Stein	10658
240	Groningen UMCG	TRB	613
253	Haren Groenstraat (n BR)	TRB	5
259	Hanzelijn Hattemerbroek	TRB	275
260	Hattemerbroek Bedrijventerrein	TRB	557
272	Hellevoetsluis Ossenhoek	TRB	c20
407	Nijverdal de Regge	TRB	24
740	Hazerswoude Rijndijk	TRB	7
741	Hempens Wâldwei	TRB	4
744	Emmeloord Ens	TRB	1
750	Groningen Helpermaar	TRB	136
752	Groningen Europapark	TRB	10
740	Hazerswoude Rijndijk	Corded Ware	207

techniques were excluded from this exchange of ideas.[239] It is possible that the Well-Aijen assemblage also fits this model.

Whilst Ittervoort and Well-Aijen provide new material for potentially developing a regional typo-chronology, a stratified site may be used for similar purposes at the local level. The sites under review provide one such example: Hazerswoude-Rijndijk.[240] This river levee site was gradually covered with clay, resulting in a stratified site that yielded ceramics from three cultural groups: Vlaardingen/Stein, Funnel Beaker and Corded Ware. The analysis takes the assignment to these cultural groups as a given, and concludes that the Vlaardingen-style pottery was slowly replaced by Corded Ware–style pottery, an outcome that is interpreted as evidence of a gradual change in behaviour of the inhabitants. Beckerman's

239 Ten Anscher 2012.
240 Appendix II: PUBID 740.

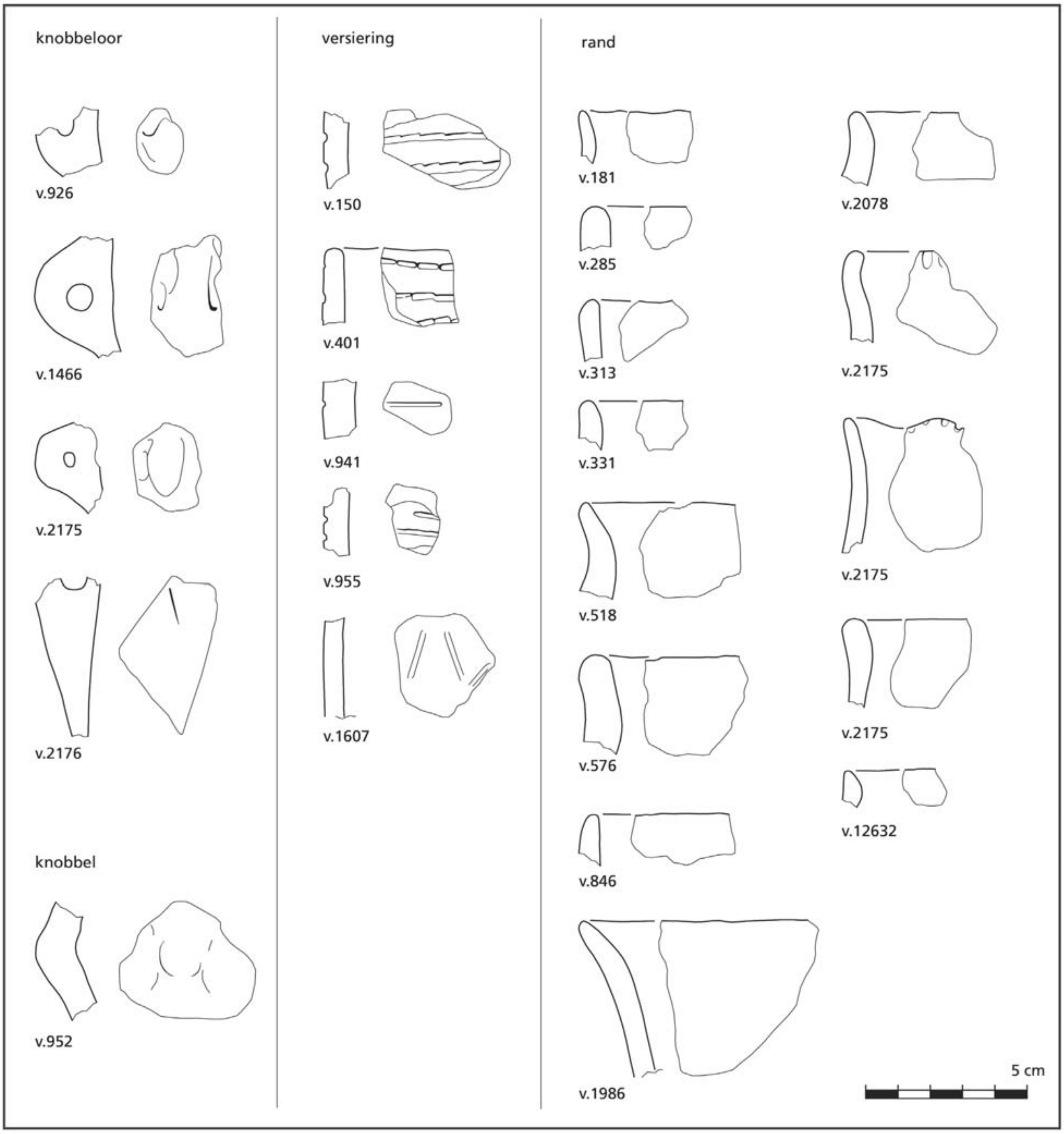


Fig 3.25 Pottery from Well-Aijen: perforated lugs and knobs (left), decoration (middle), rims (right). The assemblage is of Early Neolithic age (from appendix II: PUBID 725b).

publication on the Corded Ware settlements in the province of Noord-Holland provides a new typo-chronological scheme in which the Vlaardingen–Corded Ware transition is proposed to have been one of cultural continuity.[241] She proposes that both groups share a cultural continuum of expressions in which the factual chronological 'frontier' between the two is a matter of taste; in terms of both morphology and technology, there is no clear break. As Beckerman notes, this leaves decoration in Corded Ware style as the single distinctive character, and this by definition makes it impossible to have an undecorated Corded Ware vessel (fig. 3.26).[242]

241 Beckerman 2015. Recent analysis of ancient DNA sampled from human bone remains assocated with Bell Beaker material culture across Europe shows that socio-cultural interaction is complex in terms of expressions of cultural identity and demography (Olalde *et al.* 2017). It warns us against drawing overly simplistic conclusions with regard to the spread and societal integration of material innovations; the understanding of geographical patterns of similarity and variability requires a multidimensional interpretive framework that integrates different disciplines.

242 Beckerman 2015, 241-243.

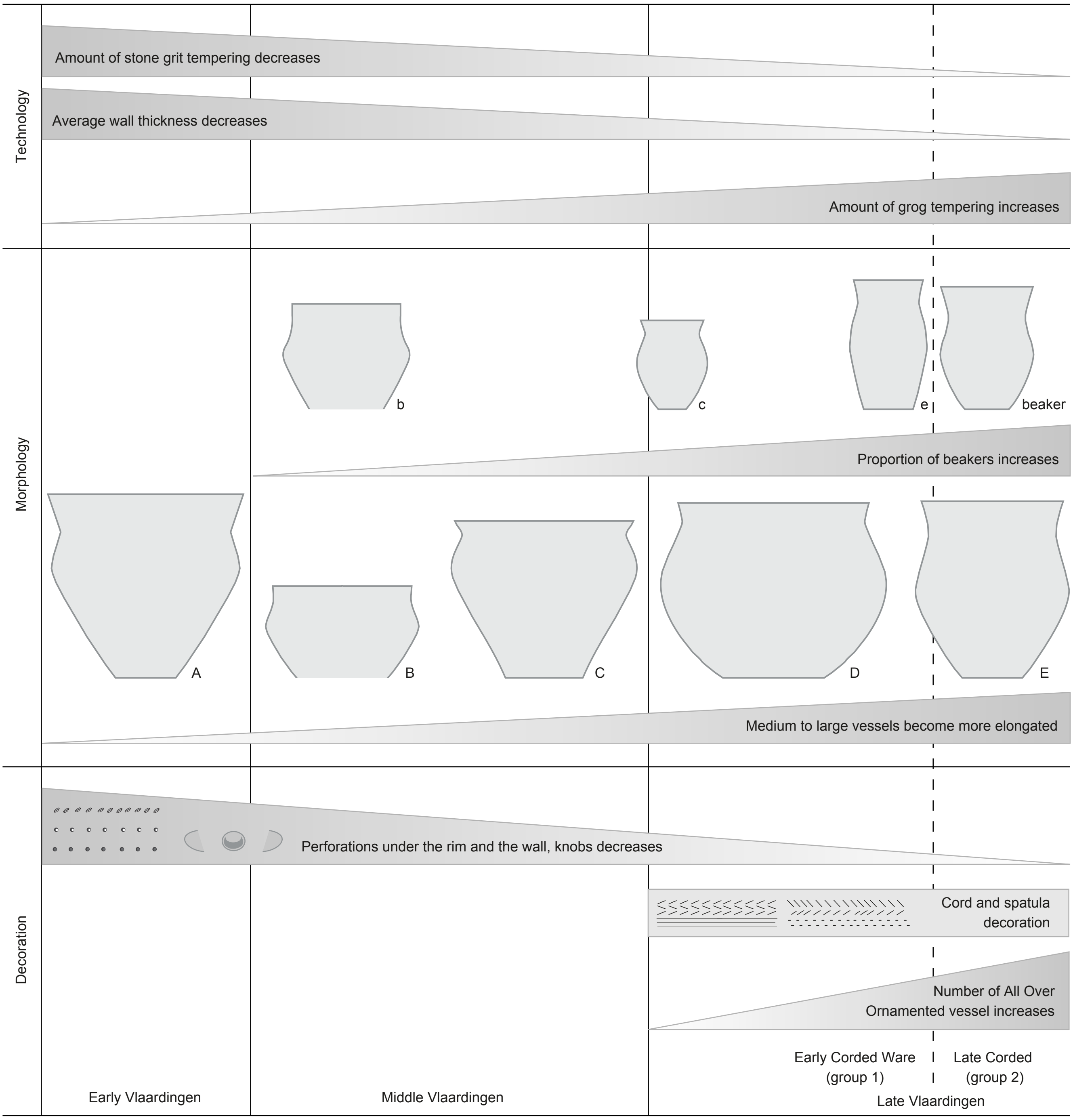


Fig 3.26 Chronological developments: Vlaardingen and Corded Ware in the coastal zone (from Beckerman 2015).

The ^{14}C-dates from Hazerswoude-Rijnsijk do not permit any distinction either.[243] It would have been interesting to test this hypothesis using the relatively large Hazerswoude-Rijndijk assemblage and to study the correlation between technology, morphology and decoration, were it not that the dataset is not available in DANS-EASY.

Regional variation

Development-led projects are by definition focussed on sites. Regional analysis is almost absent, due to a combination of, on the one hand, explicitly site-related research questions and, on the other, the absence of datasets in DANS-EASY. A rare example can be found in a regional analysis of the Hazendonk pottery from Schipluiden,[244] thanks to the simple fact that all of the sites used in the analysis had been studied by one of us (D.C.M. Raemaekers), mostly in an academic context. The analysis starts from the realisation that Hazendonk pottery is relatively well defined in terms of morphology and decorative schemes. Within this framework, regional variation has been observed in terms of the tempering agents used and the frequency of specific types of decoration, resulting in the identification of three microregions along the river Rhine. The pattern of regional variation was interpreted as being the outcome of one or more of the following three variables: mobility, exchange and mode of production. Raemaekers hypothesises that the similarities in pottery in terms of temper and decoration between the three microregions, or microtraditions, result from the traditional reproduction of pottery by several generations of potters during the colonisation phase of the coastal area. The dissimilarities amongst the three microtraditions may then be explained as the result of a 'ceramolocal' marriage system and a household mode of production (fig. 3.27).[245]

The nature and origin of resources used in ceramic production

In contrast to the topics above (typo-chronology; regional variation), the sources of the raw materials used in ceramic production may easily be addressed at the site level. Thanks to the ongoing development of research methods (e.g. XRF, micromorphology), there is great potential to generate types of data other than those on morphology and decoration, which may be used to develop new research questions concerning mode of production (e.g. at the household level, by a local specialist, imported), inter-group contacts (locally produced versus imported), or transfer of knowledge through generations. Unfortunately, these new approaches to ceramic research have yet to fully find their way into Dutch development-led archaeology; whenever they are incorporated, it always concerns pilot studies on small numbers of sherds.

Establishing the source of the clay used in pottery production allows researchers to determine whether pottery was produced locally or not. As such, it is an excellent way to address a key question about prehistoric local communities, namely, to what degree they are

	Similarities	Dissimilarities
Mobility	Colonisation	
Exchange networks		Ceramolocal marriage system
Mode of production	Tradition	Little emblemic value

Fig 3.27 Interpretation of similarities and dissimilarities of pottery traditions between microregions (after Raemaekers 2008).

243 See fig. 7.135 in Fokkens, Steffens & Van As 2016, 198.
244 Raemaekers & Rooke 2006; Raemaekers 2008.
245 Raemaekers 2008.

Table 3.9 Correlation between density and average size of stone grit temper from Schipluiden.

		<1 mm	1 - 2 mm	> 2 mm	Totals
Schipluiden	< 15%	12,3	21,6	14,7	48,7
N = 2174	15 - 25%	5,2	10,5	10,6	26,3
	> 25%	8,8	7,1	9,1	25,0
	Totals	26,3	39,3	34,4	100,0

interwoven in regional and supra-regional networks. Small numbers of pottery sherds from the Hazendonk sites of Schipluiden (n=22) and Rijswijk-Ypenburg (n=10) have been analysed for diatom contents. For Schipluiden, the results make a strong argument for local production and extraction of coastal/estuarine clay near the surface in the majority of cases.[246] However, one sherd stands out by the exclusive presence of freshwater diatom species, which suggests that the pot was produced elsewhere.[247] The use of coastal/estuarine clay also shows in the diatom content of a sherd from Rijswijk-Ypenburg.[248] Interestingly, some pots there may have been made from the same clay as those from Schipluiden. Another example concerns diatom analysis of five Funnel Beaker and Vlaardingen sherds from Hazerswoude-Rijndijk. These belong to pots that were probably manufactured from local estuarine clay.[249]

For Knooppunt Hattemerbroek,[250] the analysis was based on geochemical (inductively coupled plasma-mass spectrometry [ICP-MS]) and diatom analysis of a limited numbers of sherds; as a result the results have limited interpretive power. A single Vlaardingen/Stein sherd – from the Hanzelijn section of this site complex[251] – was analysed. A total of 1.5% (n=4) of the TRB sherds from this site were analysed. For another location within the site complex, namely, the Bedrijventerrein section[252], the TRB sample is 0.9% (n=5). The authors conclude that all sherds were produced from local clay. Regrettably, this pilot study did not lead to the conclusion that a more substantial study needs to be carried out, if for no other reason than to verify sample representativeness. One might therefore ask whether such a pilot study is of any relevance. One might equally ask why such studies are not conducted more frequently in development-led projects.

The pottery production process

As a rule, the analysed reports provide a good overview of the pottery groups found, and describe technological, morphological and decorative characteristics. At the same time, the prehistoric potters behind the pots are absent from the reports. Questions concerning the production process are not addressed, despite the possibility of querying the databases (had these been available in DANS-EASY) generated for the report in order to obtain more and new information on this topic. In this section, we present one example concerning one stage in the production process: the tempering of clay. This phase of the process requires a potter to decide on the material to be used, the size of the temper particles and the density of the particles. All three choices must have been embedded within a system of knowledge transfer within and between generations of potters, in which normative behaviour is the rule. Had this not been the case, we wouldn't be able to recognise prehistoric pottery traditions at all.

The example presented here illustrates one aspect of this knowledge transfer system: the size and density of stone grit temper. Table 3.9 shows the correlation between the density and the average size of stone grit temper particles in pottery from the Hazendonk site of Schipluiden.[253] It indicates that the potters responsible for this assemblage had no strict ideas concerning density and particle size: the top score is 21.6%, some 10.5% above the expected score, even though all nine cells hold a similar proportion of the sherds. In itself, this table and these figures have no meaning, but when one compares the results with those from other sites or cultural groups, informative conclusions can be drawn. To this end, small numbers of TRB sherds from five megalithic tombs were studied (table 3.10). For these

246 De Wolf & Cleveringa 2006, 294.
247 De Wolf & Cleveringa 2006, 294.
248 Cremer 2008, 209.
249 Demiddele 2010, 236-253.
250 Brorsson 2011; Demiddele 2011.
251 Appendix II: PUBID 259.
252 Appendix II: PUBID 260.
253 Data based on Raemaekers & Rooke 2006.

Table 3.10 TRB sherds from 5 megalithic tombs.

Bronneger		**<1 mm**	**1 - 2 mm**	**> 2 mm**	**Totals**
N = 28	< 15%	50	25	4	79
	15 - 25%	0	4	11	14
	> 25%	0	4	4	7
	Totals	50	32	18	100

		<1 mm	**1 - 2 mm**	**> 2 mm**	**Totals**
Diever	< 15%	39	12	3	55
N = 33	15 - 25%	9	15	12	36
	> 25%	0	0	9	9
	Totals	48	27	24	100

		<1 mm	**1 - 2 mm**	**> 2 mm**	**Totals**
Havelte	< 15%	55	10	0	66
N = 29	15 - 25%	17	7	7	31
	> 25%	0	3	0	3
	Totals	72	21	7	100

		<1 mm	**1 - 2 mm**	**> 2 mm**	**Totals**
Odoorn	< 15%	48	10	0	58
N = 31	15 - 25%	13	10	6	29
	> 25%	0	6	6	13
	Totals	61	26	13	100

		<1 mm	**1 - 2 mm**	**> 2 mm**	**Totals**
Spier	< 15%	40	13	0	53
N = 30	15 - 25%	3	17	23	43
	> 25%	0	3	0	3
	Totals	43	33	23	99

tombs, it is clear that most stone grit-tempered sherds are characterised by a low density and small average particle size. Notwithstanding the possibility that the observed differences relate to more practical aspects of pottery production, two possible interpretations come to mind. First, the various TRB potters may have shared a notion on this aspect of the production process, indicating that technological knowledge was exchanged between the potters. Second, the difference in tempering strategies between Schipluiden and the TRB assemblages may indicate different pottery production rules for different socio-cultural backgrounds. Hence, data that are generally produced within the context of develop-led research potentially provide information on the social aspects of pottery production.

Ware analysis

The central role of pottery analysis in develop-led research is to provide relative dating, which aids the chronological anchoring of sites, features, structures and layers without the need for ^{14}C-dates. As such, ceramic analysis is a means, rather than a goal in itself, and therefore, not surprisingly, the chapters on ceramic finds in the examined reports are mostly descriptive in nature. Various aspects of the pottery (morphology, temper, colour, thickness, decoration, etc.) are presented, but one finds little discussion about the human behaviour that resulted in the observed patterning of the material. In our perception, however, variation or, indeed, absence of variation requires explanation in terms of behavioural alternatives.

The potential of this type of study can be illustrated using the ceramic variability at the Corded Ware site of Keinsmerbrug.[254] It concerns a settlement site with a few striking characteristics: 86% of the bones derive from birds – mostly ducks – and several wooden structures have a rather flimsy characterThese findings could easily have led to a final interpretation as a specialised campsite, where processing of fowl took place on several occasions.[255] The ceramic evidence, however, provides crucial information for an alternative interpretation of the site.[256] Whilst the number of sherds is very small (291 sherds >3 g), analysis showed that the potters used seven different tempering materials, in 14 different combinations. This finding added a new dimension to the initial, subsistence-oriented interpretation of the site, and has led to the proposition that Keinsmerbrug was a seasonally occupied site where groups with different backgrounds gathered to hunt for and feast on ducks. This example shows that insightful interpretations do not necessarily require new types of analysis (it involved the same standard description as conducted in all development-led studies), but, rather, more detailed analysis of the available data and discussion amongst the specialists involved.

Function

New knowledge on the prehistoric past can derive from incorporating not only new sites, but also new research methods. One of these research topics is that of the function of the pottery, which can be investigated by scanning electron microscopy (SEM) and chemical analysis, such as direct temperature-resolved mass spectrometry (DTMS). These techniques were applied in combination on seven TRB sherds selected for analysis from Knooppunt Hattemerbroek.[257] The analysis revealed the presence of both cooked plant remains and animal fats in some pots. Others yielded no evidence about their use. The results, however, have no clear relevance, because they are based on an extremely small sample (1.3%) of the available assemblage, they are not compared with results from any other site, and they are not incorporated into the synthesis of the project.

A more fruitful application of such analysis is demonstrated by results from Swifterbant-S3, where sherds from 25 unique vessels were sampled.[258] This analysis was based on the largest pottery fragments available, which allowed the researchers to seek correlations amongst the typological and technological characteristics and the results of the SEM and DTMS analyses. It became clear that the Swifterbant-S3 pottery can be divided into two subtypes. The first subtype is relatively thick walled, plant-tempered ware, which appeared to show no evidence of food containing emmer. The second subtype is relatively thin-walled, stone grit–tempered vessels showing evidence of food containing emmer (fig. 3.28). This suggests that particular types of pottery were used to prepare food that contained emmer, which in turn may have socio-cultural or ideological meaning. It is our impression that there is much to gain when this type of analysis is an integral part of an explicit research design, instead of an unrelated, small-scale sideline of interest only to a few specialists.

254 Beckerman 2015.
255 Nobles 2012; Zeiler & Brinkhuizen 2012.
256 Beckerman 2012.
257 Kubiak-Martens & Oudemans 2011.
258 Raemaekers *et al.* 2013.

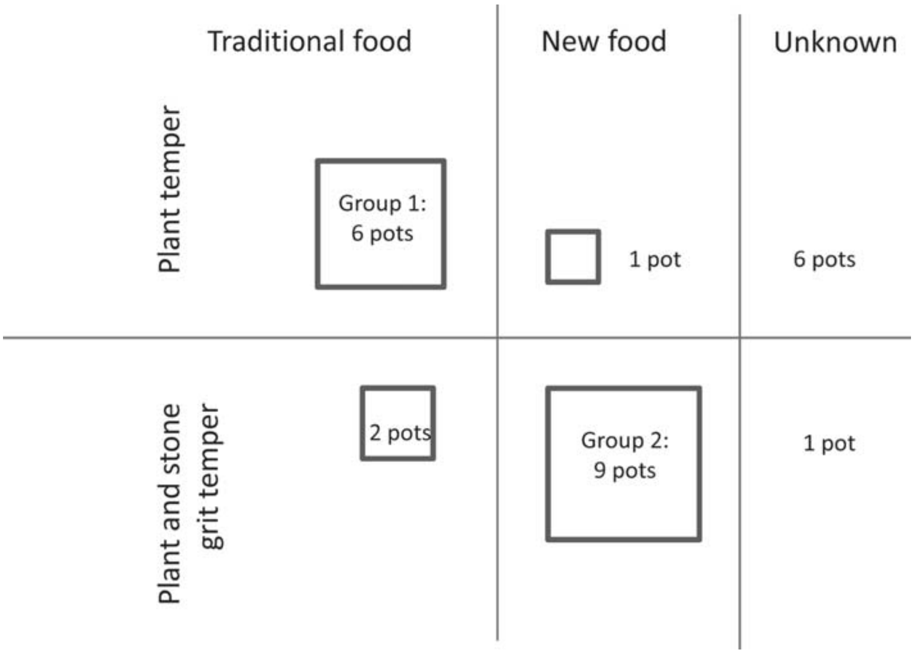


Fig 3.28 Ceramic ware and lipid analysis of Swifterbant pottery (from Raemaekers *et al.* 2013).

Concluding remarks

It is clear from the discussion above that development-led projects have made little contribution to the chronological aspects of ceramic typology and technology. This is partly due to the restricted size of assemblages: in many cases just a handful of sherds. However, 'few sherds' does not necessarily equal 'no information'. Admittedly, pottery fragments are often too small to extract morphologically and stylistically meaningful information, but archaeologists shouldn't dismiss the potential out of hand. When there is the possibility to obtain dates and contextualise assemblages, no matter how small, there is certainly potential to make some progress. The application of scientific techniques to gain information about clay sources, fabrics and functional aspects of pottery also have the potential to make a serious contribution – a potential that seems to be underestimated in development-led research. But it is not just scientific techniques that need to be used more often. Traditional approaches to fabric analysis, for instance, can provide valuable information; however, much of the work in a development context seems to end with data collection and does not progress to in-depth analysis.

4 People and space

4.1 Introduction

Space is an integral dimension of human life. Individuals move over shorter or longer distances on a daily, seasonal, annual or other cyclic basis, and for a variety of reasons. Through movement, individuals perceive their living space, consciously or unconsciously, from a range of potential perspectives, and within a specific cultural and ontological setting. Hence, space provides meaning to those who move through it; space is composed of zones and places connected by pathways or routes, inherently referring to multiple scales in space and time. This scale ranges from single spots where particular actions by single individuals take place at a particular moment in time, to vast landscape areas used by multiple groups in different ways over a period of years. These scales represent a complex interplay of behaviours, which has resulted in the initial and continuous formation of the archaeological record. And this record has subsequently undergone further, post-depositional transformations.

At a landscape scale, the cultural dimension of space is echoed by the interrelationships between meaningful places and zones. Cyclic movement and the diversity of locational use by people create a spatial structure, which, from an archaeological perspective, is not easily understood. In contexts of frequent residential and/or logistical movement of people, a landscape becomes scattered with debris of which the 'exact' age is rarely established. Consequently, lack of chronological resolution induces 'time collapse', which makes it almost impossible to identify systemic contemporaneity amongst traces of activity at the local scale.[259] In contexts of limited (or absent) residential and/or logistical movement, the archaeological footprint will likely be scatters of debris reflecting the cumulative outcome of activity at places in the landscape. Nonetheless, contemporaneity of spatially separated phenomena at the local scale will again be difficult to prove. This is not to say that topics like 'settlement systems' or 'mobility systems' cannot be seriously addressed archaeologically. If people's spatial behaviour at a landscape scale was repeated over generations, at least some identifiable patterning should show in the archaeological record. The same can be expected for what people did at particular locations.

Although broader issues of landscape-scale behaviour in early prehistory may be difficult to grasp, particularly in the context of development-led archaeology, one aspect deserves attention here. As outlined in section 3.2, the identification of raw materials – lithics in particular – has received relatively much attention. To some extent, work over the past 15 years has yielded data that permit us to draw some further inferences about raw material sources and mobility.[260] Next, we will address different aspects of the use of space at the local scale or site level, notably, the understanding of finds scatters and the identification of built structures.

4.2 Lithic resources in the landscape and mobility

Whereas distance to raw material sources combined with materiality permits archaeologists to develop hypotheses about social interaction, distance to raw material sources combined with technology permits us to draw inferences about transportation of materials and mobility. Assemblages exclusively composed of raw materials from locally available sources – that is, within the home range – likely reflect different strategies of resource exploitation and mobility than do assemblages that (also) contain raw materials originating from distant sources. The latter category of raw materials is commonly labelled 'exotic'.

Although raw material sourcing is conceptually straight forward, in many cases it is problematic or even impossible to establish whether a raw material was acquired locally or at a distant source and transported (see section 3.2.1). The Netherlands has a complex geology and should first of all be considered a sediment basin. Cycles of glacial and interglacial conditions throughout the Quaternary have resulted in far-reaching processes of erosion and sedimentation that, in turn, have led to continuous geomorphological reshaping and geographical transformation. Major rivers – the

259 Bailey 2007; Holdaway & Wandsnider 2008; Rossignol & Wandsnider 1992.

260 Another aspect concerns Mesolithic pit hearths, but this topic will be discussed in section 5.2.2.

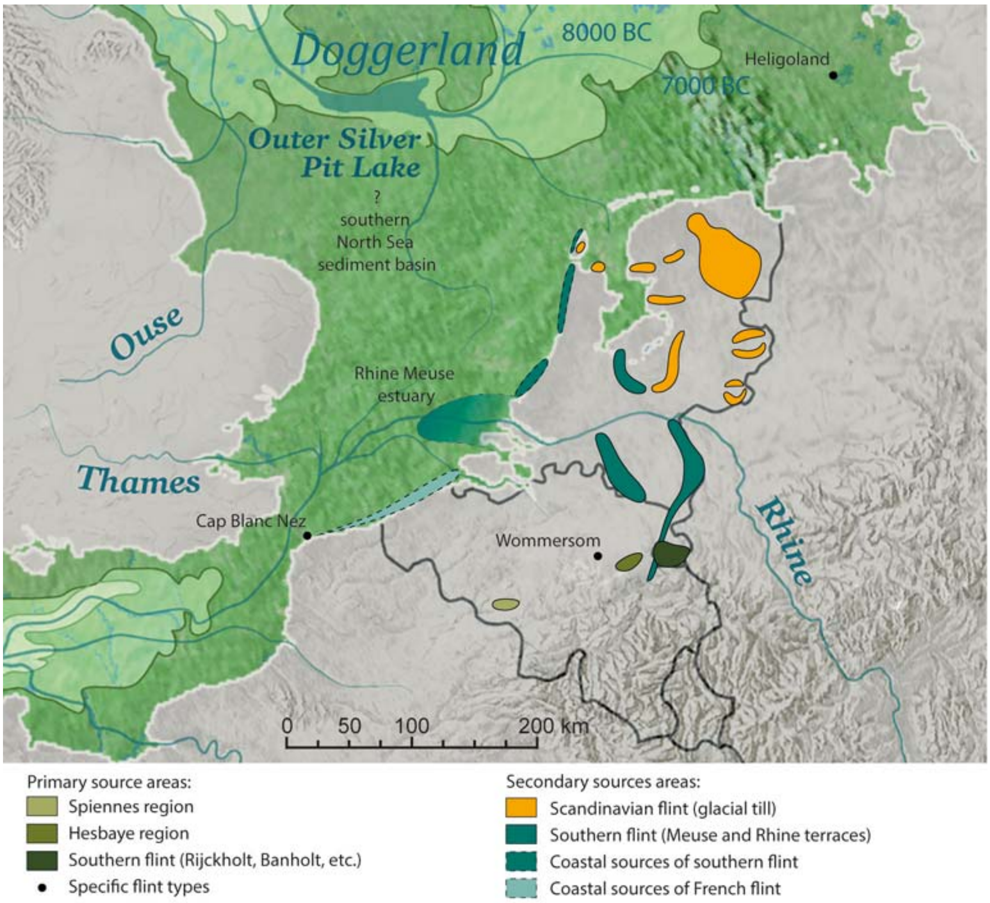


Fig 4.1 Geographical distributions of primary and secondary flint source areas in and close to the Netherlands that are (potential) sources of raw materials for the production of tools during the Late Palaeolithic through Middle Neolithic. Source areas of Scandinavian flint in northern Germany and southern Scandinavia are not indicated. The background map shows the situation of the source areas relative to the southern North Sea basin, which acted as a large sediment basin and which was accessible during the Late Glacial and Early Holocene (referred to as Doggerland). Flint and other lithic resources that were transported by rivers surrounding the basin accumulated in Doggerland. It is unknown to what extent potential source areas in this basin were exploited (map reproduced with permission of National Geographic).

Rhine, Meuse and vanished Eridanos systems – transported vast quantities of rock (e.g. flint, quartz, quartzite, sandstone) from their primary sources far inland and deposited thick layers of coarse sediment in the basin. Glaciers moving in from the north picked up rocks (e.g. flint, granite, quartz) in Scandinavia, which were left in moraine deposits in the northern half of the Netherlands. All these rocks could be found as gravel and boulders in secondary position in the landscape. Primary sources of flint are only encountered in the south-eastern part of the Netherlands, notably in the southern part of Limburg, where flint of the Rijckholt type is found. However, due to erosion, flint nodules have been transported by the Meuse River over a distance exceeding 250-300 km.

When considering the exploitation of lithic resources, it is important to bear in mind that the present-day geography is not representative for the prehistoric situation, which saw continuous change, e.g. in connection with sea level fluctuations. The availability of lithic raw materials was very different, and the North Sea basin may have been important for the alluvial accumulation of nodules from various parts of the surrounding areas (fig. 4.1). Primary outcrops could be found along the British, French and northern Danish coasts, as well as in the German Bight. Hence, the primary flint sources in the south-eastern part of the Netherlands and adjacent parts of Belgium are simply amongst the closest accessible for early prehistoric people living in what today we call the Netherlands. Whether these sources were actually exploited throughout early prehistory is, however, another matter.

Below we will take a closer look at some results that can be drawn from development-led research. The purpose is not only to demonstrate to what extent the sourcing of raw materials adds to our knowledge about regional-scale spatial behaviour, but also to identify some major problems.

4.2.1 Late Palaeolithic long-distance transport

One notable contribution of development-led research to our insight into long-distance transport of flint concerns the Late Palaeolithic Hamburgian. People of the Hamburgian were the first to colonise the landscape north of the Rhine after the Last Glacial Maximum (LGM) – which ended about 20,000 years ago. The Hamburgian is considered to represent a technological tradition rooted in the Late Magdalenian.[261] The sites attributed to the Hamburgian on the ice-pushed ridges of the Veluwe (central Netherlands) represent the southernmost extent of this tradition. Here, both narrow-spectrum and broad-spectrum assemblages have been found, suggesting inter-site functional differentiation.[262] During rescue excavations near Deventer (Epse-Olthof), at the same latitude but east of the Veluwe, Hamburgian artefacts were found on a sandy ridge bordering a palaeochannel.[263] Although the original context of this material appears to have been disturbed by Mesolithic and later activity, the composition of the assemblage suggest the artefacts to represent the remains of one or more short-lived encampments, possibly hunting stands.[264] The Epse-Olthof site thus extends the limit of the Hamburgian territory.

One striking characteristic of many Hamburgian lithic assemblages in the Netherlands is the use of high-quality, fine-grained flint of northern (i.e. Scandinavian) origin. Despite the fact that nodules of mediocre quality – showing frost cracking – and small were frequently, there seems to have been some selection as well. High-quality, often transparent, flint was used for the production of long and regular blades, which were modified into a range of tools (points, scrapers, burins, *Zinken*), e.g. at Epse-Olthof.[265] Sometimes, assemblages contain only end-products and/or large blades made of such high-quality flint, in addition to lesser quality flint, e.g. at Stroe.[266] In other cases there is also production waste resulting from the knapping of high-quality flint, e.g. at Meerveld and Epse-Olthof.[267] Such differences suggest that nodules, cores, half-products and finished tools were carried around, and that waste was left at various spots in the landscape.

As yet, it is uncertain where high-quality flint was acquired. Flint of Scandinavian origin occurs in substantial quantities in moraine deposits in the northern half of the Netherlands, but mostly nodules are rather small and of poor to mediocre quality.[268] Large nodules of high-quality flint are rare. The Epse-Olthof assemblage also contains high-quality flint (fig. 4.2), and waste indicates on-the-spot production of blades, as well as maintenance and use of tools. Amongst the flint categories was red Heligoland. This particular type of flint is only known to occur on the nowadays heavily eroded island of Heligoland, in the German Bight, at a distance of c.250 km as the crow flies from Epse-Olthof. A small number of blade fragments and small chips that could almost all be refitted into a single unit provide clear evidence for on-the-spot knapping. However, most of the nodule seems to have been worked elsewhere, whilst the core was not been abandoned at this location either (at least not within the extent of the excavated area). This means that a nodule of red Heligoland flint was transported at least 250 km (in reality this will have been much farther, considering the fact that people do not travel in straight lines) and that only some fragments of that nodule were left at Epse-Olthof.

In consideration of the Hamburgian being a tradition within the Late Magdalenian, which is represented in the southern part of the Netherlands, the fact that people travelled over such a distance is in itself not surprising. Comparable distances have been recorded for the Magdalenian.[269] Apparently, groups of the Magdalenian and Hamburgian people travelled over long distances, probably in a cycle of

261 Barton *et al.* 2003; Weber 2012.
262 Rensink & De Kort 2012, 2013; Peeters & Rensink in prep.
263 Appendix II: PUBID 733.
264 Hoebe 2015; Peeters & Rensink in prep.
265 Peeters *et al.* 2015.
266 Rensink & De Kort 2012.
267 Rensink & De Kort 2013; Hoebe 2015.
268 Beuker 2010.
269 Terberger *et al.* 2013.

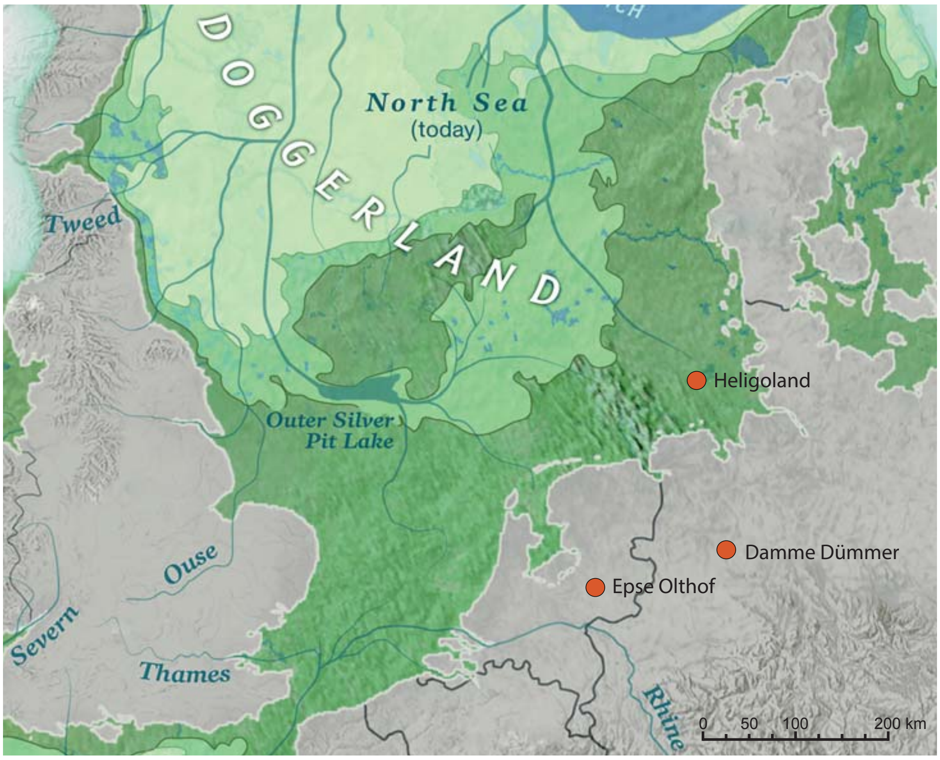


Fig 4.2 Geographical locations of Epse-Olthof and Damme Dümmer relative to Heligoland.

winter–summer residential mobility. As humble as the Epse-Olthof find may appear – after all, we only have a handful of waste – the conclusions we can draw from it are far-reaching. Apart from an isolated core from the site of Damme-Dümer (Germany; fig. 4.2),[270] it is the only evidence we have for the use of flint coming from Heligoland; we have no indications for any particular selection on this type of flint. Bearing in mind the sparseness of information about source areas, this in itself suggests that the remarkable red flint did not have any particular connotation for the people of the Hamburgian, unlike what has been suggested for the use of this type of flint in the Neolithic.[271]

More importantly, it shows that Heligoland represented a source within the territorial range where high-quality flint could be acquired. Heligoland also is a source for a grey–brown type of flint that is known to have been exploited in late prehistoric times (Late Neolithic, Bronze Age) for the production of bifacial daggers and sickle blades.[272] As yet, we do not know whether this variety of flint was also used by Hamburgian people. However, Heligoland is located relatively close (c.100 km) to the moraine outcrops in Schleswig-Holstein and adjacent parts of Denmark. These moraine deposits are rich in voluminous nodules of in high-quality Scandinavian flint. From this perspective, it may very well be possible that the high-quality flint that occurs in Hamburgian assemblages in the Netherlands was in fact acquired in this region. On the other hand, high-quality nodules could also have been collected from glacial till in the northern Netherlands, since the quality of flint from glacial till is generally better than that from boulder sand (residual deposit of eroded till). Hence, the handful of 'remarkable' waste from Epse-Olthof has led to fresh insights and opened new lines of investigation.[273]

270 Fries & Veil 2014.
271 Van Gijn & Raemaekers 2014. The cliffs of red-stained chalk containing the flint may, nonetheless, have had some special significance in this otherwise rather flat, undulating landscape. It is, however, not clear what the situation was during the time of the Hamburgian habitation; there may not have been any cliffs at all.
272 Beuker 2010; Van Gijn 2010; Beuker & Drenth 2014.
273 It should be noted that the identification of the red Heligoland flint was a coincidence. The excavator, first, was not aware that he had discovered Hamburgian artefacts, and, second, was not certain about the identification of the red-coloured flint. On the basis of photographs, the Hamburgian diagnosis was established by Dr. J.H.M. Peeters. Once the artefacts could be studied, the cultural affiliation was confirmed, whilst the possibility of the artefacts being made on red Heligoland flint was deemed probable. Confirmation came from flint experts Harm Paulsen (Schleswig, Germany) and Jaap Beuker (Assen, the Netherlands) at a later stage.

4.2.2 The Wommersom distance-decay distribution

A characteristic raw material used by Mesolithic hunter-gatherers in the southern part of the Netherlands and adjacent parts of Belgium, and continuing into northern France, is Wommersom quartzite.[274] This relatively fine-grained rock originates from a natural outcrop near the village of Wommersom, close to Tienen, in Belgium.[275] Its knapping qualities are comparable to that of good-quality flint, and it is perfectly suitable for the production of regular blades. Indeed, such blades, as well as trapezoid points made out of such blades and feuille de gui surface-retouched points, are often knapped from Wommersom quartzite.[276] It was first noted in the 1980s that Wommersom quartzite shows a clear geographical distribution pattern, roughly delimited by the Rhine in the north and east, the Scheldt in the west, the present-day French–Belgian border in the south, and the Ardennes in the south-east (fig. 4.3).[277] North of the Rhine, sporadic finds of Wommersom quartzite have been reported.[278] In quantitative terms, the overall distribution seems to be best described by a distance-decay curve, where the frequency of occurrence and quantity of material decreases as the distance from the source area increases. In view of the co-occurrence of feuille de gui points and stylistic aspects of trapeze-shaped points, it has been suggested that the distribution pattern possibly corresponds to a territory, and hence has social significance.[279]

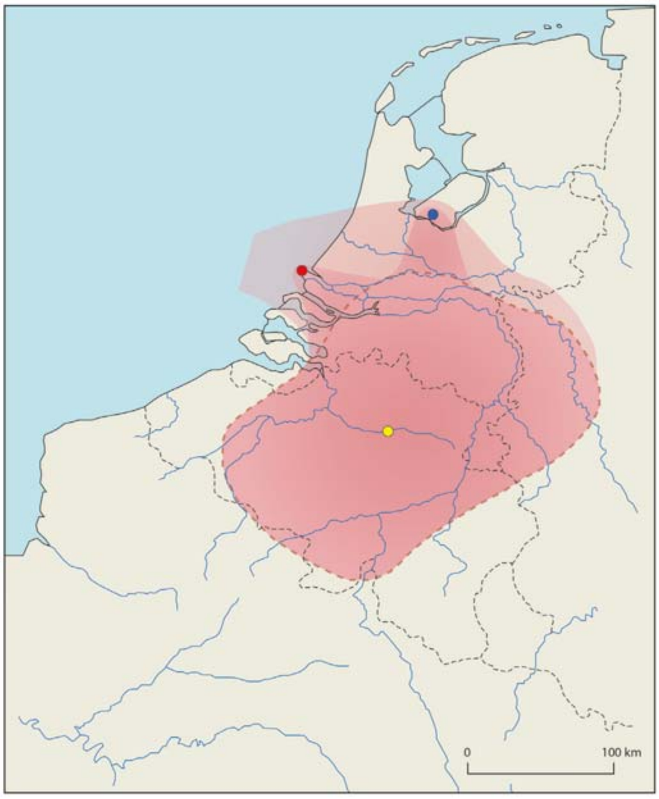


Fig 4.3 Geographical distribution of Wommersom quartzite (source location indicated by the yellow dot) during the Mesolithic. The extensions outside the dashed polygon are based on the finds of incidental pieces of Wommersom quartzite at the sites of Rotterdam-Yangtze Harbour (red dot) and Hoge Vaart-A27 (blue dot). The light pink shading represents a possible further extension of the distribution of this resource (from appendix II: PUBID 462a).

Wommersom quartzite offers an interesting case study for raw material distribution patterns in the Netherlands and surrounding areas. This type of rock is relatively easy to identify, and only one source is known where it could have been collected by Mesolithic hunter-gatherers in quantity. Other lithic raw materials, such as Rijckholt flint and various types of Scandinavian flint, do not share these advantageous properties, since these flint varieties can originate from multiple primary and secondary sources, spread over wide areas. Consequently, these can barely be mapped in a useful way, if at all. The social interpretation of the geographical distribution of Wommersom quartzite on archaeological sites is also not without problems.[280] It is possible that the distance-decay pattern is also inherent to 'average' distributions of other lithic raw materials, but which are impossible to map in the absence of 'unique' sources and mutually exclusive properties. Theoretically, it is possible that the 'reality' consists of a continuous spread of overlapping distributions, making Wommersom just one of the components. Furthermore, we are looking at a palimpsest distribution at a landscape scale – the outcome of several millennia of deposition and accumulation, instead of a 'discrete' spatio-temporal phenomenon.

Despite these problems, it is worthwhile to investigate the distribution of Wommersom quartzite from the perspective of transportation

274 Also known as *grès quartzite de Wommersom (GQW)*.
275 Cnudde *et al.* 2013.
276 Cf. Amkreutz 2013.
277 Gendel 1984, 1989; Van Oorsouw 1993.
278 Peeters *et al.* 2001.
279 Gendel 1984, 1989.
280 Peeters 2007, 198; Peeters & Niekus 2005, 226 (footnote 30).

of raw materials or tools made out of specific raw materials. If the distribution pattern reflects an 'averaged' spreading of a systematically used raw material over the course of the Mesolithic, then the Wommersom case helps us to gain insight into mechanisms of dispersion. Reports resulting from development-led work make little mention of Wommersom quartzite. It is not clear to what extent this is a consequence of expertise in identifying lithic raw materials. Most sites where it has been identified are located in the provinces of Noord-Brabant and Limburg (e.g. Borgharen Site 8, Susteren-Aardenweg, Deurne-Groot Bottelsche Akker and Casteren). All are located well within the geographical extent indicated above. The proportion of Wommersom quartzite in assemblages counting more than 100 artefacts is variable, ranging between 0.3% (Borgharen) and 20% (Casteren). The site of Casteren probably represents a short-lived special purpose encampment where Wommersom quartzite was used as a raw material for blades. Montbani blades are made exclusively on Wommersom quartzite. Several other development-led projects (Keersop-Deelgebied II, Tungelroyse Beek, Sevenum-Gelderdijk, Ekkersrijt, Middegaal, Holtum-Noord II) have produced stray finds of Wommersom quartzite.

Most notable are incidental finds of Wommersom quartzite in the assemblages from Rotterdam-Yangtze Harbour, Rotterdam-Beverwaard and Ede-Kernhem, which are located at the geographical fringe of the distribution. The Rotterdam sites represent the most westerly occurrences known at present. In the case of Rotterdam-Beverwaard, three out of four artefacts on Wommersom quartzite are leaf-shaped points, whilst the fourth is probably a fragment of such a point. Importantly, three of these come from three pits that contained cremated human and animal bone (also see section 3.3.2), and for which a Middle Mesolithic age could be established through radiocarbon dating.[281] Another pit with cremated human bone also contained a leaf-shaped point, yet made out of flint, and it is dated in the Late Mesolithic.[282] The specific context of the Rotterdam-Yangtze Harbour Wommersom finds (a blade fragment and a burnt flake) is not known since the site is underwater and could not be investigated with much precision, but the finds are of Early or Middle Mesolithic age based on the site's geology.[283] At Ede-Kernhem, the great majority of the assemblage dates to the Early Mesolithic, and only one piece of Wommersom quartzite (a point) was found.[284] One other 'geographical outlier' of Wommersom quartzite remains uncertain with regard to its identification (Rotterdam-Groenenhagen), and another has been rejected (Schoonebeek) by one of us (M.J.L.T. Niekus).

From this overview of Wommerson quartz finds, it can be concluded that results of development-led excavations have not produced a radically new picture. Instead they confirm the general distribution map. Nonetheless, it is important to note the presence of Wommersom quartzite in the Rotterdam region.[285] During the Early and Middle Mesolithic, the stream valleys of the Rhine-Meuse system and the Scheldt joined just west of the Yangtze Harbour (on what is known as the Maasvlakte, Rotterdam), and eventually formed a vast estuary (fig. 4.4).[286] The river Scheldt and its tributaries connected inland parts of the Flanders sandy plain as far as the source area of Wommersom quartzite, notably via the Rupel-Dijle-Gete system. These rivers or steam valleys possibly served as routes along which people travelled and carried various raw materials in a north-westerly direction.[287] If water routes were important to the Mesolithic 'infrastructure', then the Scheldt system possibly played a key role in relation to Wommersom quartzite, as the great majority of smaller rivers in this area drain into the Scheldt. Smaller rivers in the south of the Netherlands drain into the Meuse; in fact the watershed separating the Scheldt and Meuse drainage systems is located just south of the Dutch–Belgian border. However, we must bear in mind that many tributaries of both rivers originate more or less in the same area, which would have made it easy to cross from one system to another. Clearly, none of these smaller rivers permitted waterborne transport in the source area. Hence, much transport will have been overland in the upstream areas, whilst waterborne transport may have been farther downstream.

281 8465 ± 45 BP; 8435 ± 40 BP; 8135 ± 45 BP (all on cremated bone; Niekus *et al.* 2016).
282 6770 ± 40 BP (on cremated bone; Niekus *et al.* 2016).
283 Vos & Cohen 2015.
284 Devriendt 2015.
285 Note that the Rotterdam is one of the most westerly areas where Mesolithic and Early Neolithic sites are found close to the present-day surface and can, therefore, be investigated. Hence, the site distribution does not represent prehistoric reality.
286 Vos & Cohen 2015.
287 Peeters *et al.* 2015.

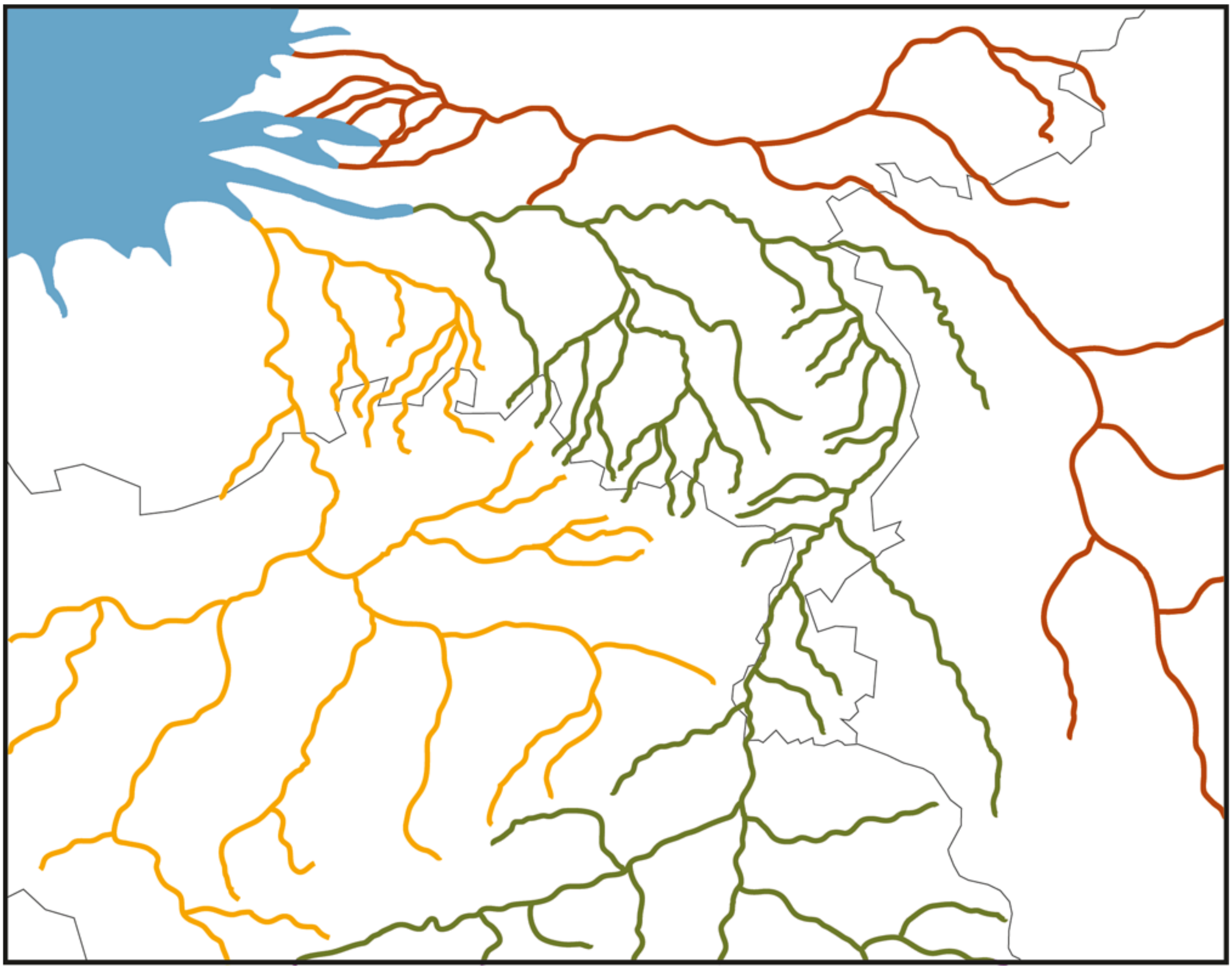


Fig 4.4 Simplified map of the Rhine-Meuse-Scheldt drainage system in the Netherlands and adjacent parts of Belgium and Germany between 6500-6000 cal. BC. Brown: Rhine system; green: Meuse system; orange: Scheldt system; blue: open sea and main estuaries (based on Kiden 2006; Vos 2015).

4.2.3 Newly 'identified' and 'ghost' raw material sources

Traditionally, reports resulting from development-led archaeology list a rather restricted range of lithic raw materials, generalised under such labels as 'Rijckholt', 'Meuse flint', 'terrace flint', 'bryozoa flint', 'Scandinavian flint' or 'northern flint' (fig. 4.5). The lack of more specific assignments is partly due to the materials themselves, as many varieties of flint show quite a number of similarities, as well as differences. This is particularly true for varieties in the 'Rijckholt family' to which Lanaye (i.e. Rijckholt), Banholt, Lousberg and Rullen flint belong. Similarly, the distinction between Rijckholt, Banholt, Spiennes (Belgium) and 'Belgian grey' can be problematic for the untrained eye. The variable experience of lithic analysts in the identification of raw materials may, in fact, be the most important reason. Few are familiar with the broad range of flint varieties, and even fewer are able to actually distinguish between them. As a consequence,

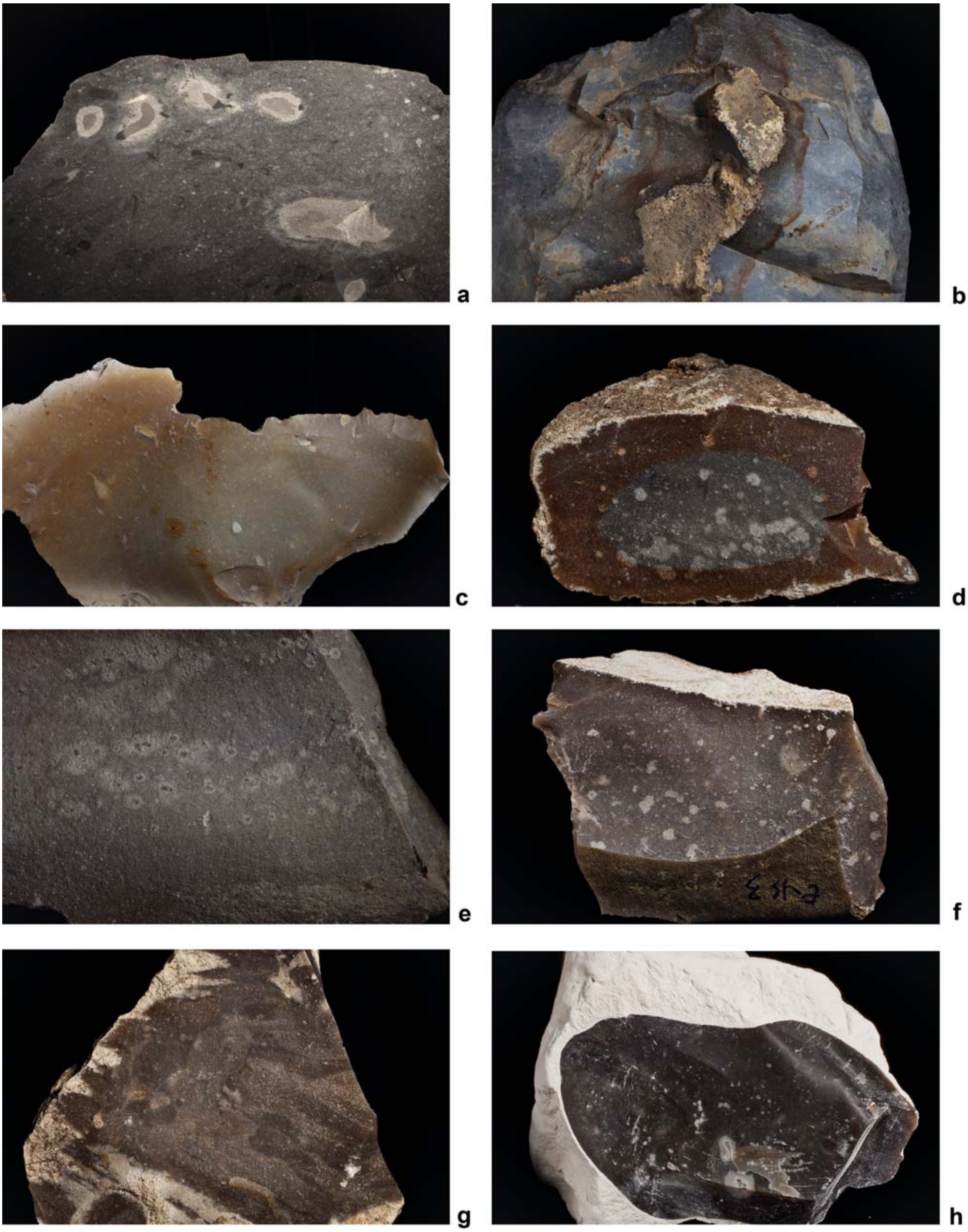


Fig 4.5 Flint varieties encountered in early prehistoric contexts in the Netherlands: (a) Lanaye, (b) Banholt, (c) Rullen, (d) Lousberg, (e) Valkenburg, (f) Simpelveld, (g) Vetschau, (h) Obourg.

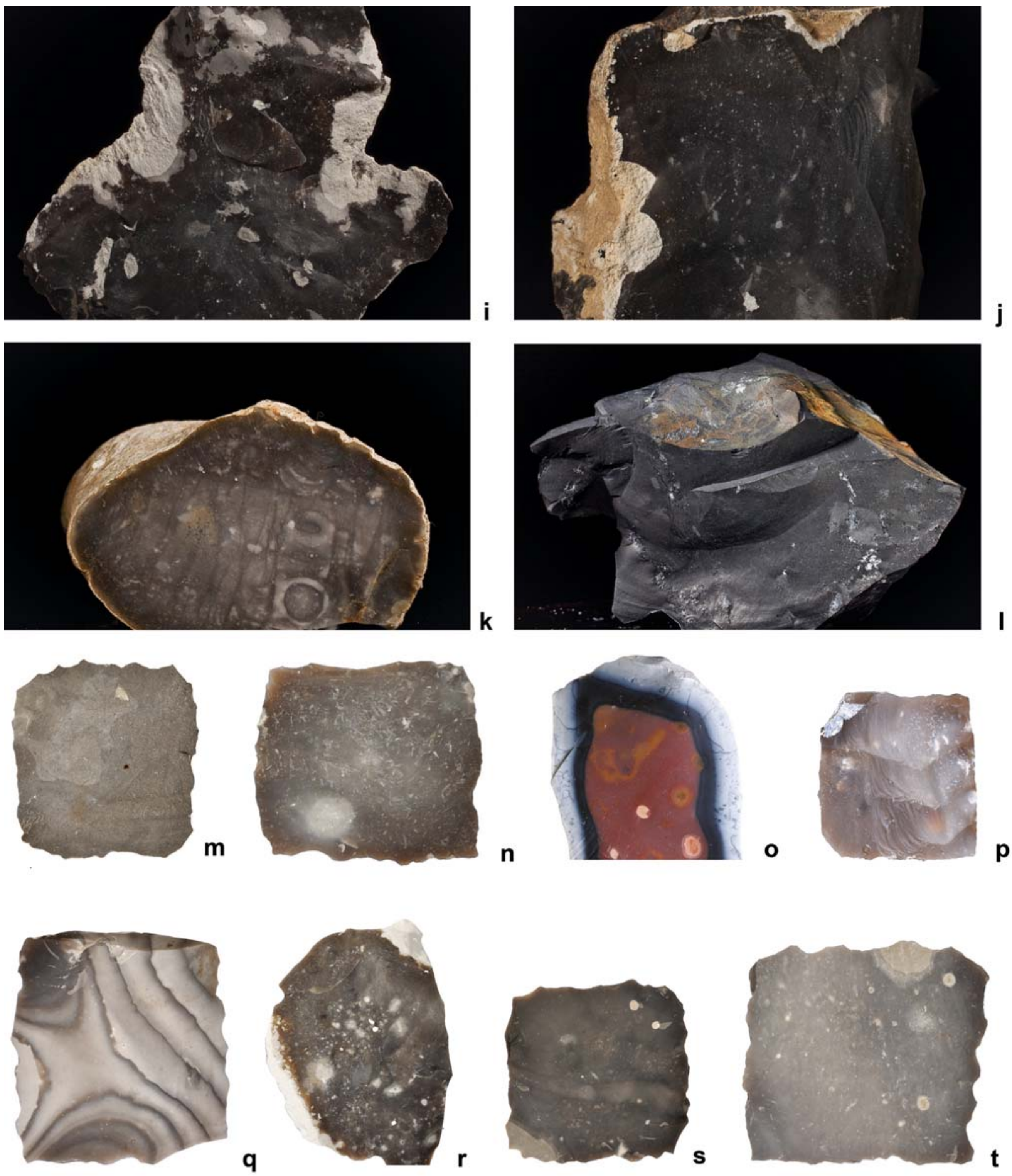


Fig 4.5 Continued: (i) Orsbach, (j) Lixhe, (k) Hasbaye, (l) Ottignies phtanite, (m) Dan flint, (n) Scandinavian bryozoa flint, (o) red Heligoland flint, (p) tabular (grey-brownish) Heligoland flint, (q) Falster flint, (r) speckled Senonian flint, (s, t) Scandinavian Senonian flint (a-l: photos by T. Penders, reference collection of Dr M. de Grooth; m-t: photos by J. Beuker).

results of development-led 'specialist analyses' are difficult to compare and do not permit researchers to draw reliable conclusions with regard to the use of raw material sources during early prehistory. However, we will take a look at some specific aspects regarding the identification of lithic raw materials of which the source had not previously been identified. In addition, we will consider some 'ghost' materials: raw materials of which the source has not been identified, but actually could be identified.

One variety that makes a first appearance in some reports reviewed for this study is so-called Cap Blanc Nez flint, a fine-grained, somewhat translucent blackish to dark grey–coloured flint that is frequently mottled with lighter inclusions (fig. 4.6).[288] Nodules consist of rounded, ovoid pebbles with a pounded outer surface and bluish to greyish colour. A pounded outer surface is characteristic of flint nodules exposed to rolling in the intertidal zone. As the flint bears some similarity to material that is eroding out of the coastal cliffs at Cap Blanc Nez near Calais (France) it is now designated to that source, despite the fact that no analytical data (microscopic; chemical) exist to confirm this origin. The pebbles may have been transported over large distance by sea currents – perhaps, as some have suggested, as far as the Belgian province of Zeeland[289] – which makes it impossible to determine where the material was collected. As yet, this type of flint has only been reported from the Hazendonk sites of Schipluiden and Rijswijk-Ypenburg.[290] It is, however, possible that this raw material is confined to Neolithic coastal sites, as it is also known from Belgian near-coast contexts.[291] The question whether it might be represented in assemblages from other periods and sites cannot be answered, as its identification seems to be connected with the few researchers who are familiar with this variety of flint, at least for the time being.

What about 'ghost' sources? At Knooppunt Hattemerbroek, two unidentified types of flint were reported for several contexts, dating to (possibly) the Late Palaeolithic (Context 2.08 and 3.03) and Early Mesolithic (Context 6.12); this range of dates may point to a chronologically connected exploitation of those varieties.[292] The first unidentified variety is described as a fine-grained light to dark beige flint with bryozoa and incidental inclusions (fig. 4.7).[293] The material can be considered to be Scandinavian bryozoa flint,[294] which can be found in glacial moraine deposits in the northern Netherlands. The second unidentified variety is described as a fine-grained, multicoloured banded flint; colour bands are different shades of grey, sometimes with a beige to light brown tone.[295] The pronounced bands vary in width and are pinkish to purplish in colour when burnt. Based on the published photos, we consider it almost certain that this material is actually Senonian Falster flint, a variety that has its primary origin in Denmark (Falster, Lolland and southern Zealand) but can be found in secondary position on beaches and in glacial moraine deposits.[296] Small nodules of mediocre to poor quality can be found in the northern Netherlands where Saalian till is encountered near the surface. Whether or not the material from Knooppunt Hattemerbroek comes from sources in the Netherlands is impossible to say on the basis of the published information. Likewise, it is impossible to say that it comes from sources closer to the primary occurrences in Denmark. However, in the context of the Late Palaeolithic, it is far from excluded that materials originated from distant sources, as we have seen with regard to the use and transport of red Heligoland flint by Hamburgian hunter-gatherers. If this was also the case for the Falster flint, it urges us to think differently about regional-scale use of space and mobility.

288 Houkes 2008; Van Gijn & Houkes 2006.
289 Van Gijn & Houkes 2006, 133.
290 Houkes 2008; Van Gijn & Houkes 2006.
291 Van Gijn & Houkes (2006, 133; pers. comm. P. Crombé) refer to the site of Doel, near Antwerp.
292 Verbaas *et al.* 2011, 339, 342, 344, 349, 357, 365.
293 Verbaas *et al.* 2011, 343.
294 Source assignment based on a published photo (Verbaas *et al.* 2011, 341, fig. 7.1).
295 The colour description is based on published photos (Verbaas *et al.* 2011, 341, fig. 7.1).
296 Högberg & Olausson 2007, 96-99.

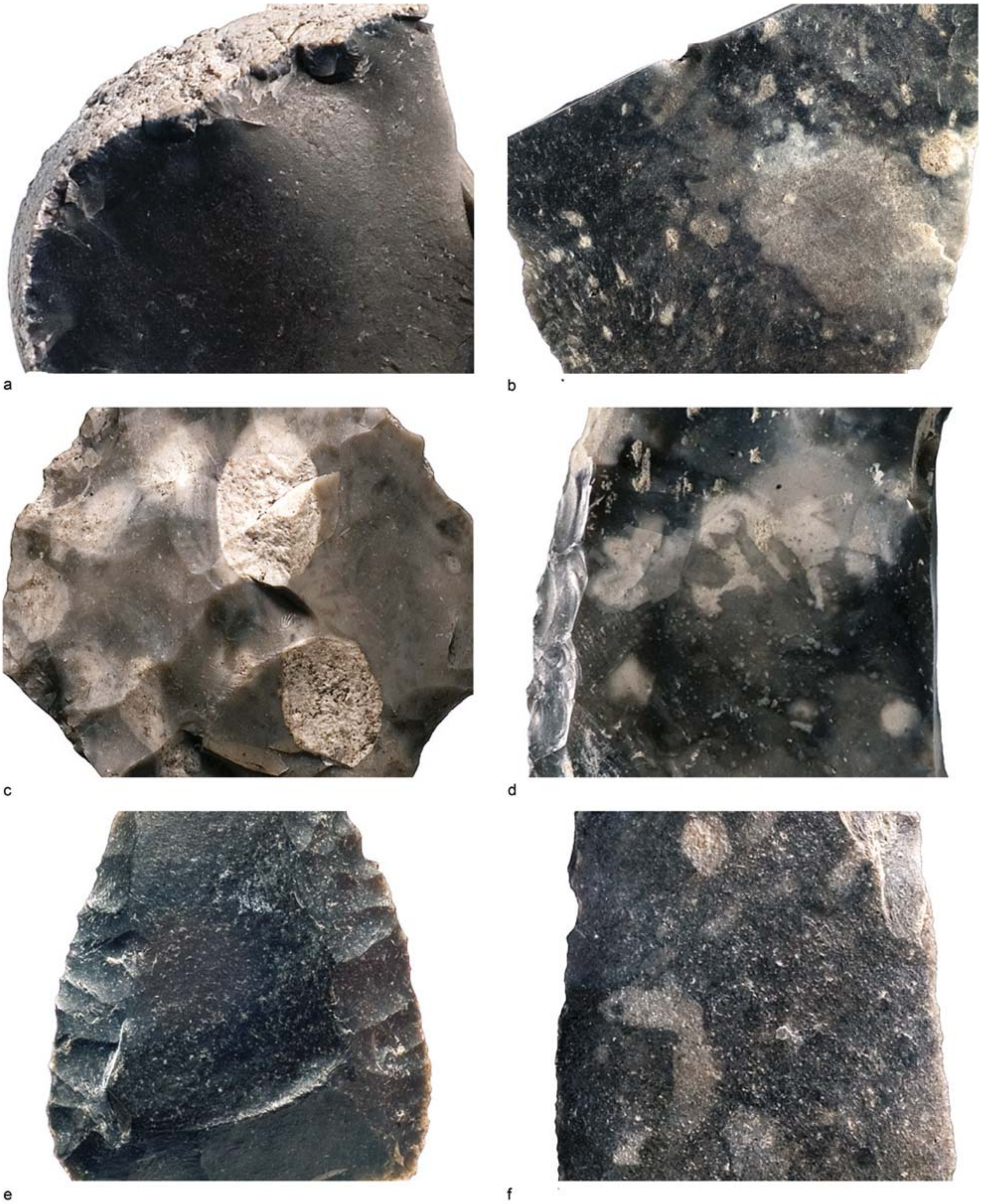


Fig 4.6 Flint varieties identified at Schipluiden. a: rolled pebble; b: Cap Blanc Nez; c: Belgian flint (Hesbaye?); d: mottled greyish flint, probably Belgian, with waxy texture; e: relatively coarse-grained black flint; f: grey flint from Spiennes or possibly Rijckholt (from appendix II: PUBID 732).

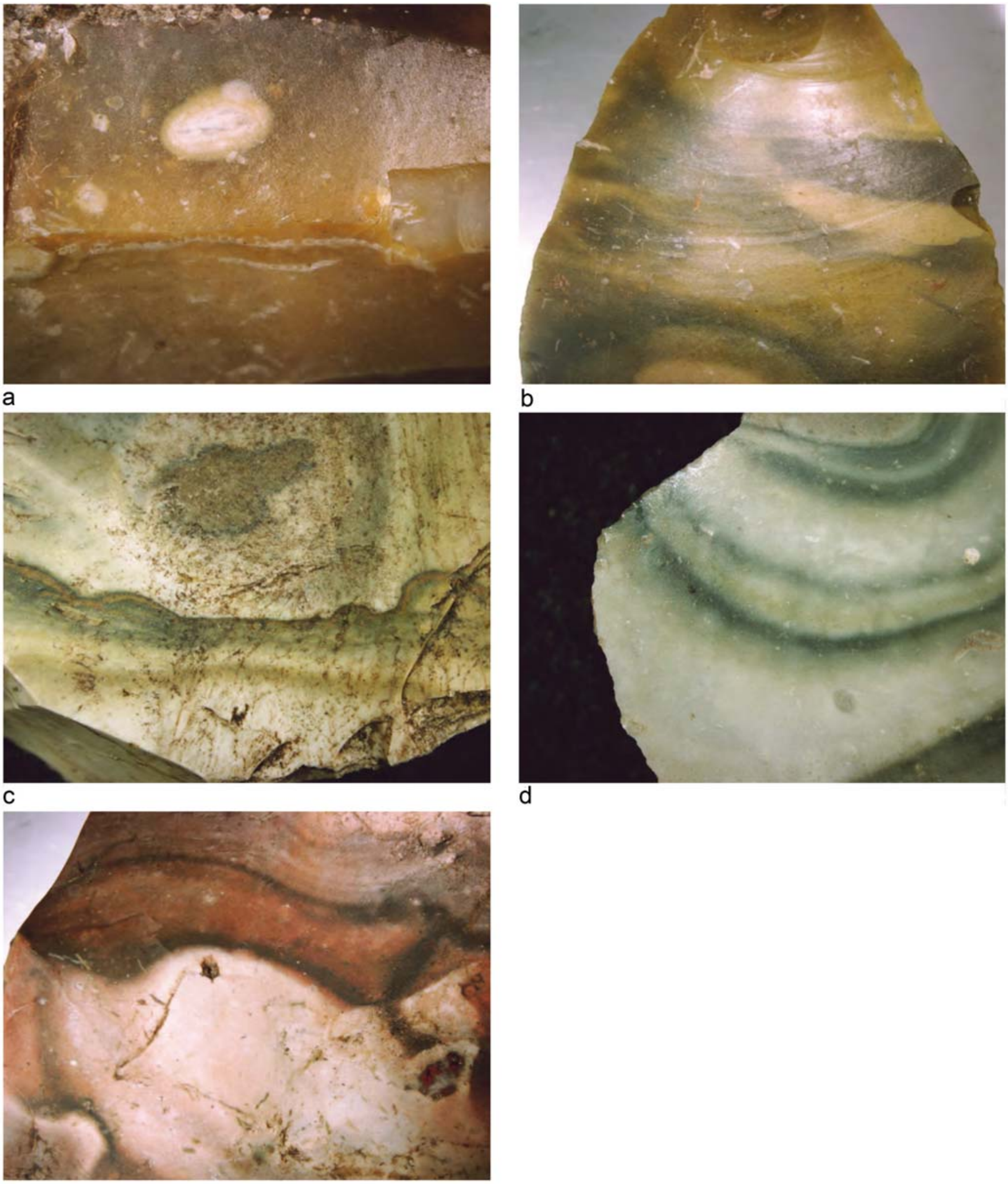


Fig 4.7 'Unidentified' flint varieties from Knooppunt Hattemerbroek. The variety in photo a may be Scandinavian bryozoa flint; the variety in photos b-e can be identified as Falster flint (from appendix II: PUBID 259).

4.3 Place and space

It is evident that archaeological questions about the use of space are not confined to the landscape scale. Because the great majority of fieldwork is focussed on 'sites', which are defined in terms of concentrations of material remains of human activity and anthropogenic soil features, most questions are related to the use of space at the site scale.[297] Typically, spatial analysis of scatters of debris and features aims at the identification of dwelling structures or other built structures, and to define activity areas or special purpose areas. It is about the organisation of space, and, in the ultimate situation, analysis should enable us to describe what people – even individuals – at some moment in time did within the spatially constrained window of the excavation, a snapshot of the past. Clearly, nowadays archaeologists are perfectly aware of the fact that this is not an easy task and, indeed, in the majority of cases an impossible one. Repeated use of locations or particular landscape zones has led to the merging of scatters of material remains and features, as well as accumulation and mixing. The resulting palimpsests require being unravelled to make them understandable in terms of spatially and temporally 'discrete' entities, which can subsequently be interpreted in terms of behaviour. Due to the fact that 'archaeological time' differs from 'ethnographic time', owing to the rather limited chronological resolution of the archaeological record, this goal remains the unreachable Holy Grail.

This problem has led many archaeologists to believe that palimpsests cause nothing but trouble when it comes to the 'reconstruction' of spatial behaviour, and all the more so for periods during which people had the habit of building dwelling structures that left few recognizable traces in the archaeological record. Yet, palimpsests probably form the overwhelming majority of contexts excavated in development-led archaeology, simply because these have a better chance of being found during surveys due to their relatively high density of artefacts. And it is this high finds density that is often used as an argument in favour of excavation: the investment in time and money is valued in terms of the number of boxes of finds that the site is expected to generate. Low-density scatters with more discrete spatial and temporal resolution are rarely identified in the survey stage of research, and will only show up in excavations that cover a substantial surface area. But as excavations of vast areas mostly involve the documentation of late prehistoric and/or early historic settlement or funerary contexts,[298] low-density scatters of early prehistoric remains tend to be found by chance – the 'by-catch' we mentioned earlier. If such scatters are excavated at all, standard methods are followed, instead of methodologies tailored to the study of early prehistoric remains and which can be expected to return the maximum gain from the potential at hand.

To sum up, in development-led archaeology, early prehistoric sites face two problems where it comes to research questions aimed at understanding how people used (and perceived) space at the local (intra-site) scale. The first is perceptual. Palimpsests are believed to have limited information value, due to the spatially and likely chronologically mixed nature of the archaeological remains, which is hard to decipher. The second relates to survey design and priority setting. Low-density scatters with potentially discrete spatial and chronological resolution, and hence high information value, are rarely subjected to excavation, due to problems of site detection (survey design) and inflexible priorities in contexts where such scatters are found by chance. To what extent can these problems be overcome? As argued by Bailey,[299] palimpsests are the result of particular aspects of structured human behaviour, and hence represent an important phenomenon, which needs to be considered in archaeological theory building. Clearly, there are limits to the sort of information that can be extracted from palimpsests: it is of no use to search for 'Activity X' conducted by 'Individual 1' at 'Point-in-time T' unless one is working on a single-phase, low-density site. However, palimpsests *can* be understood in terms of underlying structured behaviour, which has resulted in the identification of recurrent patterns within an otherwise intangible mass of material and/or features.[300] To make palimpsests archaeologically meaningful requires a change of perspective and of methodology. To second problem is one of attitude. Here, the development of less rigid project outlines and the willingness of firms to involve specialists in a timely manner are of importance.

297 See Lock & Molyneaux (2006) for discussion on various issues of scale.
298 Such excavations are normally focussed on machine-aided feature recovery.
299 Bailey 2007.
300 Peeters 2007, 2010.

4.3.1 In search of spatial differentiation

So how has development-led research dealt with issues of spatial behaviour at the intra-site level? In the NOaA 1.0, research questions are focussed on the impact of depositional and post-depositional factors on the archaeological record, the interpretive possibilities, the identification of activity areas and phases of habitation, the identification of built structures, and even the significance of empty space (see appendix I).

Questions like these generally form the basis of the design of fieldwork strategies and choice of methodology. Spatial units of finds collecting and recording are expected to be appropriate to discern archaeologically meaningful patterns within an otherwise continuous distribution of material remains and soil features. Point location collecting and recording (piece plotting) is considered the most precise by many, but it is clearly a time consuming and consequently costly approach. Used within academic research projects until the 1980s, such 'high-resolution' methods are no longer applied. Insights into high-resolution distribution patterns of material remains have led to a new standard of finds collection and recording in stratigraphic and/or standardised (yet arbitrarily chosen) spits in 50 × 50 cm grid units. Soil features are either treated as single entities (polygons) or integrated into a stratigraphically defined grid system. Although the database structure connected with such a grid-oriented methodology is rather straight forward, spatial analysis of the data is not. Before turning to the results from development-led projects, we will briefly illustrate this with insightful examples from 'academic' analysis of extended datasets from the Mesolithic–Neolithic site of Hoge Vaart-A27 (province of Flevoland) and the Late Neolithic Corded Ware Culture sites of Keinsmerbrug, Mienakker and Zeewijk (province of Noord-Holland).[301]

Some examples from academic studies
Initial efforts to discern archaeologically meaningful patterns within the extended finds distribution recorded at Hoge Vaart-A27 – a vast palimpsest – was limited to visual inspection of distribution maps, created for a variety of finds categories and features.[302] This, however, did not lead to any deep insight into the underlying formation processes, nor to identification of spatial structures, such as hut or house plans. Further analysis of stratigraphically defined grid-cell units was conducted along two lines: 2D 'fuzzy set' and cluster analysis and 3D spatial analysis.[303] The 2D analysis built on the spatial patterning discerned within a low-density distribution, which had been recorded in relative isolation at the site (fig. 4.8).[304] It served as a 'model' for the identification of structural patterns 'embedded' within the vast palimpsest that made up most of the distribution. This approach also permitted the potential identification of 'deviant' patterns, which also require explanation. Based on this analysis, it could be concluded that the palimpsest distribution was primarily composed of material remains that were also found in the low-density distribution, and that despite the process of mixing and blurring, the spatial characteristics of various aspects of behaviour were still identifiable.[305] In a way, specific aspects of activity had left a spatial 'fingerprint'. The 3D spatial analysis more specifically explored the relationships of different categories of features (pit hearths and surface hearths in particular) to the distribution of material remains. The independently obtained results permitted the researchers to underpin their impressions with regard to stratigraphic relationships and phasing, which were largely founded on field observations.[306]

In the case of the three Late Neolithic sites, legacy data were used to analyse spatial aspects that had thus far only been described on the basis of visual inspection of excavation plans. As in the case of Hoge Vaart-A27, data referred to stratigraphically defined grid-cell

301 Hogestijn & Peeters 2001; Kleijne *et al.* 2013; Peeters 2007; Smit *et al.* 2012; Theunissen *et al.* 2014.
302 Peeters & Hogestijn 2001.
303 3D analysis conducted by Merlo (2010); 2D analysis conducted by Peeters (2007).
304 Peeters & Hogestijn 2001.
305 Peeters 2007.
306 Merlo 2010.

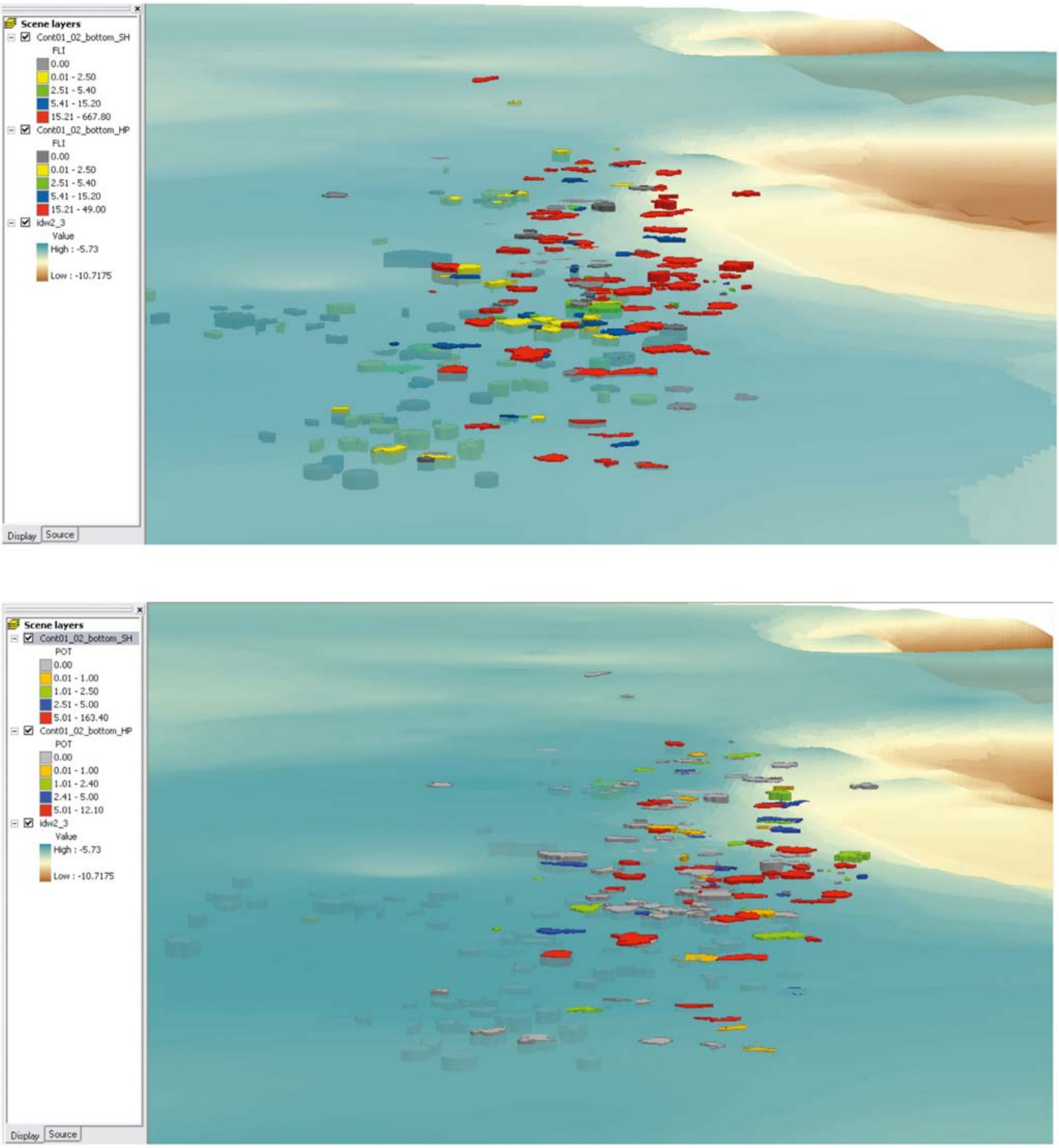


Fig 4.8 Screenshots of the 3D analysis of flint and pottery frequencies in features at Hoge Vaart-A27 (from Merlo 2010). Although such data can easily be displayed in a 2D environment, the 3D visualisation makes stratigraphic relationships between surface hearths (large quantities of flint or pottery) and pit hearths (quantities close to zero) more clear.

units. Through a combination of visual data inspection, quantitative analysis and multivariate visualisation, it was possible to discern archaeologically meaningful patterns within these highly complex datasets.[307] Not only was it possible to identify particular activity zones, it was also possible to link such zones to structural features, such as house plans.[308] Although these structural features were partly apparent from the excavation plans (recorded postholes), more detail was brought to light through the analysis of distribution patterns of material remains. In the case of Mienakker, for instance, it became clear that a structure initially interpreted as a house by the excavator,[309] in fact is part of a much larger structure associated with a human burial that is interpreted as a ritual structure.[310] This structure shows striking similarities in overall layout with a structure documented at Zeewijk.[311] At Keinsmerbrug, the possible presence of a single, flimsy hut was initially reported, but further analysis permitted the identification of a succession of rebuilt dwelling structures in connection with a surprisingly broad range of pottery fabrics and styles.[312] Finally, the analysis of the Zeewijk dataset permitted the academic researcher to identify particular activity zones and to deepen our insight into depositional and post-depositional formation processes (fig. 4.9).[313] Altogether, the in-depth spatial analysis of these three sites permitted the researcher to develop an entirely new insight into Corded Ware Culture settlement dynamics and the social meaning of places.[314]

It is important to note that none of this would have been achieved if the analysis had been restricted to visual inspection of excavation plans and maps showing plain distributions of selected finds categories. Furthermore, it has become clear from these studies that there is no off-the-shelf solution to the analysis of intrinsically complex spatial data, partly because data are not necessarily mutually comparable, even when similar collecting and recording methods are used, and partly because each archaeological site has unique characteristics.

Some examples from development-led work

Let us now turn to development-led archaeology. First of all, it appears that any sort of enquiry of spatial data is focussed on the identification of activity areas – areas that, on the basis of material remains as being used as proxies for particular behaviours, are interpreted as functionally distinct spatial entities. Clusters of such remains, or proxies, are often viewed as representative for spatially 'bound' activity. This, however, is an assumption: "*The traditional concept of 'activity area', although perhaps useful in terms of observable activity performance (e.g. in an ethnographic context), is not necessarily a valid concept in terms of deposition. Simply put, people might well perform 'activities' in 'areas', but there is no reason to expect them to map those areas with their garbage; material products of activities may often be collected in dump locations along with the products of other activities performed in other areas.*"[315]

In other words, the spatial occurrence of a behavioural proxy does not necessarily map the actual space where that particular activity was executed. Activities are part of a more or less complex context of cultural behaviour connected with the handling of 'waste' or 'garbage'. In addition, archaeological spatial patterns are the result of myriad post-depositional processes that have transformed the patterns that initially emerged, and which need to be understood in order to interpret the archaeological patterns in terms of human spatial behaviour.[316] Indeed, to reach such an understanding requires in-depth analysis of spatially referenced data, data which are collected as a standard procedure in development-led archaeology. Yet, the great majority of projects have not incorporated spatial analysis as a specialism within the project setup. As a consequence, interpretation of recorded spatial patterns is normally restricted to visual inspection of (computer-generated) distribution plots, but exceptions to the rule do exist, e.g. for Dronten-N23 and Schipluiden.[317] The lack of in-depth spatial analysis is without a doubt (at least partly) a consequence of spatial restrictions on the fieldwork: the area being developed does not cover the 'entire' site;

307 Nobles 2012, 2013, 2014.
308 For a discussion about criteria for house reconstructions, see Fokkens, Steffens & Van As 2016, 59-66.
309 Hogestijn & Drenth 2000/2001.
310 Nobles 2013.
311 Nobles 2013.
312 Nobles 2012.
313 Nobles 2014.
314 Nobles 2016. Fokkens, Steffens & van As (2016) have expressed their doubts about these interpretations, due to the problems of stratigraphic complexity and the palimpsest nature of these sites.
315 Rigaud & Simek 1991, 217.
316 Schiffer 1999.
317 Wansleeben & Laan 2012; Wansleeben & Louwe-Kooijmans 2006.

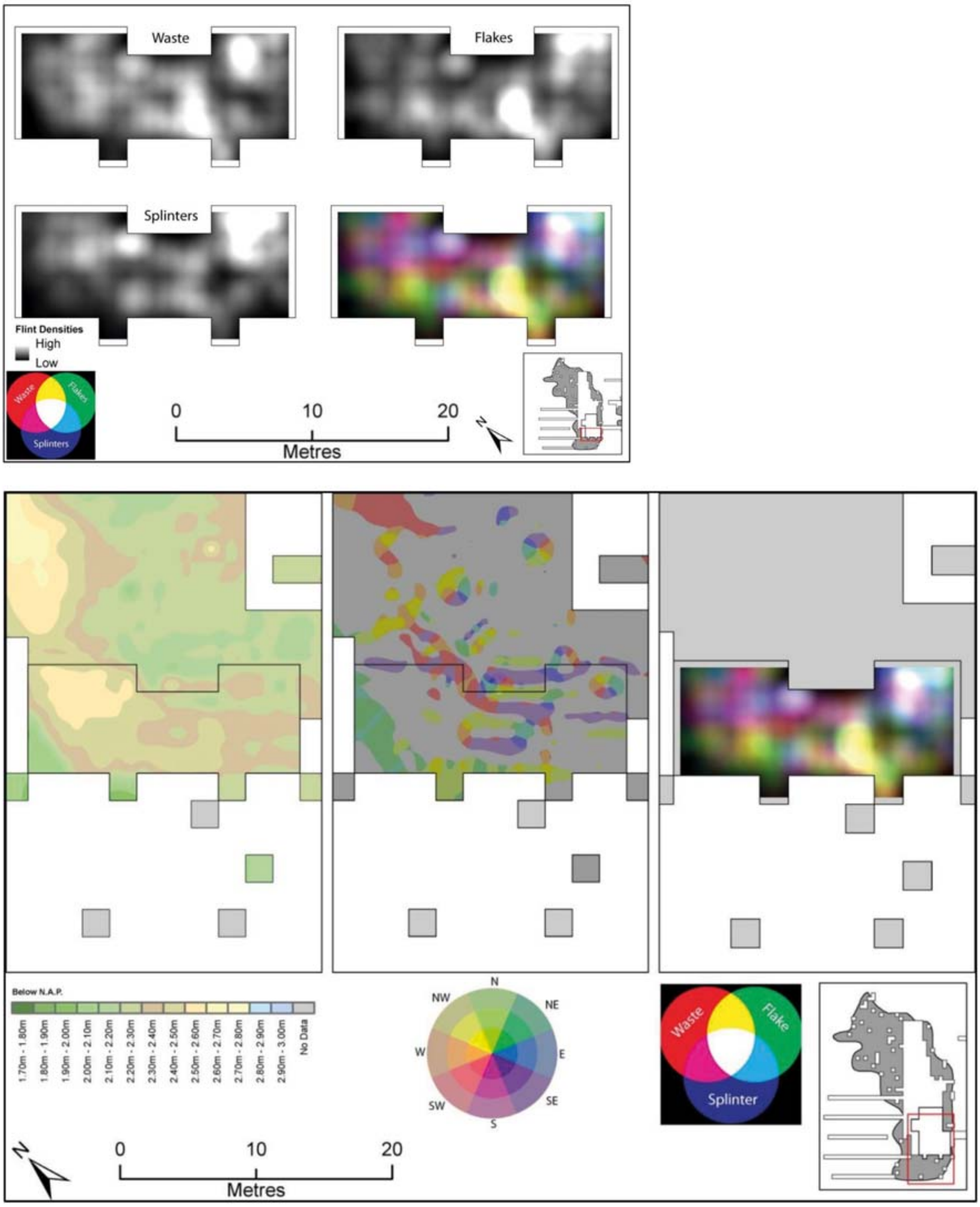


Fig 4.9 Example of the spatial analysis of the Late Neolithic site of Zeewijk (from Nobles 2016). A: Kernel density estimates and multivariate visualisation of the flint data (KDE bandwidth = 1.75 m); B: elevation (a), slope (b), the flint multivariate visualisation (c).

hence, it is partly excavated. Although this does not exclude the possibility of conducting spatial analysis per se, it does restrict broader interpretations of analytical results due to the fact that the unexcavated part of the site remains a black box. In such cases, the choice to put little effort into the analysis of spatially referenced data is defensible.

Our analysis uncovered many examples from the past 15 years of development-led archaeology. Rotterdam-Groenenhagen, for instance, is a site of the Early Neolithic Swifterbant Culture, located on an aeolian river dune, and of which only a 23 × 10 m trench could be investigated (fig. 4.10).[318] The full spatial extent of the site is unknown, as the assessment was restricted to the area to be impacted. The trench clearly does not comprise the 'full' distribution of archaeological phenomena, making any interpretation of observed clustering of particular materials within the distribution precarious. Another example is Rotterdam-Beverwaard, where Mesolithic and Neolithic remains were found, amongst which (exceptional) pits with cremated human bone dating from the Mesolithic.[319] The site is located on the same river dune as Rotterdam-Groenenhagen. Material remains were collected in 1 × 1 m squares within a 20 × 15 m excavation pit, but again the distribution of remains evidently continues beyond the investigated area (find distributions stop abruptly at the limits of the excavated area). Spatial patterns are superficially discussed on the basis of visual inspection of the distribution plans.

It is important to note that the lack of spatial analysis is not restricted to partially excavated sites. Several sites that were subjectively defined as 'delimited' scatters of archaeological remains, and which are supposed to have been completely excavated, were not subjected to spatial analysis, despite the availability of reliable spatially referenced data. Again, the lack of analysis may relate to limited budgets, but it is also possible that the potential is being underestimated or that there is insufficient in-house knowledge about analytic methods. At Zutphen-Looërenk, for instance, a 'complete' concentration of Mesolithic lithics was excavated within an area measuring 13 × 10 m.[320] Although steps were taken to extract information about formation processes on the basis of the vertical distribution of finds, inferences about spatial behaviour relied on visual inspection of distribution plots. Similar approaches can be noted for Ede-Kernhem and Dronten-N23.[321]

The identification of remains of built structures, such as storage facilities and especially houses, is as problematic as the identification of archaeologically meaningful patterning in finds scatters.[322] One possibility is to adopt a data-driven approach that aims at the *a posteriori* identification of structures from excavation data. Indeed, many claims for structures derive from the inspection of digitised excavation plans.[323] Of course there are some drawbacks to this approach, particularly when the density of features (postholes) is high: straight or curved lines are easily found, but the individual features may in fact have had no structural relationship in prehistoric reality. In the case of clear plans, reliability is still acceptable, but in the case of irregular configurations, reliability decreases without the availability of supporting data.[324] Preferably, remains of built structures should be recognised in the field, as this can direct choices with regard to the treatment (sections, sampling) of the features comprising the structure. However, this does not obviate the usefulness of desktop analysis of excavation plans, whether or not in combination with finds scatter analysis; the interaction of specialists in cultural phenomena and specialists in spatial analysis may prove profitable.

It is mainly in the context of large-scale development projects that opportunities exist to anticipate spatial analysis at a level beyond 'eyeballing'. Not only do possibilities exist to assess the potential on the basis of more extensive survey results, there is also is – often – more money available for post-excavation analysis. In the case of the Mesolithic sites of Leeuwarden-Hempens and Dronten-N23, and the Middle Neolithic site of Schipluiden, for instance, more effort was put into the characterisation of spatial patterns and the analysis of interrelationships.[325] Typically, these large-scale projects also involve academic researchers. Schipluiden was excavated by the commercial firm (Archol) of the Faculty of Archaeology at the University of Leiden, whilst the scientific supervision lay with Prof. L.P. Louwe Kooijmans; M. Wansleeben of that university performed the spatial analysis.

318 Appendix II: PUBID 468.
319 Appendix II: PUBID 463a.
320 Verneau-Peeters & Fermin 2007.
321 Appendix II: PUBID 538, 745.
322 Nobles 2016.
323 Fokkens & Jansen 2002; Fokkens, Steffens & Van As 2016, 59.
324 See Fokkens & Jansen (2002) for reliability classes.
325 Noens 2011; Wansleeben & Laan 2012; Wansleeben & Louwe-Kooijmans 2006.

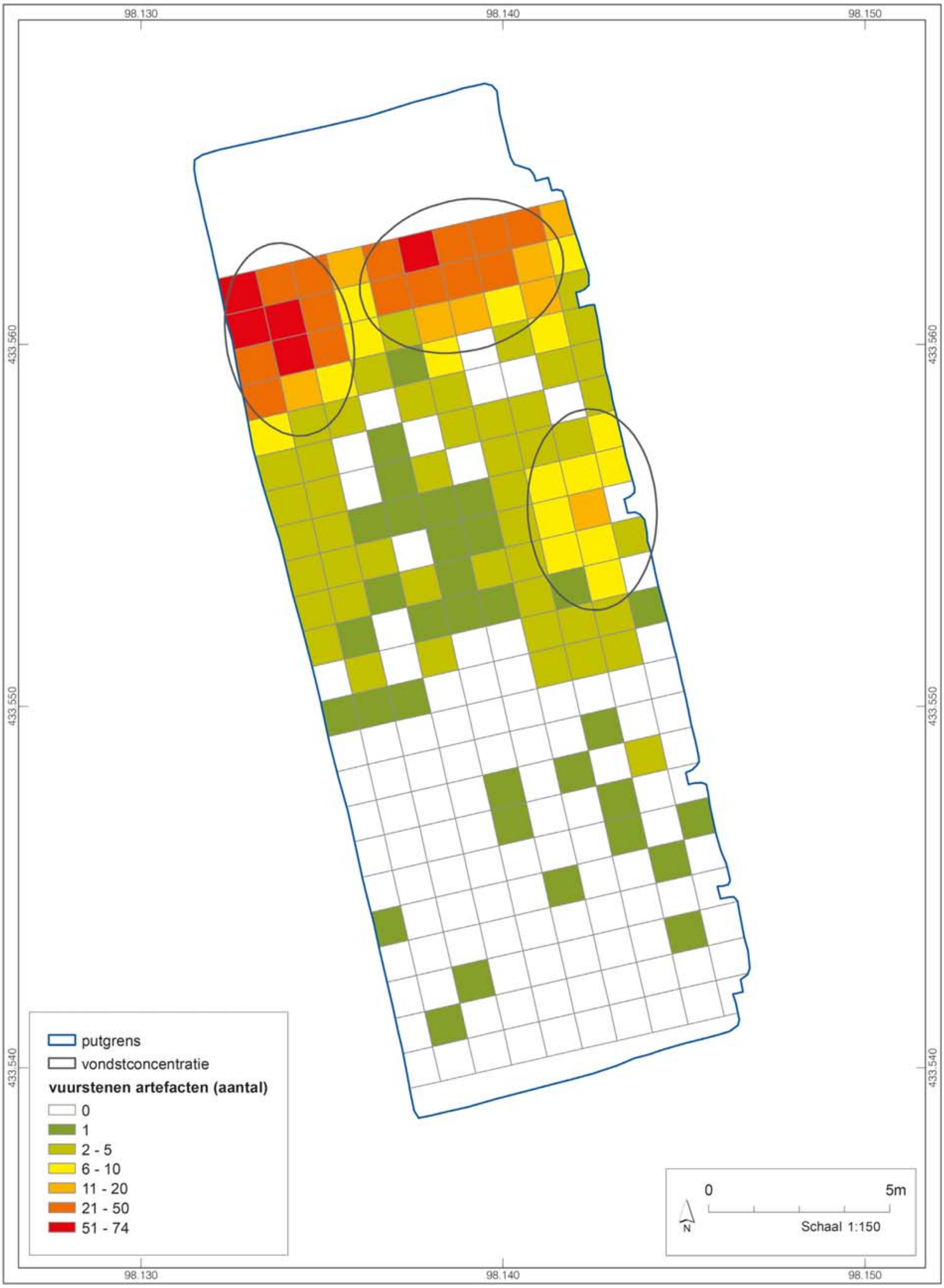


Fig 4.10 Horizontal density distribution of flint at Rotterdam-Groenenhagen. The circles indicate 'clusters' within a continuous, yet only partially investigated, area (from appendix II: PUBID 468).

Dronten-N23 was excavated by a consortium of commercial firms, one of which was Archol; the spatial analysis was conducted in close cooperation with M. Wansleeben. Finally, the analysis of Leeuwarden-Hempens was conducted by G. Noens, as part of his PhD work at the Archaeological Institute of Ghent University (Belgium). This situation is in fact comparable to that surrounding the analysis of Hoge Vaart-A27, referred to above. The excavation and basic analysis of this site was conducted in a development-led setting on the eve of the implementation of the Malta legislation; the report was published in 2001.[326] The subsequent in-depth 2D and 3D spatial analysis was, however, conducted in the context of PhD research.[327]

To sum up, the degree to which spatially referred data is analysed relates partly to the expected representativeness of the excavated 'sample window' for what is considered to be 'the site'. It also partly relates to money and, perhaps more importantly, to the involvement of academic staff or parallel embedding in PhD projects. At this point, then, we come to the question of what development-led archaeology has brought that may enable us to reach a new understanding of spatial behaviour of early prehistoric people. Below, we will further explore to what extent insights have been gained concerning the research questions listed at the start of this section.

4.3.2 Understanding finds scatters: activity areas?

In a broad sense, an 'activity area' is an undefined swath of space within which one or more individuals executed one or more tasks for some purpose. The identification of such an area is dependent on the archaeological traces recorded and the spatial interrelationships of those traces. Highly influenced by the ethno-archaeological work of Binford,[328] such identification assumes that low-density finds scatters, consisting of both material remains and structural features, result from short-lived phases of human presence and hence offer the best chance for successful identification of activity areas. Of course, this is a valid assumption; after all, the longer the time span of human presence at some 'spot' in the landscape, the greater the chance for disturbance (e.g. cleaning), of accumulation of remains, and successive mixing and blurring of patterns. The NOaA 1.0 therefore explicitly mentions the importance of sites with high spatial resolution and integrity.[329] However, as outlined in section 4.3, we find ourselves in the paradox that most of the effort is put into the investigation of sites with high finds densities, which often represent palimpsest contexts with restricted spatial resolution and integrity.

We will concentrate on sites that were subjected to more extensive spatial analysis to investigate the behavioural context of the finds, namely, the Mesolithic sites of Dronten-N23, Leeuwarden-Hempens, Ede-Kernhem, Epse-Olthof and Zutphen-Looërenk. These sites primarily consist of distributions of knapped flint and other types of rock. If present, features on Mesolithic sites represent pit hearths. With the exception of Leeuwarden-Hempens, vertical density distributions were evaluated by the excavators in order to assess the possibility of stratigraphic differentiation, prior to the analysis of horizontal spatial patterning. In all cases this led to the conclusion that horizontal finds distributions could be analysed integrally, without taking any notice of vertical stratigraphy.

Investigation of horizontal patterns typically consists of the presentation of density distribution maps for various finds categories (e.g. flint, stone, bone, hazelnut, charcoal) and typological or technological categories (e.g. points, scrapers, blades, cores). The plotted data concern either counts or weight of some selected category per recording unit, which in all of the sites mentioned above consist of 50 × 50 cm squares. In the case of Dronten-N23, additional plots are provided for groups of four squares, resulting in a 1 × 1 m grid on the map (fig. 4.11). Quantities are plotted according to a selected assemblage frequency distribution method, such as equal count, equal range, or natural break, but it should be noted that none of the reports mention which method was applied. The distribution plots obtained are normally taken at face value, without any further transformation of data. In the case of Dronten-N23, however, moving average transformation was applied in order to obtain a smoother distribution surface, at least for some broad categories of finds (fig. 4.12).[330] For a comparable purpose, kriging interpolation was

326 Hogestijn & Peeters 2001.
327 Merlo 2010; Peeters 2007.
328 Binford 1978.
329 Deeben *et al.* 2006, 31.
330 Wansleeben & Laan 2012, 107-108.

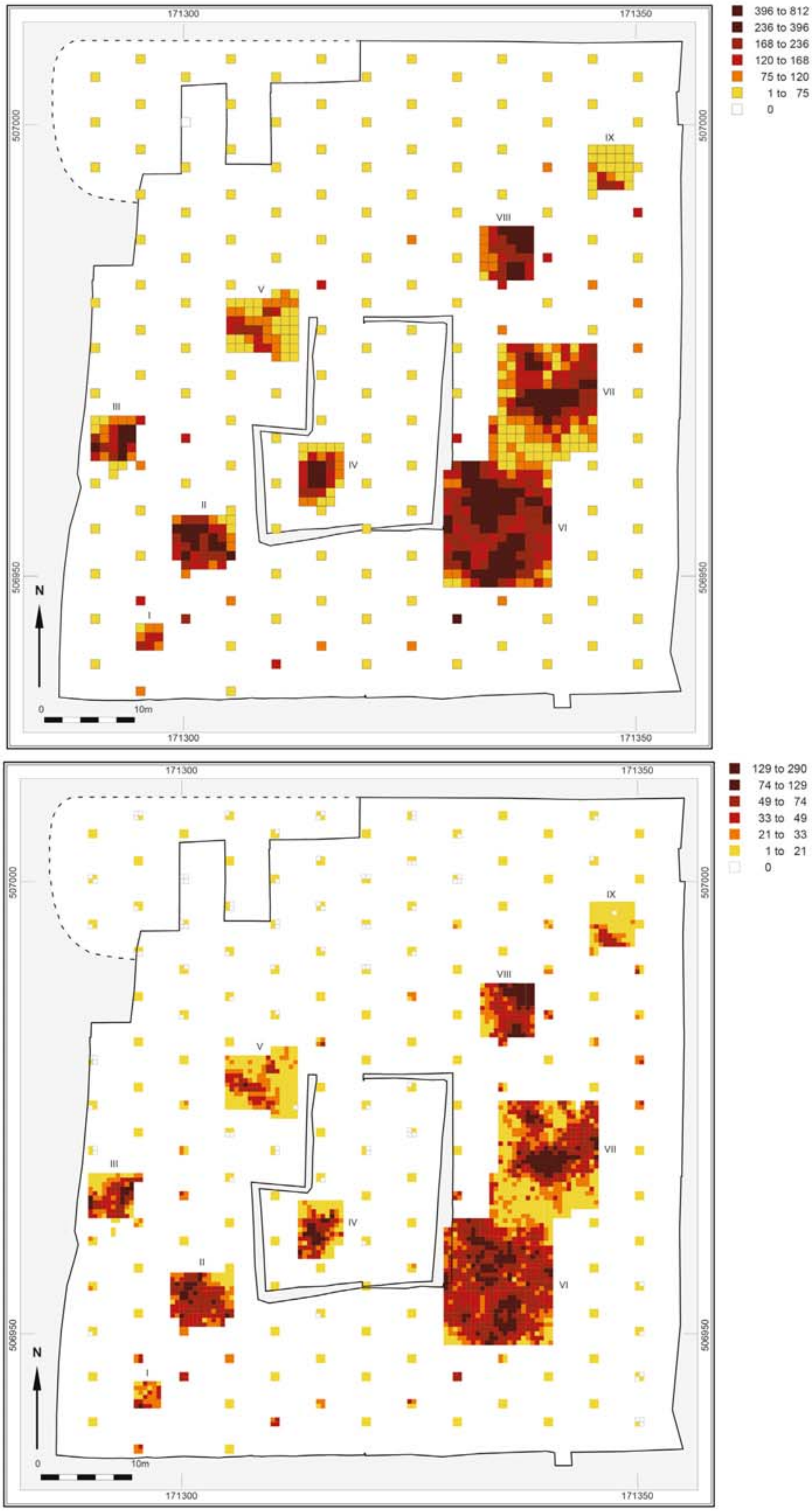


Figure 4.11 Horizontal density distribution of flint at Dronten-N23. Top: density distribution in 1 × 1 m squares; bottom: density distribution in 50 × 50 cm squares (from appendix II: PUBID 538).

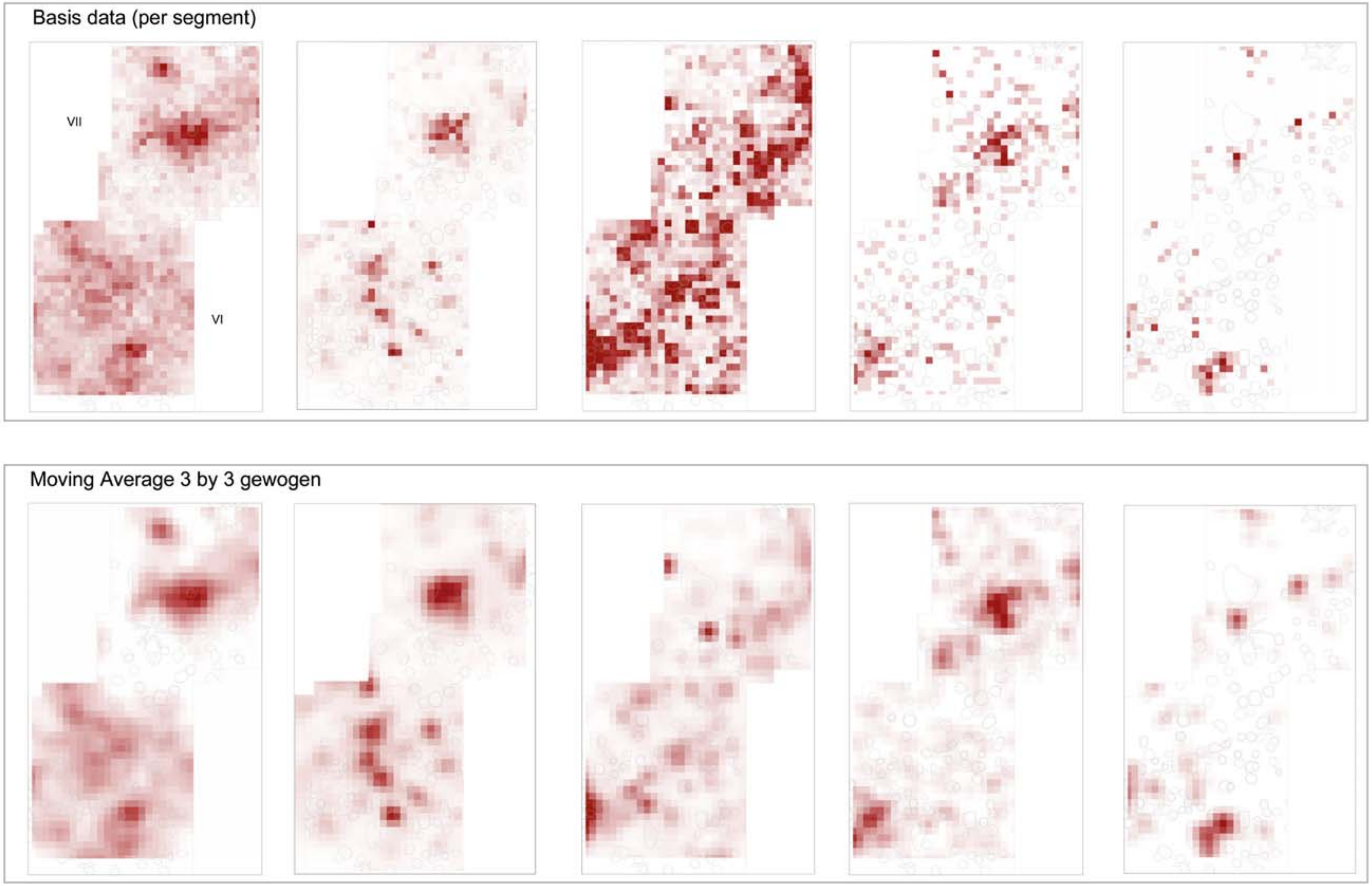


Fig 4.12 Horizontal density distributions in 50 × 50 cm squares of various find categories (from left to right: flint, hazelnut shell, charcoal, stone, bone) at Dronten-N23. The maps in the top row show the original frequency distributions; the maps in the bottom row show the moving average distributions (from appendix II: PUBID 538).continuous, yet only partially investigated, area (from appendix II: PUBID 468).

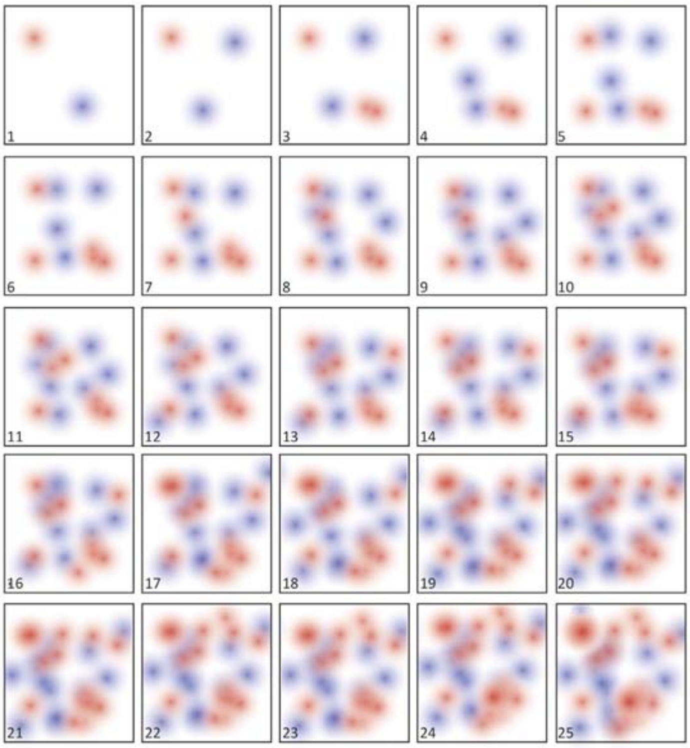


Fig 4.13 Simplified model of pattern formation resulting from random accumulations of ‘flint events’ (red) and ‘nut events’ (blue) for Dronten-N23 (from appendix II: PUBID 538).

applied on the data from Leeuwarden-Hempens, albeit that here the technique was applied to a dense set of coring data.[331] Kriging interpolation was also applied to data from Knooppunt Hattemerbroek.[332]

It is evident that the application of such techniques as moving average and kriging obscures details that are present in the original data, and that these techniques are unsuitable for spatial analysis aimed at the identification of activity areas.[333] In fact, it is not clear at all what the added value of these exercises is meant to be, other than obtaining ‘cleaner’ distribution maps. The actual evaluation of resulting maps continues to rely on visual inspection and subsequent interpretation of observed patterns. For Dronten-N23, the conclusion is drawn that the resulting patterns are the result of a growth process that involved continuous accumulation and merging of small individual clusters of material remains, which themselves are the product of short-lived activities or ‘events’ (fig. 4.13).[334] It has been suggested that such patterns have fractal properties, but this is not supported by any further analysis of spatial properties. The recognition of self-organised pattern formation in finds distributions is important because it provides clues to a better understanding of palimpsests.[335] This, however, requires in-depth analysis, such as has been performed by means of fuzzy set and ‘percolation’ analysis on data from the Early Neolithic site of Hoge Vaart-A27 (phase 3).[336]

So what about activity areas? Not surprisingly, the ‘strict’ identification of discrete activity areas remains problematic within these palimpsest sites. For Leeuwarden-Hempens, the inspection of distribution maps of various finds categories and functional categories of microwear has not led to the identification of isolated, activity-specific clusters (fig. 4.14). The overall distribution is diffuse and ‘random’, which suggests an underlying process of gradual accumulation and merging of initial patterns, as has been suggested for Dronten-N23. A similar picture emerges from the distribution patterns at Epse-Olthof (fig. 4.15), where three merged sub-clusters of comparable typological and functional composition were recorded.[337] Zutphen-Looërenk consists of a smaller scatter within which two

331 Noens, 2011, 131-142.
332 Laan 2011; Wansleeben *et al.* 2011.
333 Nobles 2016.
334 Wansleeben & Laan 2012, 109-112.
335 Peeters 2007, 167.
336 Peeters 2007, 132-169.
337 Peeters, Verneau & Admiraal 2015.

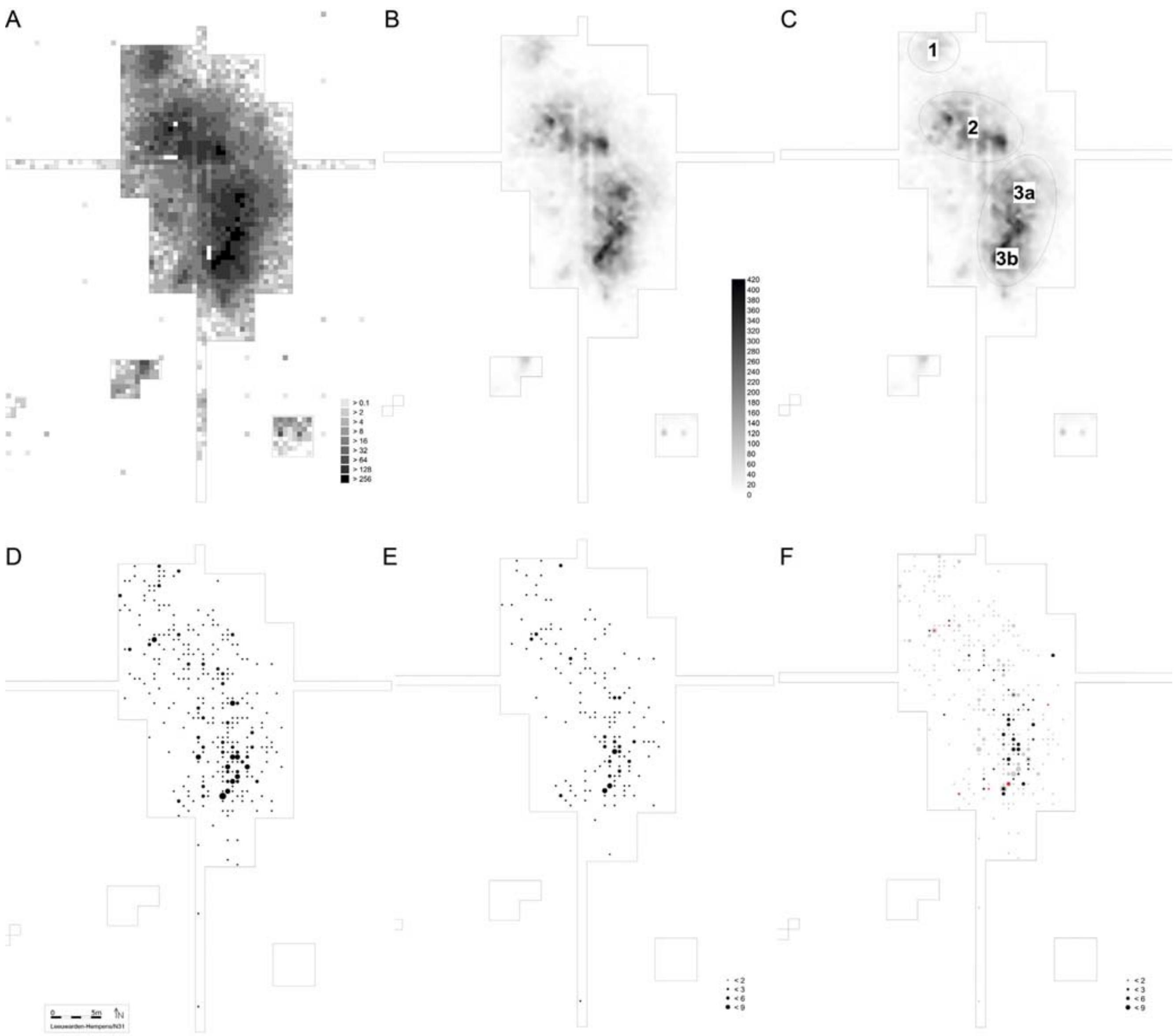


Fig 4.14 Horizontal density distributions of flint at Leeuwarden-Hempens (from Noens 2011). A: frequency counts; B: interpolated densities (kriging; interval 1 artefact); C: subdivision into 'concentrations'; D: distribution of artefacts studies for use-wear analysis; E: distribution of artefacts showing use-wear traces; F: distribution of artefacts showing traces of hide processing (black dots: studied by V. Beugnier; red dots: studied by J. Schreurs; grey dots: studied for use wear).

Fig 4.15a Horizontal density distribution of flint at Epse-Olthof (from appendix II: PUBID 733).

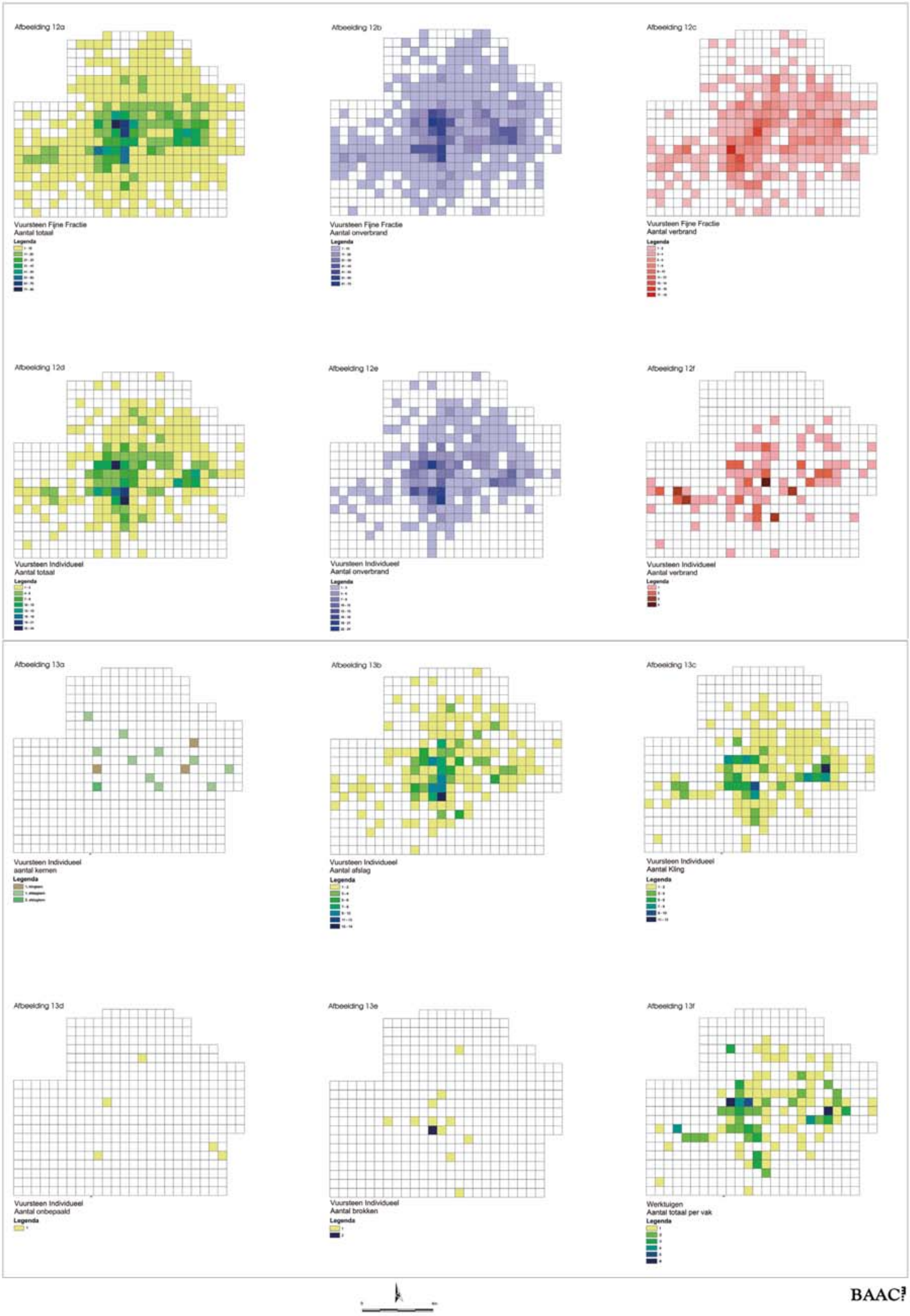


Fig 4.15b Horizontal density distribution of flint at Zutphen-Looërenk (from appendix II: PUBID 733).

sub-clusters are visible, which, again, are not fundamentally different in composition; scrapers tend to be somewhat more spatially concentrated compared with backed bladelets and microlithic points.[338] Again, we seem to be looking at a compound distribution of material corresponding to multiple activity phases.

Within the various sections excavated in detail at Dronten-N23, several 'concentrations' were delimited within an otherwise continuous distribution of finds.[339] Differences in assemblage composition are reported with regard to microlith types, and are interpreted in chronological terms. Broadly speaking, however, two groups of assemblages were distinguished. One is dominated by high points with an addition of only a few scrapers; smaller 'satellite concentrations' may represent special activity areas. The other is characterised by more or less equal representation of points, backed bladelets and scrapers, and other retouched tools. It is possible that such differences reflect functional variability amongst campsites, at least under the assumption that the two assemblage groups reflect behavioural contexts that were separated in time and space. At the smaller intra-concentration scale – the campsite – no further functional spatial differentiation has been reported, which may indicate the absence of differentiated spatial zonation within such concentrations.

Even in cases where smaller spatial distributions have been recorded, it appears difficult to distinguish well-defined activity areas at the intra-site level. Ede-Kernhem concentration 3, for instance, covers almost 33 m^2. The low average density of finds (flint) suggests rather short-lived activity.[340] The location of a hearth is vaguely indicated by clustered burnt flint in association with charred fragments of hazelnut shell (fig. 4.16). Next to this postulated hearth is evidence for a flint-knapping location (debitage); cores and rejuvenation flakes were found at several metres' distance. Tools are, however, more evenly distributed, although points tend to cluster close to the workshop. Taken together, this pattern suggests that there is spatial differentiation that can be understood in terms of variable activities (e.g. flint knapping, point production).[341] Ede-Kernhem concentration 5 is smaller in size and shows a different picture (fig. 4.17). Three possible hearths and three or four flint-knapping locations have been postulated. The distribution map of burnt flint counts,[342] however, shows that potential positioning of the hearths is disputable. Nonetheless, there seems to be a spatial relation, with higher frequencies of debitage indicating knapping locations. Distributions of other artefact categories seem to demonstrate comparable tendencies to Ede-Kernhem concentration 3. The lack of clear clustering of tool types leads to the conclusion that activity areas cannot be discerned. It is suggested that the hearths did not function simultaneously. Instead, each hearth and associated knapping location would represent a single, short-lived period of activity, which was primarily focussed on hunting (maintenance of hunting gear?); scrapers are lacking in the assemblage.[343] Hence, the overall distribution represents a small-scale palimpsest of events. Yet other concentrations at Ede-Kernhem (concentrations 7a, 7b) have been interpreted as base camps due to the broad range of tool categories and quantities of debitage, which are suggested to reflect longer time spans of diverse activity. Variable degrees of clustering of tool categories may indicate more or less well-defined activity areas, but the distribution maps provided remain difficult to read and interpret due to format and layout.

338 Verneau-Peeters & Fermin 2007.
339 Niekus *et al.* 2012.
340 Devriendt 2015, 163-178.
341 The pattern observed for Ede-Kernhem concentration 3 is largely comparable to that of the Hoge Vaart-A27 northern concentration (Peeters 2007).
342 Devriendt 2015, 182, fig. 9.14.
343 Devriendt 2015, 185.

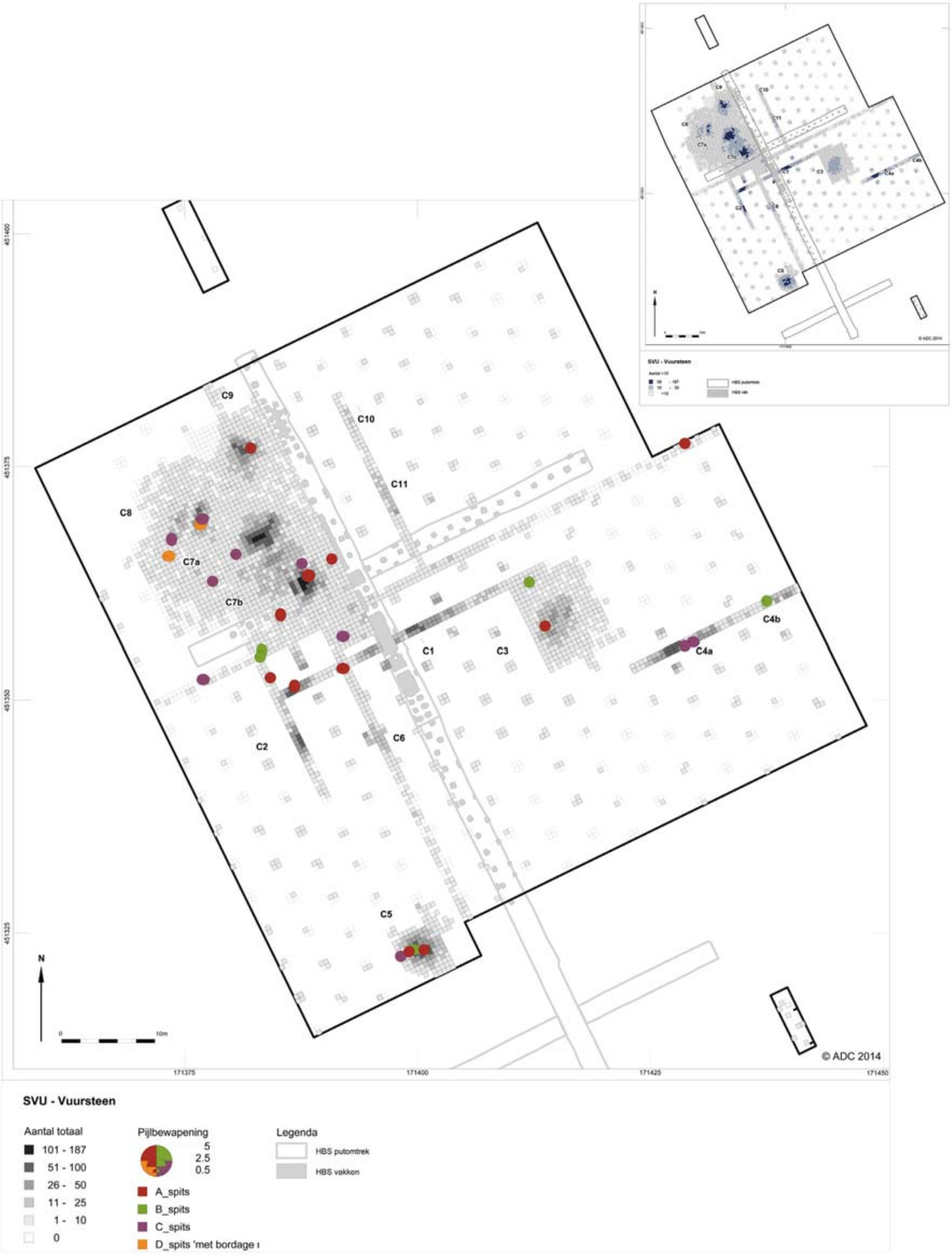


Fig 4.16 Horizontal density distributions of flint (grey shading) at Ede-Kernhem within the investigated area, and the relative importance of various microlith types (from appendix II: PUBID 745).

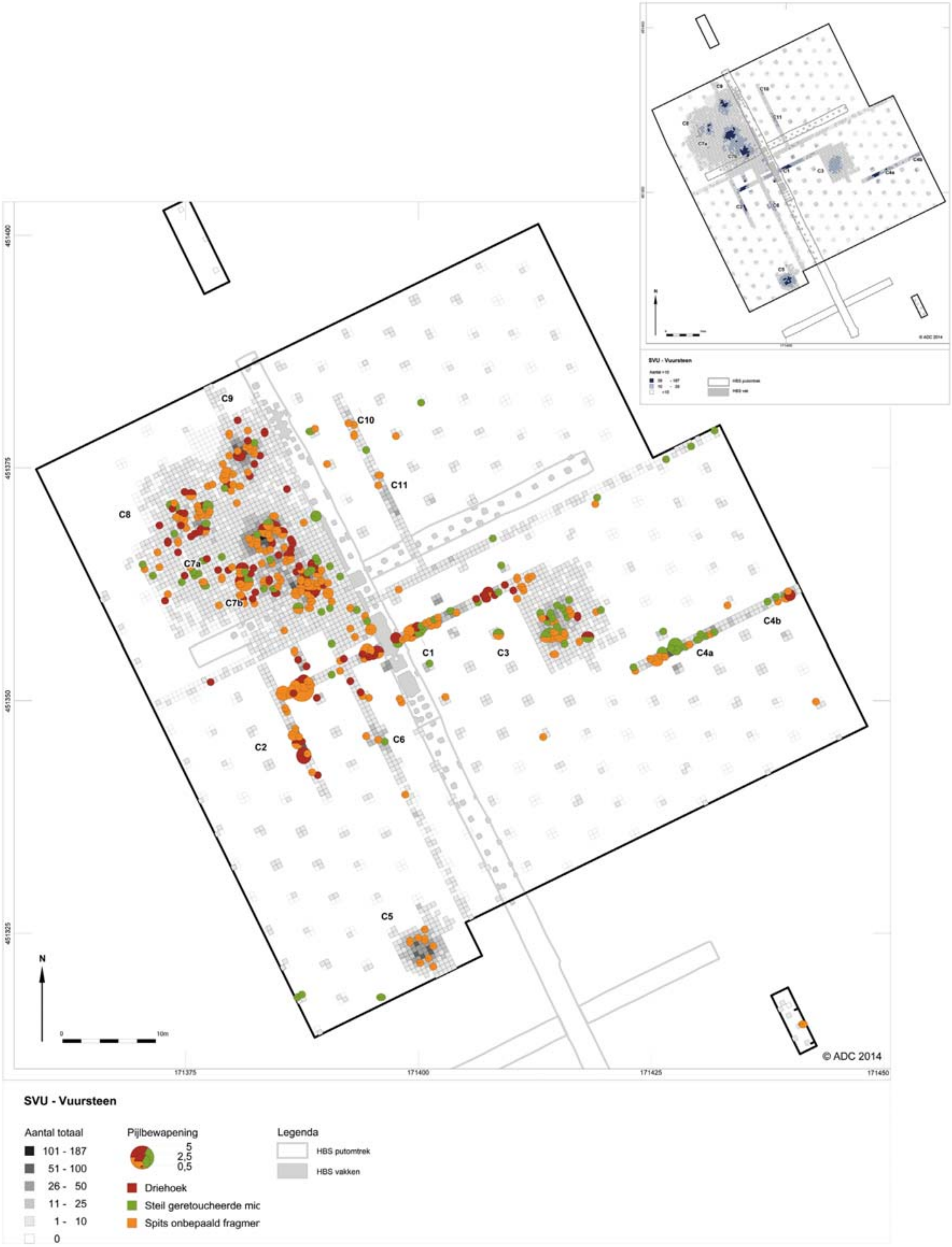


Fig 4.16 Continued.

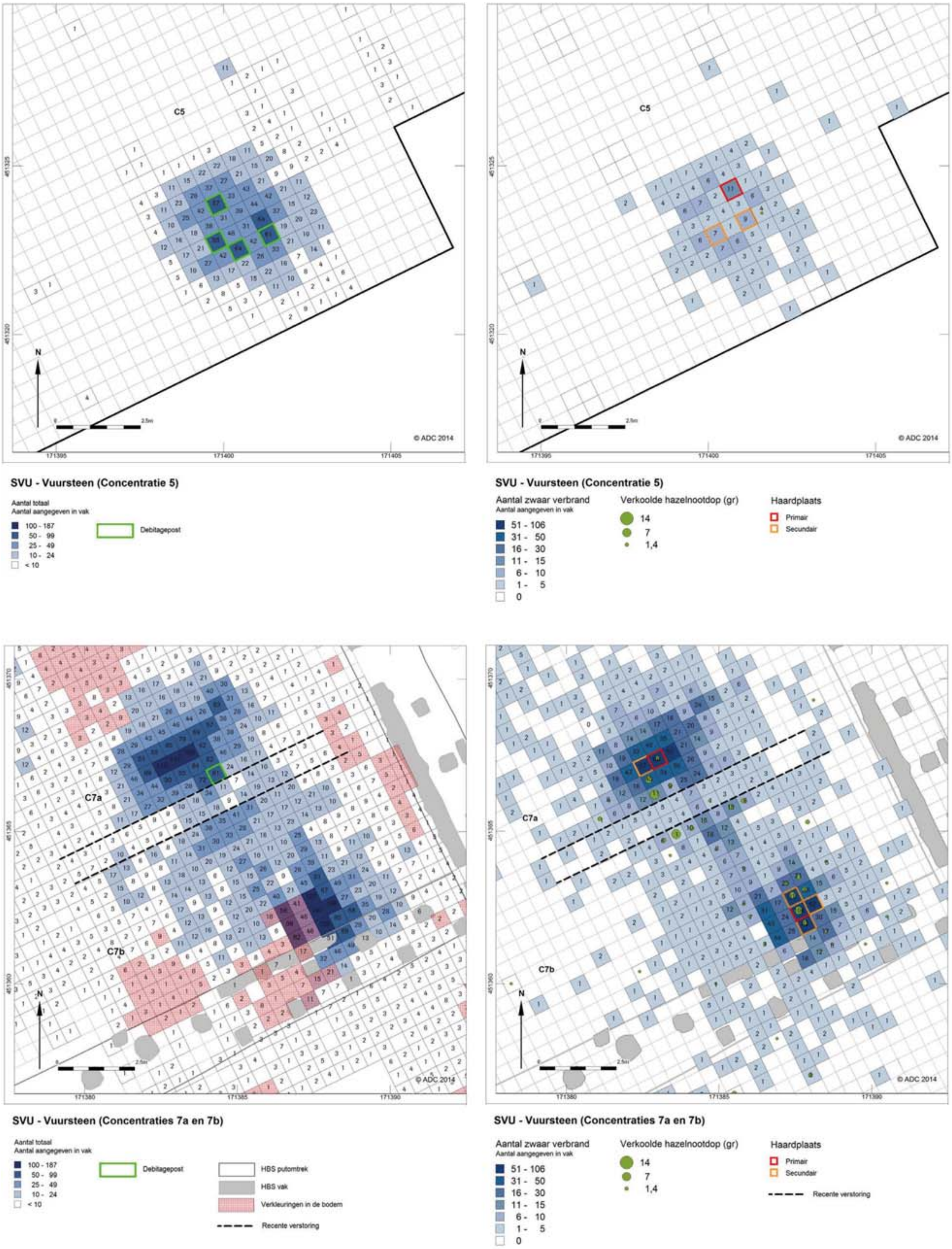


Fig 4.17 Horizontal density distributions of flint at Ede-Kernhem for concentrations 5, 7a and 7b. Green squares represent postulated knapping locations; red and orange squares represent primary and secondary hearth locations (from appendix II: PUBID 745).

Another small site dating to the Mesolithic has been excavated at Groningen-Meerstad.[344] The flint assemblage is homogenous and seems attributable to a single chronological phase (Middle Mesolithic). It is probable that the overall distribution represents a short-lived period of activity. Distribution maps of various finds categories (fig. 4.18), however, do not provide evidence for clearly defined activity areas, in that distributions are rather diffuse. It is not clear whether this reflects an absence of spatially separated functional zones, or whether the original pattern is distorted due to post-depositional disturbance.

From the above examples, it could be concluded that the identification of activity areas has been only minimally successful, be it in small, single-phase concentrations of finds or in small to extended palimpsest distributions. But dismissing such attempts to identify activity areas may well be too easy. First, we need to take a critical look at our expectations. The concept of activity areas is rooted in the premise that activities in 'ethnographical time' are bound to a restricted space and functionally focussed. This snapshot perspective does not correspond to the spatial dynamics of short-lived activities, which are related to a particular context of behaviour, namely, a set of tasks. Tasks may have been conducted not only within culturally structured space, thus creating a blueprint of spatial organisation, but also in open-air settings, where one can quickly change locations. In outdoor settings, the material output of related tasks can result in seemingly unstructured or random spatial patterns. Second, it should be noted that none of the development-led projects have included multivariate spatial analysis in their research. As we note above, we are dealing with one-by-one and category-by-category visual inspection of distribution maps. It is only occasionally that an effort is made to come to an understanding of what such patterns could actually mean in terms of behaviour. In the case of the Mesolithic-Neolithic site of Groningen-Europapark, categories of flint were reorganised in terms of so-called product groups[345] in order to obtain insight into technologically differentiated space (fig. 4.19).[346] Although this did not result in the identification of activity areas, it helped to obtain a better understanding of the processes that led to the formation of this palimpsest finds distribution. The previously mentioned analysis of Hoge Vaart-A27 provides another example of how insight into the behaviour-based formation of a palimpsest can be approached, and how this can lead to conclusions about long-term activity patterns.[347]

The identification of activity areas in the narrow sense, whilst not impossible, is only realistic in contexts that were immediately covered over with sediment, under calm conditions, and subject to at most minimal post-depositional disturbance. A situation like this may apply to Well-Aijen.[348] The majority of development-led excavations, however, do not meet these criteria. For this reason it seems to be a better choice in many situations to focus spatial analysis of finds scatters on the identification of patterns that can inform us about underlying processes of site formation. After all, if the majority of sites investigated represent palimpsests – even small, 'single-phase' sites – we have to develop ways to come to a better understanding of how the spatial patterns therein emerged, and what these patterns tell us about human behaviour or post-depositional processes. From a broad landscape perspective, the emergence of extended palimpsests due to long-term use of zones for various activities is significant; determining the band-width of activities and chronological shifts can be highly informative.

344 Arnoldussen *et al.* 2012.
345 Collins 1975.
346 Fens & Mendelts 2015.
347 Peeters 2007.
348 Appendix II: PUBID 592, 725. The final report is not yet available.

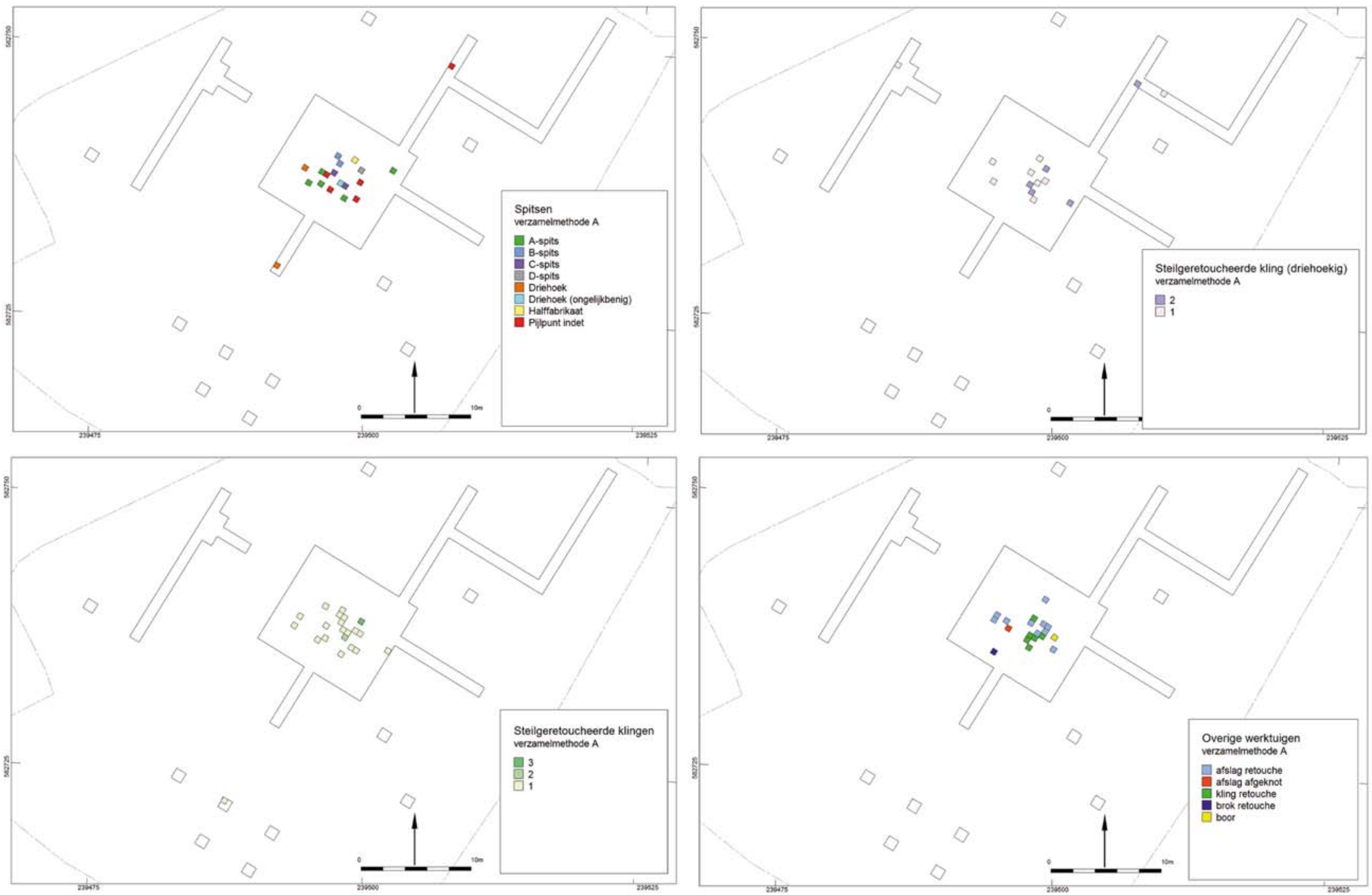


Fig 4.18 Horizontal density distributions of various tool categories at Groningen-Meerstad (from appendix II: PUBID 255).

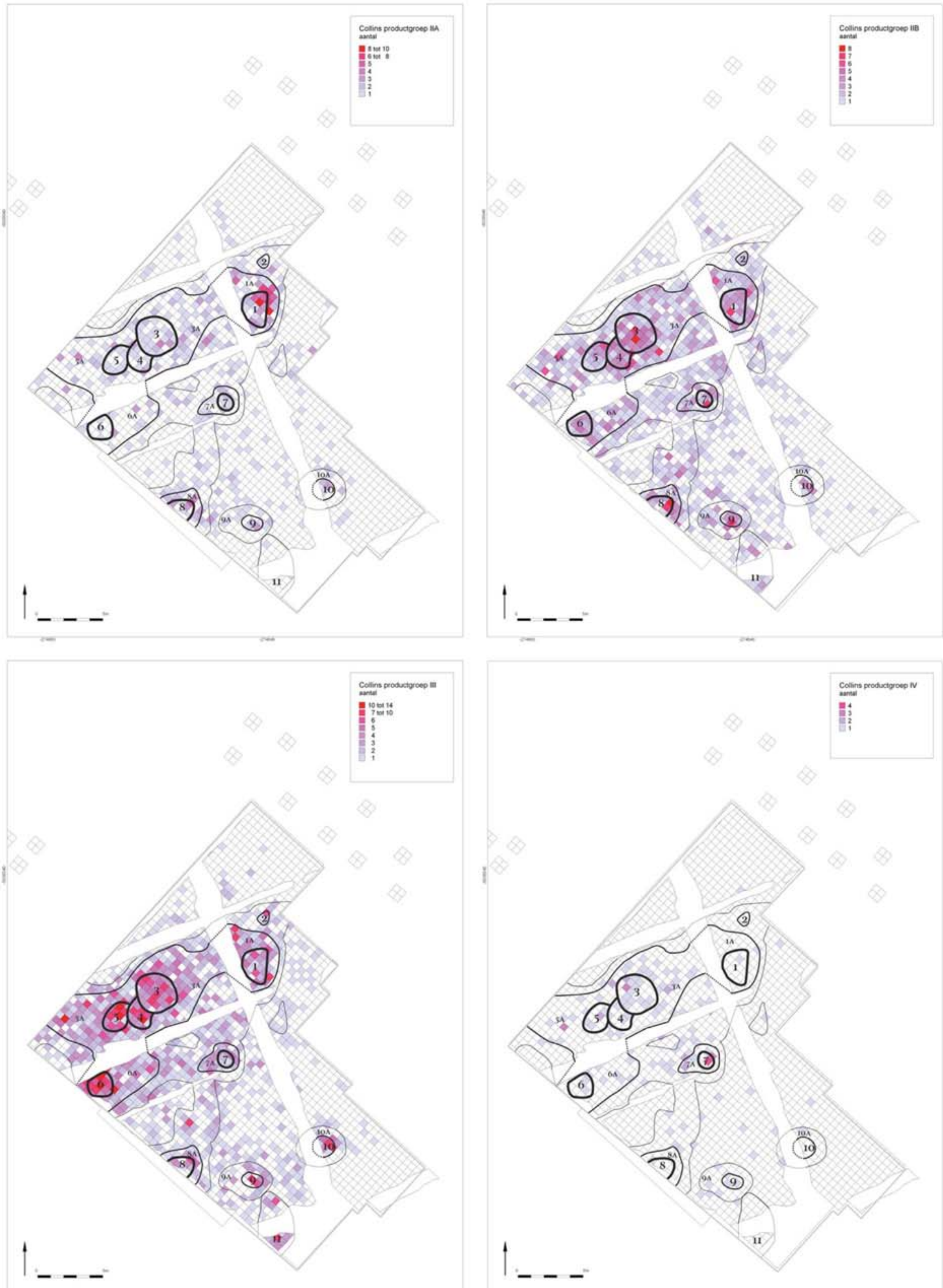


Fig 4.19 Flint distribution patterns at Groningen-Europapark organised according to the technological product groups as defined by Collins (1975). Top left: product group IIA; top right: product group IIB; bottom left: product group III; bottom right: product group IV (from appendix II: PUBID 752).

4.3.3 Tents, huts, houses and other built structures

Expectations about existence of remains of built structures are generally higher for the younger periods of prehistory than for older periods (say, hunter-gatherer contexts). Prehistoric hunter-gatherers are equated with tents and ephemeral huts. Sites dated to the Neolithic are all too often equated with permanent settlements and house building, and the search for built structures has become an end in itself. Developing an understanding of how space is used in a social context generally seems to be overlooked. Of course, the identification of house plans is straight forward in some cases, but often there are plenty of difficulties. The identification of built structures is largely viewed as a matter for visual inspection and reference to house plan typologies and preconceived layout:[349] regular configurations of features are matched to mental templates of what houses should look like in particular time periods. As mentioned in section 4.3.1, in those cases where plans of dwelling structures are less obvious and cannot easily be identified, problems arise. In our view, there is no reason to disregard such 'unconfirmed' structures. Certainly in the context of early prehistory, we know very little, so every bit helps. Relationships between finds scatters and features are often not investigated, even though researchers cannot know a priori what may be extracted from such analysis. Below we will provide an overview of the contribution made through development-led projects.

Late Palaeolithic and Mesolithic

Despite the fact that in all cases the possibility of built structures was taken in consideration – sometimes explicitly – none of the development-led projects under consideration here yielded evidence for their presence, neither in the spatial distribution of finds, nor in configurations of anthropogenic features, such as postholes. Clearly, the identification of potential structures, such as tents or huts, within finds scatters requires in-depth spatial analysis.[350] However, as we have seen in the previous section, this is notoriously problematic. A late Early Mesolithic low-density scatter at Zutphen-Ooyerhoek provides a rare example of a postulated tent structure (fig. 4.20).[351] Anthropogenic features other than hearths have hardly ever been recorded at hunter-gatherer sites. Features that could potentially be interpreted as postholes are often considered with extreme caution in the field, as postholes are equated with more permanent structures, and this doesn't match the general idea of hunter-gatherer lifeways. However, evidence for huts with sunken floors has been found at two of Hardinxveld-Giessendam sites, namely, Polderweg and De Bruin (fig. 4.21), dated to the Late Mesolithic and Early Neolithic.[352] Likewise, the numerous huts with sunken floors from southern Scandinavia show that such structures are no exception. Plans of huts with 'heavy' posts have been found at several sites in Scandinavia (Tågerup) and the United Kingdom (Howick, East-Barns, Broom Hill, Low Hauxley, Mount Sandel), and one possible example is known from the Netherlands (Baarn-Drie Eiken).[353] It is very well possible that the lack of evidence for built structures in many projects is the result of prejudice, excavation methods – excavation in small squares (a much used method in the Netherlands) makes the identification of features difficult – and perhaps an abundance of caution. Interestingly, two recent development-led projects – Soest and Kampen-Reevediep[354] – have yielded convincing evidence for Mesolithic huts with heavy posts (fig. 4.22); both are closely comparable to Baarn-Drie Eiken and the Scandinavian and British examples.[355]

349 Arnoldussen 2008; Fokkens *et al.* 2016; Lange *et al.* 2014; Waterbolk 2009.
350 Tools such as the rings-and-sectors method (Stapert 1992) are available for analysis of point-density data, but the application to grid-cell data is not without problems.
351 Verneau & Peeters 2001, 40.
352 Hamburg & Louwe Kooijmans 2001; Louwe Kooijmans & Nokkert 2001.
353 Karsten & Knarrström 2003; Peeters 2007; Van Haaff *et al.* 1988; Waddington 2007; Waddington & Bonsall 2015; Woodman 1985.
354 Geerts *et al.* 2016.
355 Three Mesolithic hut plans have been postulated for the site of Westelbeers (Dijkstra *et al.* 2016), excavated in the 1970s and 1980s by amateur archaeologists under the supervision of Dr. R.R. Newell (of the Biologisch-Archaeologisch Instituut, University of Groningen, now the Groningen Institute of Archaeology). Two consist of semi-circular configurations of 'postholes'; the diameter of the configurations measures c. 5-6 m, which conforms to other north-west European examples. The third one is more elongated, and measures c. 4 × 7 m. Although it may certainly involve hut plans, the information provided about the features makes it difficult to be certain about this interpretation.

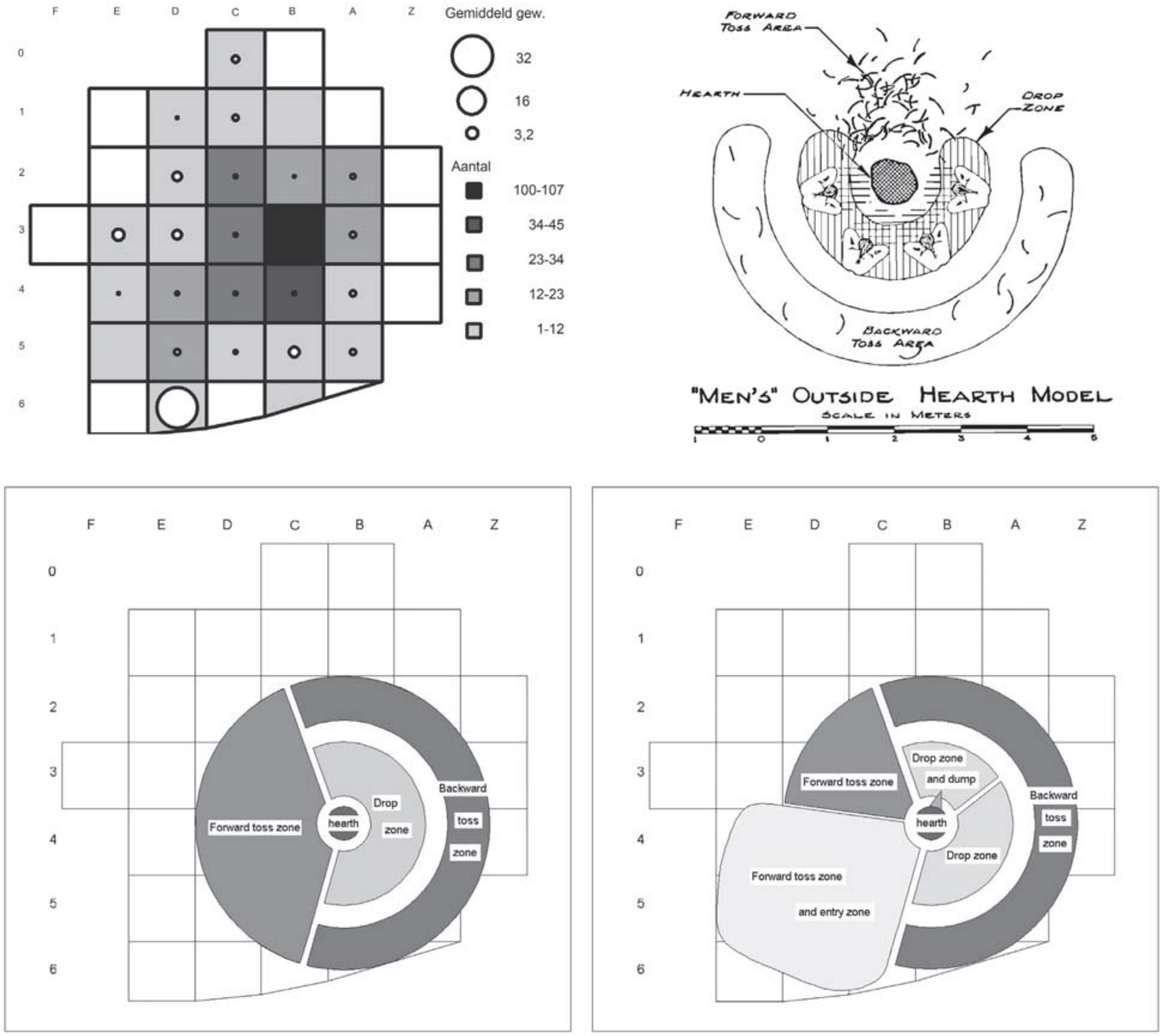


Fig 4.20 A Mesolithic scatter of flint at Zutphen Ooyerhoek. The average weight distribution of artefacts per 1 × 1 m square suggests a 'centrifugal' effect, which can be explained in terms of Binford's 'drop-and-toss zone' model (from Verneau & Peeters 2001).

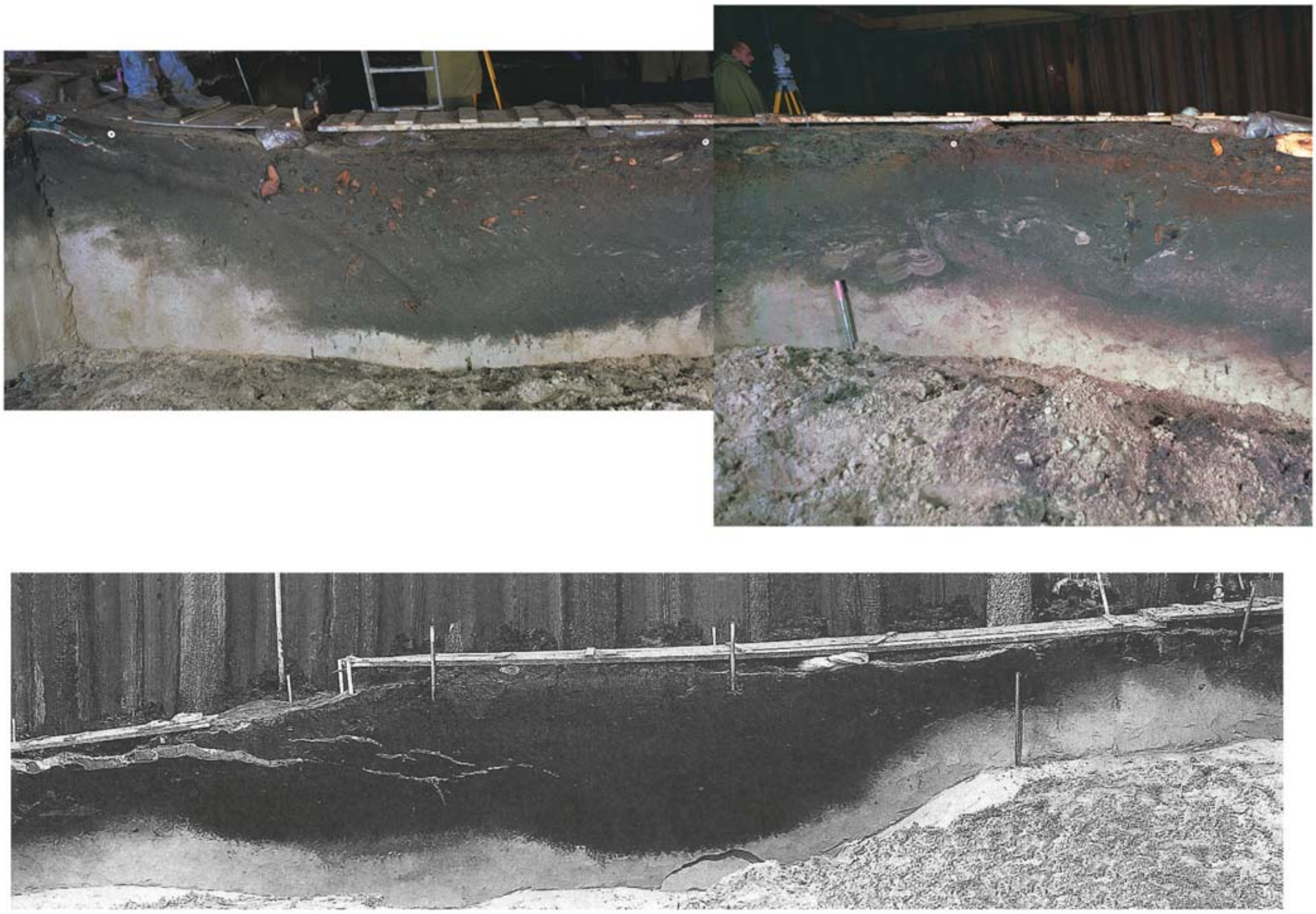


Fig 4.21 Mesolithic features at Hardinxveld-Giessendam De Bruin (top) and Hardinxveld-Giessendam Polderweg (bottom) which have been interpreted as sunken-floor dwelling pits (from Louwe Kooijmans & Nokkert 2001; Hamburg & Louwe-Kooijmans 2001).

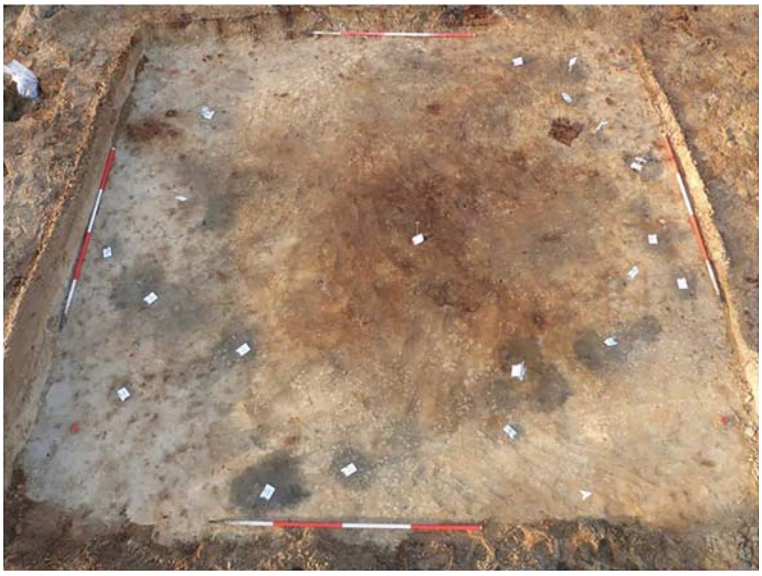


Fig 4.22 Mesolithic dwelling structure at Soest. The darker grey features are postholes visible in the C-horizon; the brown illuviation zone within the circular arrangement of postholes appears to represent the sunken floor of the dwelling (photo courtesy of BAAC).

Linear Bandkeramik

The highly standardised house plans of the Linear Bandkeramik (LBK), which are easily recognised even when only partially represented in an excavated area, have been reported at Elsloo-Riviusstraat, Stein-Heidekampweg and Sweikhuizen-Geverik.[356] Although the layout of the house structures is well known, little is known about the internal use of space in LBK houses in general, because the habitation layers (i.e. occupation surfaces) are not preserved, due to erosion. Indirect evidence about the activities conducted in and around houses comes from pits adjacent to houses. It is assumed that pits adjacent to a house are related to the extraction of loam during the building of that house, and that these pits were subsequently used for disposal of waste from the household.[357] Hence, data on the contents of pits in relationship to house plans can be informative. The extent to which this is the case is variable. Sweikhuizen-Geverik, for instance, involved a narrow pipeline trench, which can offer only sparse spatial information; even though the data are provided, no conclusions can be drawn. In contrast, Elsloo-Riviusstraat occupies a larger area, which contains several LBK house plans, some of which are associated with pits (fig. 4.23); information about the contents is provided at the level of individual features, but interpretations remain restricted to generalised terms, such as 'loam pit' and 'silo'. At Beek-Kerkeveld, no house plans were found, but a complex of ditches was interpreted as part of an LBK enclosure (known by the German term *Erdwerk*; fig. 4.24); it seems probable that the area investigated concerns the peripheral zone of a settlement.[358] The enclosure is the first to be attributed to the LBK in the Netherlands, although some reservations must be made concerning its dating, since little LBK material was found in the ditch fill. Comparable structures are also known from other Neolithic contexts, such as Michelsberg; but in the absence of Neolithic finds other than LBK, its attribution to the LBK is, in our opinion, defensible.

Generally speaking, the few development-led projects that have reported on LBK structures remain somewhat descriptive an 'impressionistic' in their interpretation. However, this seems to be due to the restricted spatial extent of the investigated areas and hence justifiable. This is not the case for Maastricht-Cannerberg, where large-scale development-led fieldwork on an LBK settlement permitted in-depth analysis. Although the report falls outside the selection criteria of our study due to its publication date (2016),[359] it is worthwhile to briefly refer to the obtained insights. First, it appears that the orientation of houses at this location partly deviates from the NW–SE orientation that was considered to be the norm for the LBK. At Maastricht-Cannerberg, the main orientation is WNW–ESE to W–E (fig. 4.25).[360] Apparently, there is more variability than hitherto expected. Second, the application of a 20-phase relative typo-chronology of ceramics permitted researchers to analyse spatio-temporal dynamics within the settlement area.[361] The results suggest relatively contemporaneous occupation for a limited number of houses, as well as the rebuilding of houses next to their predecessors, leading to the emergence of clusters of house plans.[362] Typically, house plans do not overlap, which suggests that the locations of the predecessors were still visible when their successors were being constructed. This possibly indicates a rather short-lived use of houses, not exceeding a single generation of occupants. The relatively high chronological resolution furthermore permitted to reconsider the issue of house yards. In contrast to what has long been assumed, the number of pits per yard appears variable; however, most house yards have silo pits.[363] A further insight involves the use of flint varieties, which originate from various sources in the region. At some moment in time, corresponding to ceramic phase 14, a local variety of Lanaye flint became dominant,[364] and pits with abundant blade production waste – amongst which many blade cores – indicate specialist activity. As tools of this flint variety are lacking in the settlement itself, it is suggested that this production functioned within a regional exchange system.[365] Within a wider regional context, variability in the use of flint varieties between and within settlements points to the socially bound exploitation of raw material sources.

356 Appendix II: PUBID 194, 528, 537.
357 Coudart 1998, 73; Stäuble 1997, 23.
358 Appendix II: PUBID 53.
359 Van Wijk 2016. It is important to note that the extensive analysis and report are the result of the dedication of the researchers involved; much more time has been invested than was contractually assigned.
360 Van Wijk 2016, 101-102.
361 This typo-chronology was developed by Van de Velde (2014) on the basis of statistical analysis of LBK pottery assemblages. In total, 20 phases were distinguished, as opposed to the seven phases defined by Modderman (1970) that formed the chronological framework for discussion LBK developments until recently. Van de Velde's phasing is of a strictly statistical nature; it provides no basis for establishing an absolute chronology in connection with ^{14}C-dates, and the duration of each phase is therefore unknown.
362 Van Wijk 2016, 102-109; Van Wijk & Van de Velde 2016, 130-139.
363 Van Wijk 2016, 104-125.
364 This refers to the so-called LC1 variety (Knippenberg 2016, 181).
365 Knippenberg 2016, 193-195.

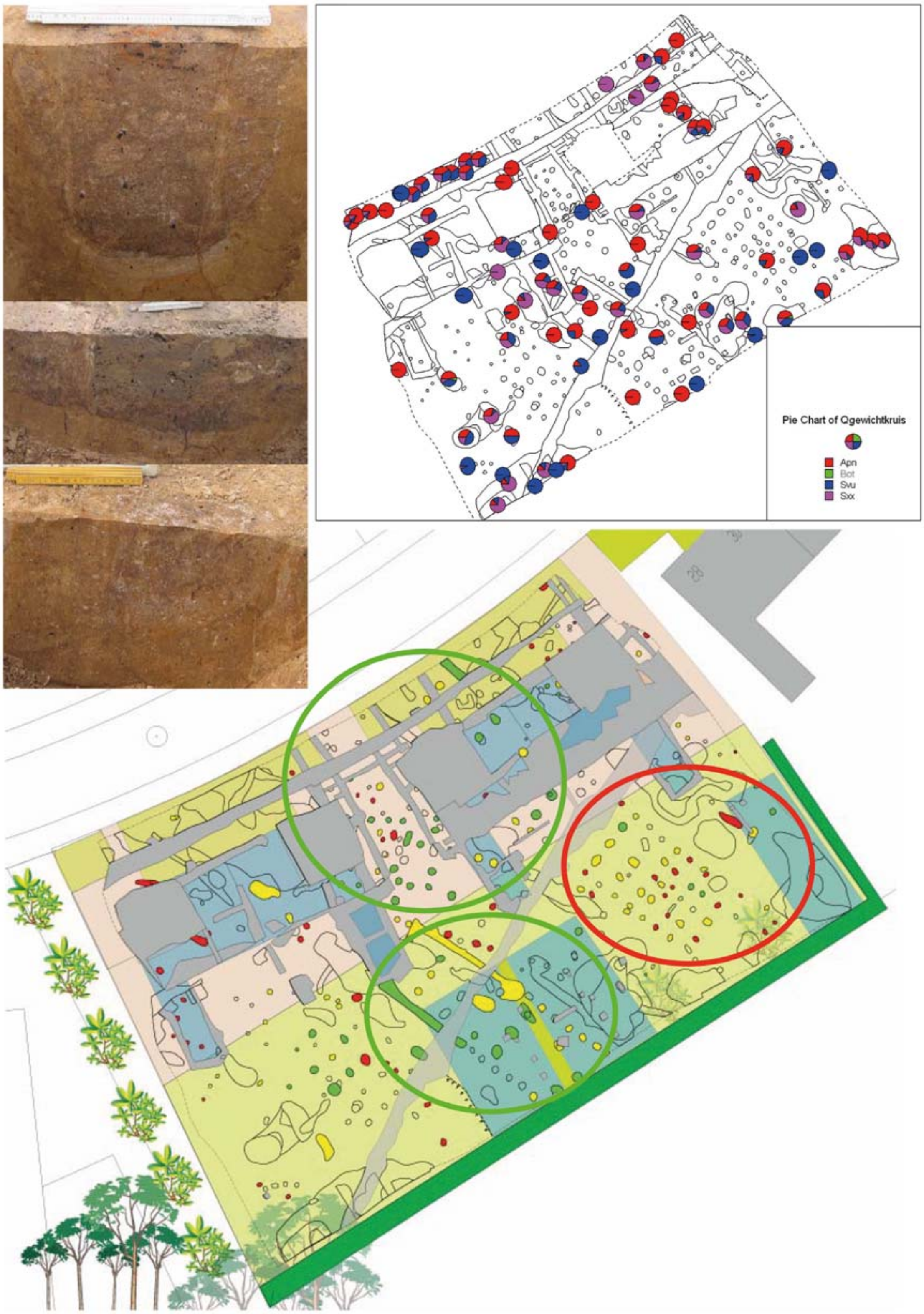


Fig 4.23 LBK house plans at Elsloo-Riviusstraat (from appendix II: PUBID 194). The maps provide spatial information about the degree of preservation and finds composition of features (red: pottery; green: bone; blue: flint; purple: stone). The photos show the preservation classes of postholes, which basically reflect visibility due to bleaching (top: good; middle: mediocre; bottom: bad).

Figure 4.24 Possible LBK enclosure at Beek-Kerkeveld (from appendix II: PUBID 53). The LBK features are indicated in brown; orange-coloured features are of medieval age.

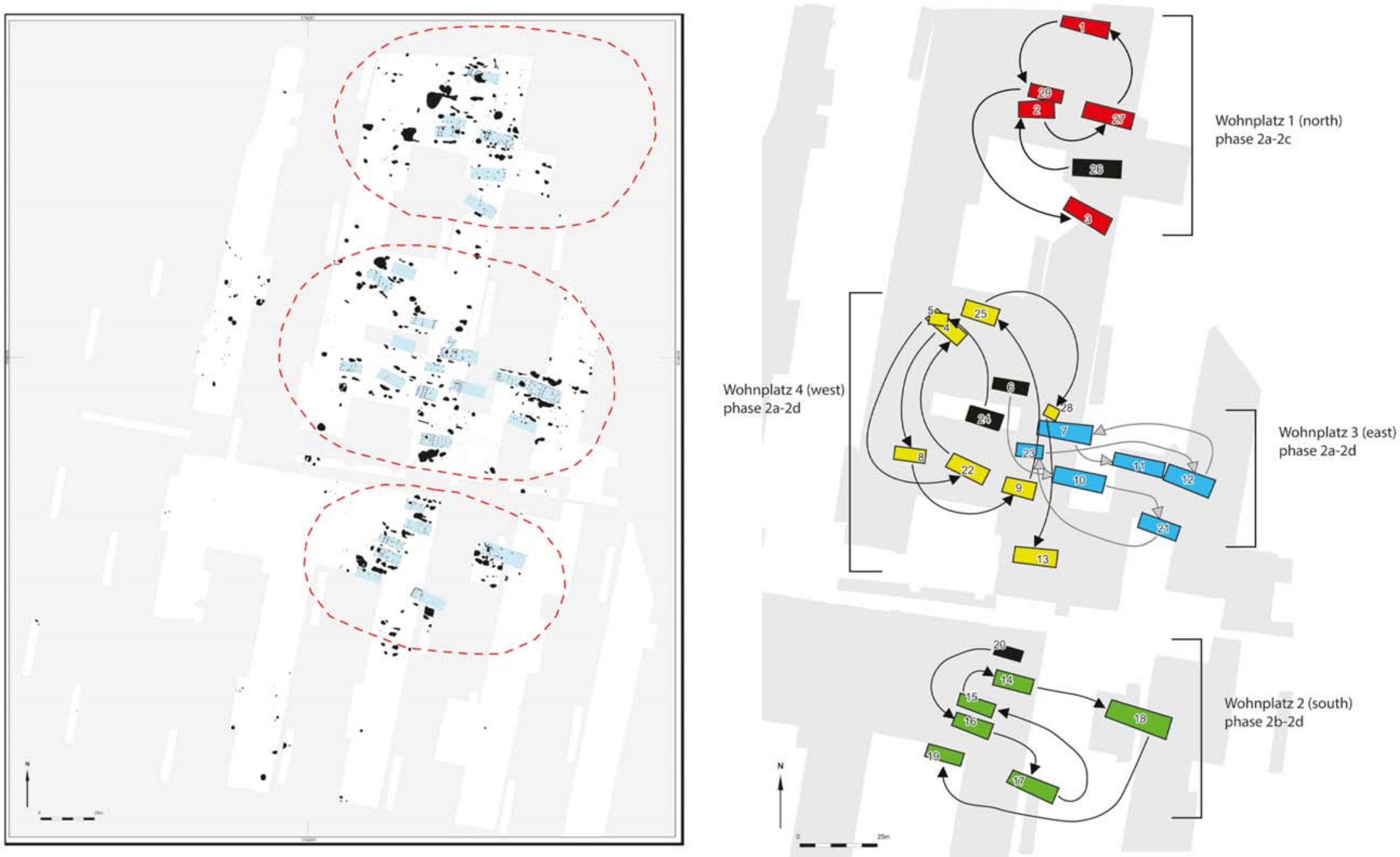


Fig 4.25 LBK structures and zones of habitation at Cannerberg, and a schematic representation of shifting house yards (from Van Wijk 2016).

Funnel Beaker Culture

Most notable are the built structures attributed to the Funnel Beaker Culture (known by its German abbreviation, TRB) that were discovered at Knooppunt Hattemerbroek. At this extended site complex, evidence for a palisade was found in section 7, within the excavated trajectory of the Hanzelijn railway. The palisade consists of a closely set curvilinear alignment of posts in a narrow ditch (fig. 4.26), and has been interpreted as part of a causewayed enclosure.[366] Within the excavated area, the palisade could be followed over a distance of 73 m, but it is clear that the structure must have been far larger, as this distance represents only about one fifth of a circle. Although 'complete' enclosures are never entirely circular, this still means the enclosure would have had a diameter of approximately 100 m. The attribution of the palisade to the TRB is tentatively based on the appearance and soil characteristics of the features themselves, on comparison with features dating to other periods (Mesolithic, Late Neolithic, Bronze Age), and on their stratigraphical context. Despite the limited quantities of pottery fragments securely attributed to the TRB, these form the majority of finds in this section of the excavated area; material dating to other periods is, however, also present. This makes an attribution of the palisade to the TRB a possibility, although there is no direct support from the spatial distribution of finds.[367] Several postholes within the enclosure are reported to have comparable characteristics and are potentially part of a house, although this cannot be confirmed. Furthermore, a 5 m long ditch with closely set posts within the enclosure possibly represents the remains of an earlier phase; two ^{14}C-dates confirm an attribution to the TRB period.[368] The enclosure found at Knooppunt Hattemerbroek is the third in the Netherlands. The other two were found at Anloo (province of Drenthe) and Uddelermeer (province of Gelderland).[369] It is assumed that these enclosures had a defensive or ritual function.

About 1600 m south-west of the enclosure, excavations south of Knooppunt Hattemerbroek yielded evidence for TRB domestic activities, including, potentially, the remains of built structures (houses?).[370] Within a 40 × 50 m wide zone, 65 postholes were attributed to a particular phase of activity on the basis of their appearance and soil characteristics. In some postholes, TRB pottery fragments were found, including, in one case, a large part of a pot (rim, neck and body) and a part of a baking plate, which could be interpreted as a 'construction offering' (see section 3.3.1). The excavators identified two square or rectangular structures on the basis of a limited number of postholes (fig. 4.27). These possibly represent houses comparable to Hunte 1 (north-west Germany), although the report recognises that this interpretation cannot be convincingly underpinned due to 'missing' postholes.
The spatial distribution of the finds does not provide further support either, despite the relatively good preservation of the finds layer that covers the features.

366 Knippenberg & Hamburg 2011, 162-164.
367 Wansleeben *et al.* 2011, 106-111.
368 GrA-39676: 4565 ± 30 BP; GrA-39755: 4560 ± 30 BP.
369 Harsema 1982; Waterbolk 1960.
370 Knippenberg & Hamburg 2011, 115-124.

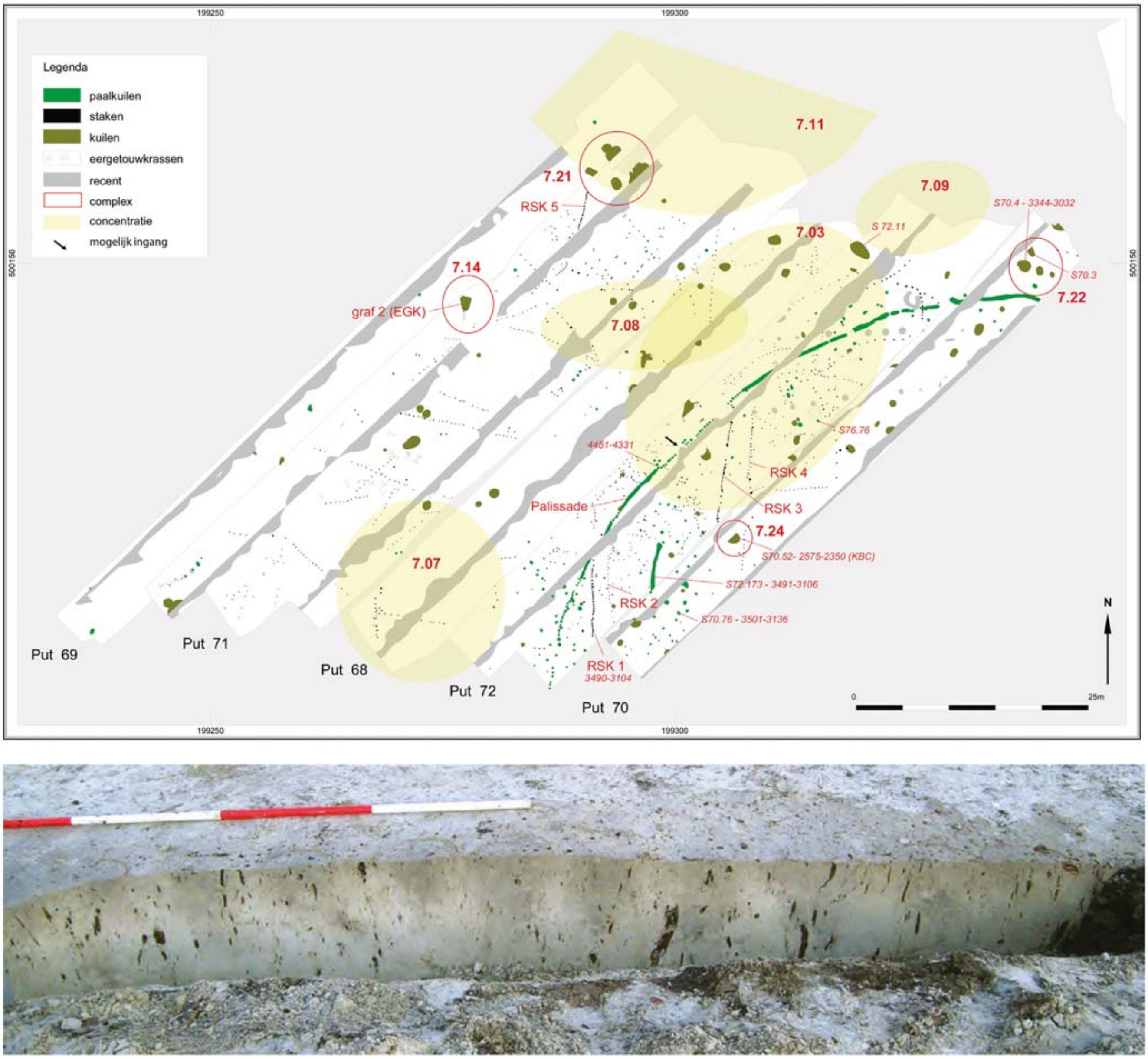


Fig 4.26 Part of a TRB enclosure/palisade (bright green) and a section showing a series of closely set posts at Knooppunt Hattemerbroek (from appendix II: PUBID 259).

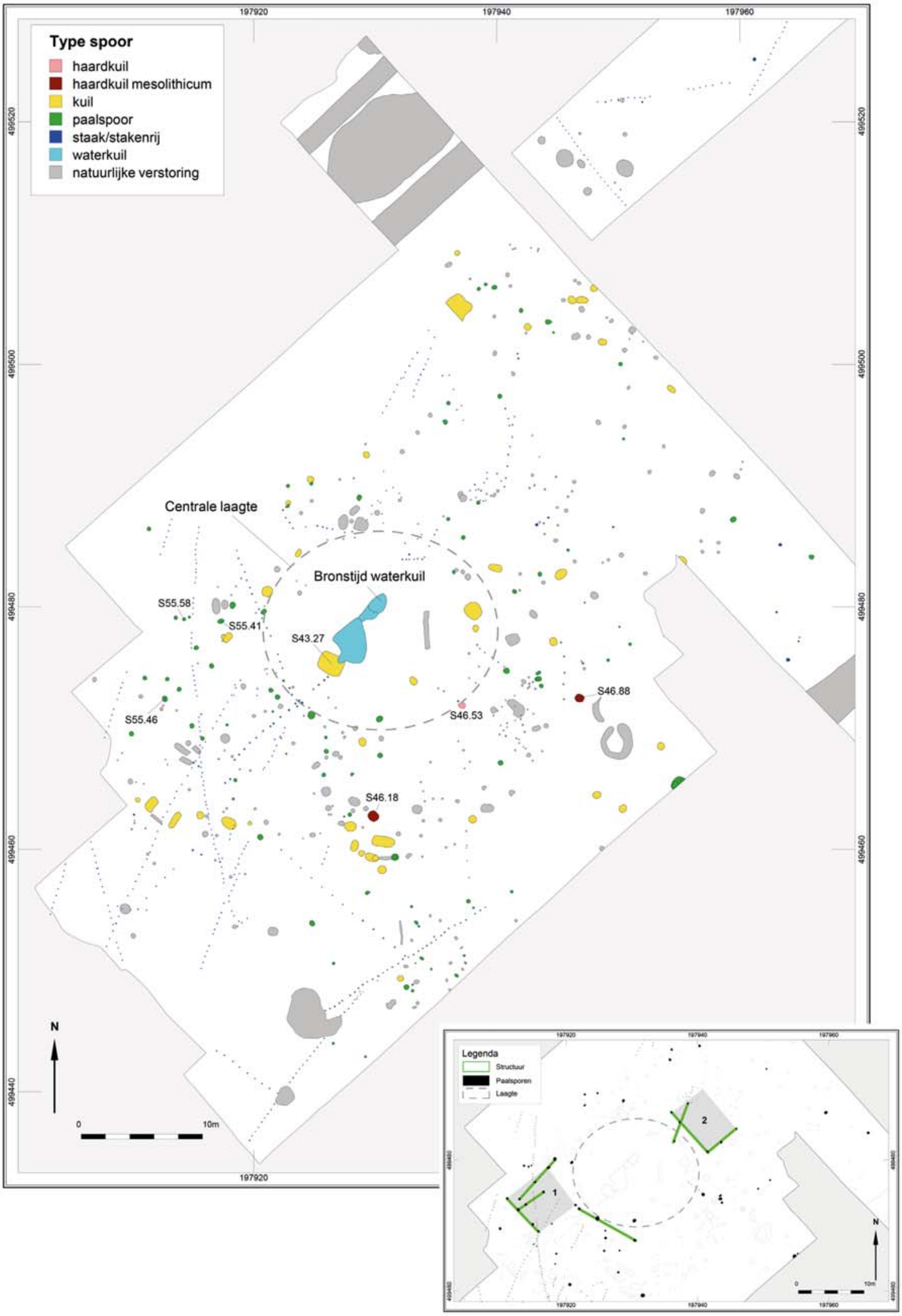


Fig 4.27 Zone with postulated (in green) structures dating to the TRB; linear arrangements of stakes and a water pit (in blue) date to the Bronze Age (from appendix II: PUBID 260).

Although it is clear that TRB occupation was well represented in the landscape near Knooppunt Hattemerbroek, it is also clear from the reports that insight into built structures remains limited. There is no reason to exclude the attribution of the palisade and traces of domestic activity to the TRB period, even though the supporting evidence remains scanty. And the finds near Knooppunt Hattemerbroek make it clear that we have to remain aware that there is the potential for TRB occupation in this part of the country. Evidence for TRB habitation is known from the Noordoostpolder, west of Knooppunt Hattemerbroek, as well as from Zwolle-Ittersummerbroek, to the north-east.[371]

The recent discovery of a TRB site near Dalfsen, only some 15 km from Knooppunt Hattemerbroek, provides an illustrative example of what can be expected in the context of development-led research – in this case an extended cemetery consisting of 137 inhumation graves and several cremation graves (fig. 4.28) that is the biggest TRB cemetery known in NW Europe thus far.[372] Right next to the cemetery, a house plan was found that can also be attributed to the TRB. The pots from the graves mostly belong to a single phase – Brindley phase 5, maybe some phase 6/7[373] – which spans a restricted period of two centuries (2900-2700 cal BC). This provides a unique opportunity to

371 Ten Anscher 2012; Clevis & Verlinde 1991.
372 Van de Velde & Bouma 2016.
373 Brindley 1986.

Fig 4.28 TRB flat grave cemetery (light grey), monumental structure (dark grey) and house plan (black) at Dalfsen (from Van der Velde & Bouma 2016).

study pottery traditions at the level of what are perhaps single but successive households, assuming that the people buried in the cemetery originate from the same settlement and represent several generations of families.
The discovery at Dalfsen in particular urges us to think differently about the TRB. Until recently, our picture of the TRB was largely based on megalithic graves in the north-eastern part of the Netherlands; clearly, there is a potential that exceeds all expectations, given the fact that in the Netherlands each square centimetre is assumed to have been disturbed.

Stein Group, Hazendonk Group and Vlaardingen Group

Middle Neolithic built structures have been reported from Hof van Limburg (Stein Group), Rijswijk-Ypenburg and Schipluiden (Hazendonk Group), and Hazerswoude-Rijndijk and Hellevoetsluis-Ossenhoek (both Vlaardingen Group). The cultural affiliation and function of the possible structure from Hof van Limburg are far from clear (fig. 4.29).[374] Here, two alignments of features, interpreted as postholes within a large pit, form a roughly rectangular configuration measuring 2.7 × 1.5 m. The nature of this possible structure is unknown due to the absence of finds in the features themselves. Even its attribution to the Stein Group is uncertain: it is based on the appearance and soil characteristics of the features and on the absence of Iron Age pottery, which is present in other parts of the excavated area.

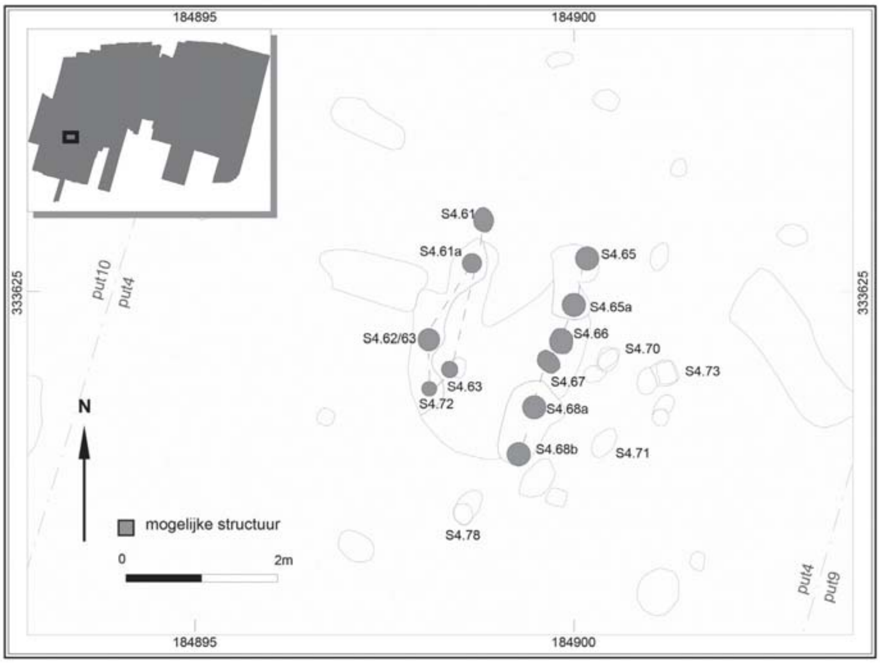


Fig 4.29 A possible Middle Neolithic (Stein Group?) structure at Hof van Limburg (from appendix II: PUBID 219).

[374] Van Hoof *et al.* 2013, 83-84.

The cultural context for Rijswijk-Ypenburg and Schipluiden, however, is clear: here we are definitely dealing with Hazendonk settlements.[375] At Rijswijk-Ypenburg, three house plans and three other built structures were identified (fig. 4.30).[376] The house plans are two-aisled and rectangular or oval in outline, measuring c. 9.7-8 m in length and 4.5-4 m in width. The other reported structures are simple rectangular yet irregular configurations of postholes. The attribution of postholes to some particular structure was based on several variables: posthole diameter, depth, shape and infill. Visual inspection of distribution patterns of various finds categories was used to identify functional zones relative to the structures (fig. 4.31). It is important to note that the lack of continuous data in finds distributions – due to differences in finds collection strategies, and subsequent choices with regard to sampling for specialist analysis – prevented a more analytical approach. And in contrast to Schipluiden, where moving average interpolation was applied, at Rijswijk-Ypenburg it was decided not to mitigate for missing data through interpolated values, in order to prevent the loss of potentially meaningful information within the actually recorded distributions (see section 4.3.2).

It remains uncertain whether house structures are also present at Schipluiden. As the excavators state, the only spatial structures that can be identified within the distribution of postholes consist of *"single rows of relatively large postholes set at irregular distances relative to one another"*.[377] The search for house plans comparable to those of, for instance, Wateringen,[378] Ypenburg,[379] Haamstede-Brabers[380] and Vlaardingen[381] (fig. 4.32), remains

[375] Appendix II: PUBID 732.
[376] Houkes & Bruning 2008.
[377] Hamburg & Louwe Kooijmans 2006, 62.
[378] Raemaekers *et al.* 1997.
[379] Koot *et al.* 2008.
[380] Verhart 1992.
[381] Glasbergen *et al.* 1967.

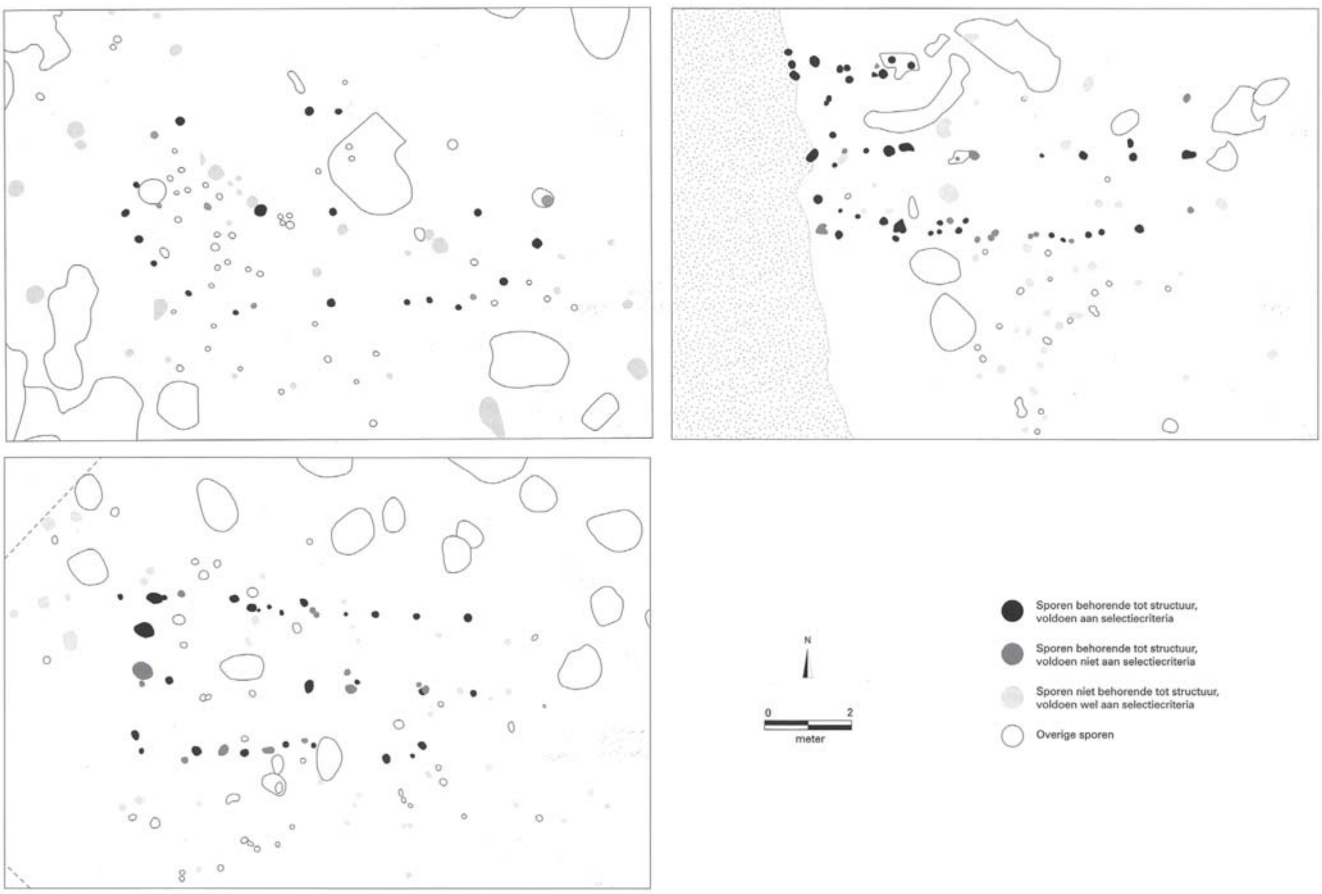


Fig 4.30 House plans of the Hazendonk Group from Rijswijk-Ypenburg (from Houkes & Bruning 2008). Black: features which meet the selection criteria and belong to the structure; dark grey: features which do not meet the selection criteria but belong to the structure; light grey: features which meet the selection criteria but do not belong to the structure; white: other features.

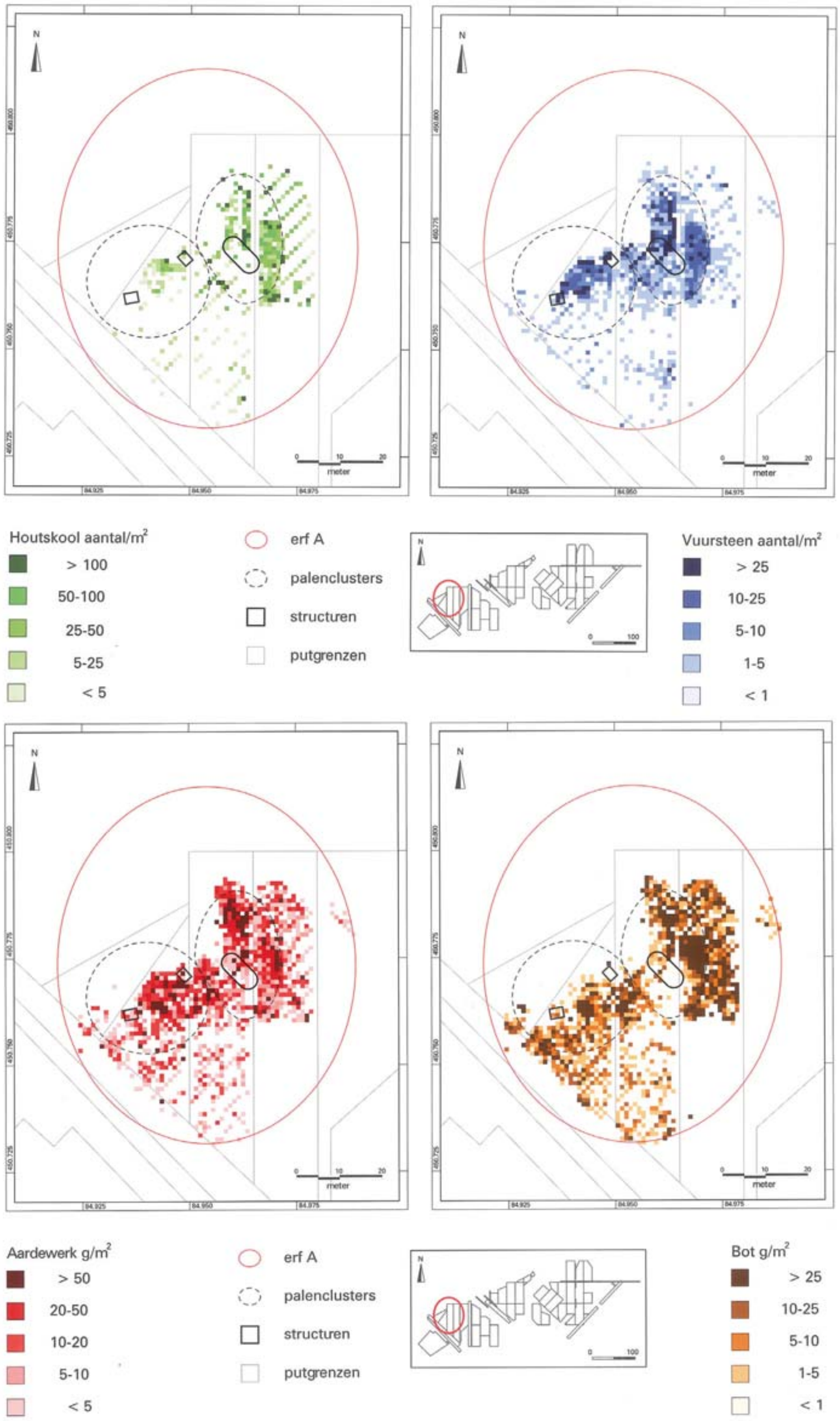


Fig 4.31 Distribution patterns of various find categories in a zone defined as homestead A of the Hazendonk Group at Rijswijk Ypenburg (from Dorenbos 2008). Top left: charcoal by number per m²; top right: flint by number per m²; bottom left: pottery fragments by weight per m²; bottom right: bone by weight per m²; red oval: homestead; dashed black ovals: clusters of postholes; solid black shapes: structures.

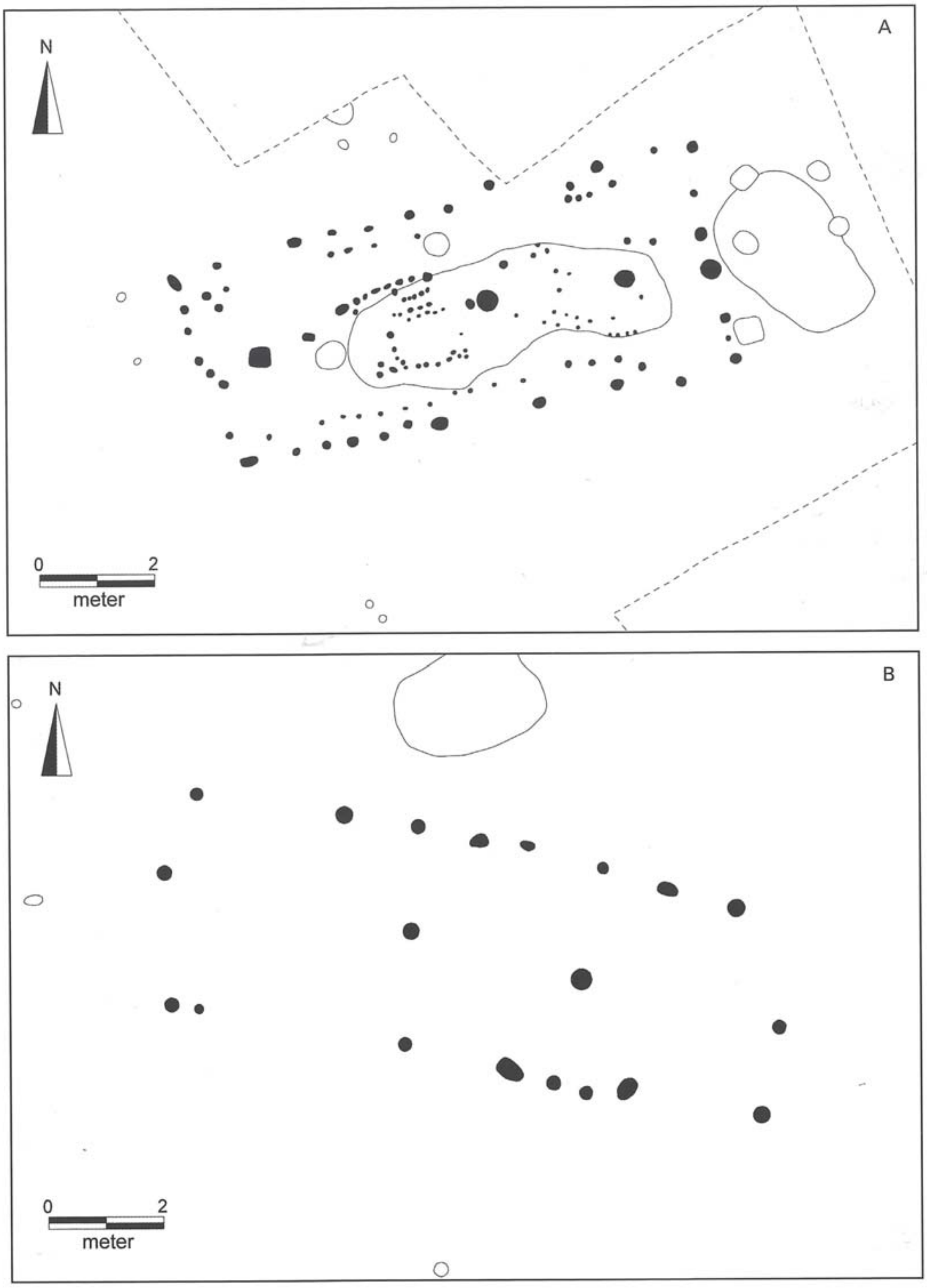


Fig 4.32 House plans from Heemstede-Brabers and Wateringen 4.

unsuccessful. It is very well possible, however, that houses were frequently rebuilt and shifted to higher parts of the dune as groundwater tables rose.[382] It is assumed that a rectangular ditch with rounded corners, found on top of the dune, delimited the final house or hut structure. However, there is no supporting evidence from the distribution of finds, as the highest part of the dune had been subject to erosion. The emphasis on concentrations (read: high densities) of finds comes with a co-notation of importance and can lead to straight forward assumptions about spatial association of finds and features such as postholes. In the case of Schipluiden, four clusters of postholes combined with concentrations of finds were interpreted as primary activity areas and possible 'farmyards'.[383] The next step is that farmyards are equated with households;[384] in other words, the built structure and its surroundings are given social meaning. This is not to say that farmyards don't have social meaning, but the problem is that the nature of the built structures themselves has not been established.

In contrast to the problematic identification of house plans, Schipluiden has yielded undisputable remains of multiple fences surrounding the dune. The fences consist of regularly spaced sets of posts (fig. 4.33). Another palisade or fence has been reported from Hellevoetsluis-Ossenhoek (fig. 4.34).[385] Here, the structure consists of closely spaced single posts or stakes. The alignment runs parallel to ard marks. It is highly possible that the fence delimited a field and was primarily meant to protect crops. Postholes for heavier posts, some of them with wood preserved within them, are also present, and may well belong to house structures. However, because the research was limited to several test trenches, there is not enough spatial information to isolate any structure with certainty. A comparable constraint is noted for Hazerswoude-Rijndijk, where fieldwork was restricted to trenches.[386] Several alignments of postholes have been documented, and these are believed to be part of a house plan. The same area also produced several hearths in several successive layers. Although not unequivocal, it is certainly possible that the features are part of a larger built structure that may have been rebuilt or repaired on one or more occasions.

From the above discussion, it is clear that development-led archaeology has yielded evidence for built structures on several occasions. Yet, it is also clear that the interpretive possibilities are often hampered by the restricted scale of fieldwork, by the shape of trenches, by site erosion, or by the complexity of the archaeological data itself. In order to reach sound conclusions regarding the presence of, for instance, house or hut structures, we argue for deeper and integrated analysis of spatial data. Typically, structures and features are reported separately from one another, and are barely used to effect an integrated synthetic analysis of various categories of information (finds). At the same time, however, we acknowledge that the cases mentioned above show that there is much potential, certainly at sites where well preserved finds layers ('cultural layers') are likely to cover structural features. In anticipation of such situations, high-resolution spatial recording of finds categories from such layers and the underlying features is a prerequisite for an analysis of both types of data that is focussed on the identification of built structures. In other situations, where the identification of built structures is unproblematic but cultural layers are lacking, meticulous analysis of finds and data by means of 'traditional' approaches can actually lead to new insights, as is shown in the Maastricht-Cannerberg example.

382 Hamburg & Louwe Kooijmans 2006, 62.
383 Wansleeben & Louwe Kooijmans, 2006, 72.
384 Wansleeben & Louwe Kooijmans, 2006, 86.
385 Van Hoof 2009, 59.
386 Diependaele 2010.

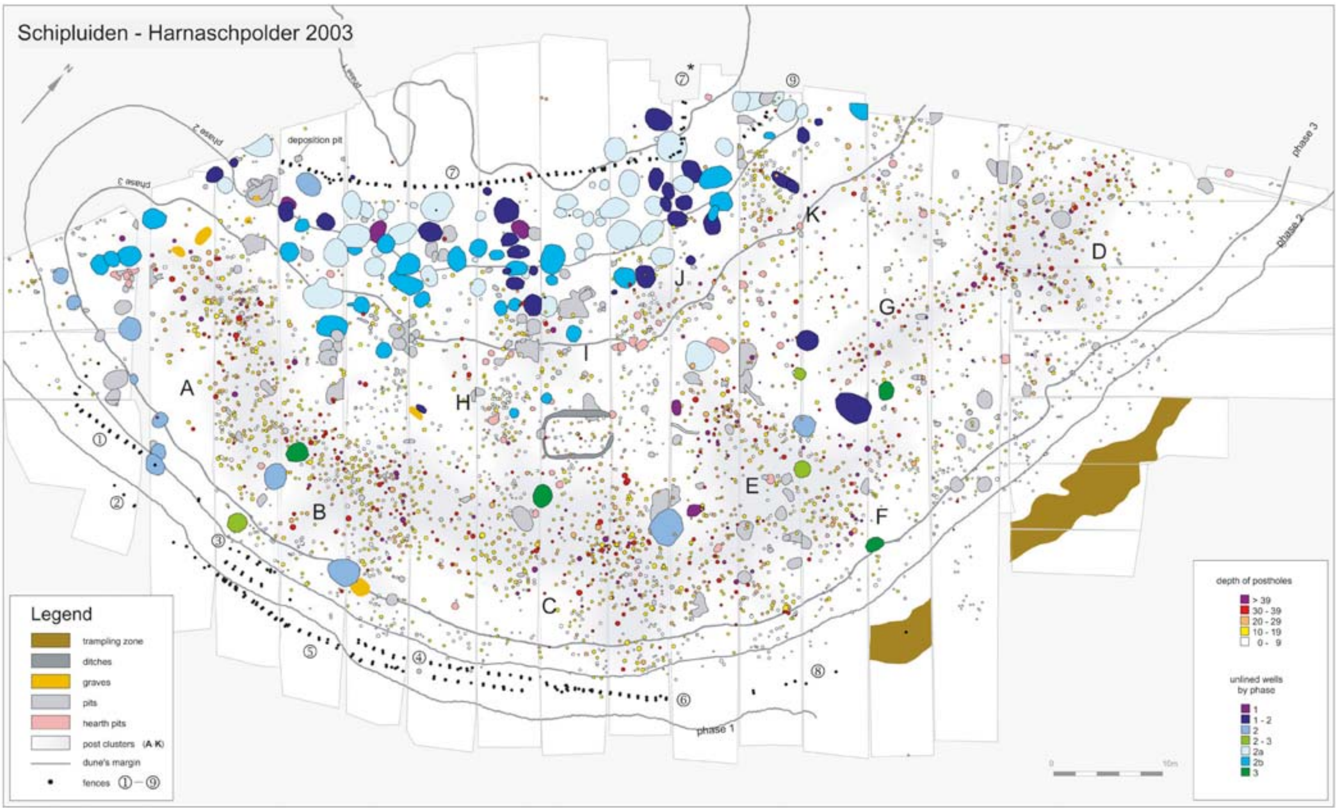


Fig 4.33 Fences are clearly visible around the dune at Schipluiden. Wells are mainly concentrated along the northwestern and western slopes of the dune (from appendix II: PUBID 732).

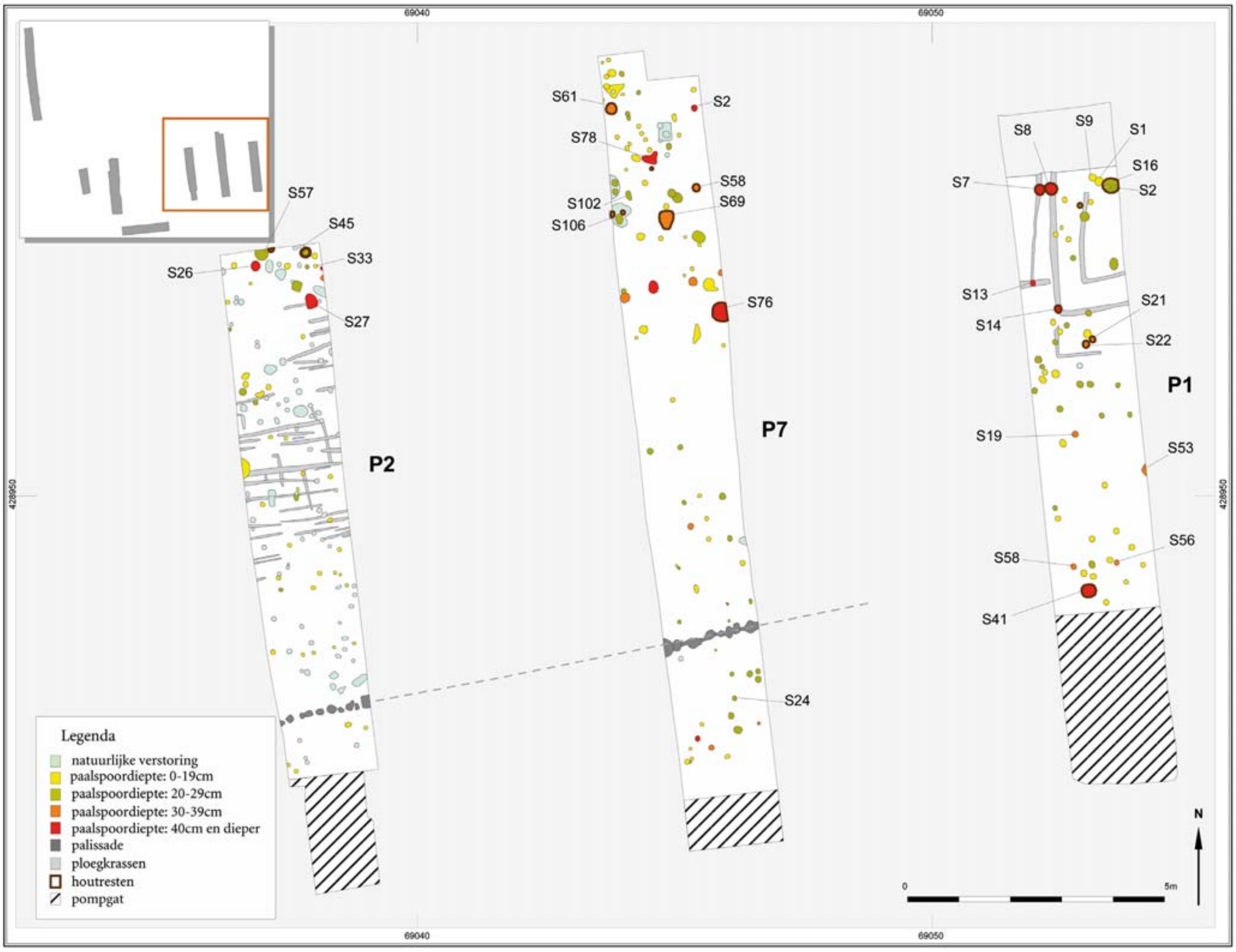


Fig 4.34 Palisade or fence at Hellevoetsluis-Ossenhoek consisting of closely set posts (from appendix II: PUBID 272).

5 People and environment

5.1 Introduction

The relationship between people and environment is a recurrent theme in archaeology. Although environment is a rather coarse concept, the term is generally applied to the entire of biotic and a-biotic features in a mostly vaguely defined or undefined stretch of land or space. Hence, the environment is composed of plants, animals, rocks, land surface, water, and according to some scholars, even scent and sound.[387] If we stick to humans, it is what surrounds an individual at some place in the landscape, and can also comprise other human individuals with whom there will be some degree of interaction – a socio-cultural environment. Generally speaking, however, the archaeological use of the concept of environment is strongly connected with the non-human dimensions. And often, if not most of the time, reference is made to the environment as a guiding or even deterministic framework for subsistence and dwelling; this is also the case in the NOaA 1.0. Of course, the behaviour of early prehistoric people cannot be set apart from the environment, but the environment cannot be set apart from human behaviour either. Hence, the relationship between people and environment can be extremely complex; indeed, it becomes more appropriate to speak about cultural landscapes.[388]

In this chapter we will focus on the interaction between humans and environment. In the NOaA 1.0, the relationship between people and environment features in the chapters 'Palaeogeography and genesis of the landscape', 'Archaeobotany', 'Archaeozoology and physical anthropology' and 'Early Prehistory'.[389] These chapters cover a wide range of topics and aspects from various research angles and address broad themes, such as landscape evolution, domestication, trade, subsistence and ritual. Such themes require analysis beyond the site level. The research questions are, however, rather strongly site- and object-focussed, which makes a synthetic analysis at multiple spatio-temporal scales difficult. This is all the more true when one considers the diversity of taphonomic processes that may have influenced the composition and quality of the assemblages and subsequent datasets. After all, information about botanic and faunal aspects of the environment largely depends on the preservation of such remains. In view of the variable geogenetic evolution of the Netherlands at the national scale, taphonomic processes create major bias owing to the large scale development of wetland conditions, or the absence thereof. Furthermore, it should be borne in mind that the interpretation of environmental data at the local scale requires a good understanding of the interrelationships of environmental processes at multiple spatial and temporal scales. This combination of factors makes any synthetic analysis concerning people-environment relationships in the context of development-led research difficult.

It is therefore no surprise that the subject is treated in a descriptive fashion in the great majority of reports. Relatively small-scale field investigations and fieldwork at sites with poor or limited preservation of organic components leave little room for in-depth analysis and interpretation, and this is clearly the case in most of the development-led projects. Indeed, our analysis of reports felt much like a survey of arguments: to what extent are conclusions substantiated by the actual data? Comparable data are not always interpreted in the same manner at different sites. And many research results may be relevant at the site level, but barely at a more general level, if at all. Hence, a small number of extensive reports account for most of the noteworthy results and novel ideas about the meaning of organic material categories for early prehistoric people. Most notably this concerns the large-scale excavations at Dronten-N23 (Mesolithic), Rotterdam-Yangtze Harbour (Mesolithic), Knooppunt Hattemerbroek (Mesolithic) and Schipluiden (Neolithic).[390]

5.2 Exploitation and use of organic resources

Traditionally, the first topics that come to the archaeologist's mind with regard to bioarchaeological studies are about food resources and the reconstruction of the environment. Of course, these are important topics for our understanding of how people in the past exploited the landscape.

387 See e.g. Ingold 2000.
388 Cavallo *et al.* (2006, 20) note that the distinction between research questions concerning the natural landscape, on the one hand, and the cultural landscape, on the other, is in fact artificial.
389 Brinkkemper *et al.* 2005; Cavallo *et al.* 2006; Deeben 2005, 2006.
390 Appendix II: PUBID 260, 732, 740.

People's stomachs needed to be filled, and the environment set the outer limits in terms of resource potential. Notably, these aspects have received, and still do receive, lots of attention. This being said, the study of other aspects of human use of organic materials has a long history as well. These other aspects are numerous, and include the production and use of tools (e.g. combs, awls and harpoons), building and construction material (e.g. fish weirs, thatching, posts) and clothing (e.g. leather, plant fibre clothes). In addition, social and cosmological relationships between people and organic material can be expressed through specific objects, such as pendants made out of bone or plant material, or the symbolic or ritual treatment of items, such as antler, bone or plant material (e.g. branches, flowers). Clearly this makes thematic discussions under such headings as 'People and Material' (chapter 3), 'People and Space' (chapter 4) and 'People and Environment' (this chapter) artificial. People, material, space and environment are interconnected aspects of life. However, in order to avoid one big tangle of topics being discussed, we will focus the present section on food procurement and processing and on the use of wood for other purposes than the production of implements (this topic is presented in section 3.2.2).

5.2.1 Subsistence and food processing

Topics related to food economy or subsistence dominate much of the archaeological literature. In many cases, however, the archaeological record is rather poor in this respect. Even when remains of potential food stuffs have survived, it is often not all that easy to distinguish between food remains and natural background 'noise' or accumulation. Also, it is difficult to establish how representative assemblages are of the original range of food resources. Generally speaking, the further one goes back in time, the rarer the reports that contain data on organic remains that can be connected with the food economy. This is partly due to the overrepresentation of development-led research in parts of the Netherlands where preservation conditions for organic material are poor (see chapter 2). Older sites with the potential for preserved organic material are mostly expected in parts of the country where these are covered in metres of sediment. As a result, the potential availability of (new) information about exploitation and use of food resources is extremely fragmentary and biased. We will discuss some central topics and related problems below in reference to the results of development-led investigations.

Animals in the landscape

Animals played an important role in early prehistoric economies. Sites with good preservation conditions have provided insight into various aspects of animals as a resource for food, hide, fur and bone/antler. Bone remains inform us about which animal species were exploited, how they were butchered and which parts were used for which purpose(s). Nonetheless, very little is known about these aspects for major parts of early prehistory. This is particularly the case for the Late Palaeolithic to Early Neolithic. Results from development-led research permit us to discuss some particular problems and peculiarities of the faunal record.

A remarkable find dating to the Early Mesolithic is an incomplete red deer skeleton found in the stream valley of the Tungelroyse Beek near Mildert (fig. 5.1).[391] The Early Mesolithic age of this assemblage was established by means of a ^{14}C-date.[392] The skeletal elements found represent the crown tines of the antlers, the skull, the mandible and the anterior half of the rib cage. A second individual is represented by a mandible. Despite the absence of evidence for butchery (cut marks, bone fractures) or traces of projectile impact, the report suggests that the remains may well represent a hunter-gatherer kill site. A flint blade found at 6 m distance may be related to this event, but in our opinion this is far from certain. The assemblage is difficult to interpret, as it is not quite clear whether the bones recovered constitute the entire original assemblage, or, instead, represent an incomplete assemblage as the result of recovery by mechanical shovel.[393] The antler remains have fresh fractures, which indicate recent damage. The total absence of posterior body parts and limbs is nonetheless remarkable, and may well be the result of the removal of body parts by humans. At least, there are no indications that this may have resulted from recent disturbance. But the situation is complex, given a total of 147 animal bones of various species found in a

391 Appendix II: PUBID 395.
392 9650 ± 50 BP (lab.nr. not given in source publication).
393 Poluted soil was removed by means of a mechanical shovel. This soil could not be checked for the presence of bones.

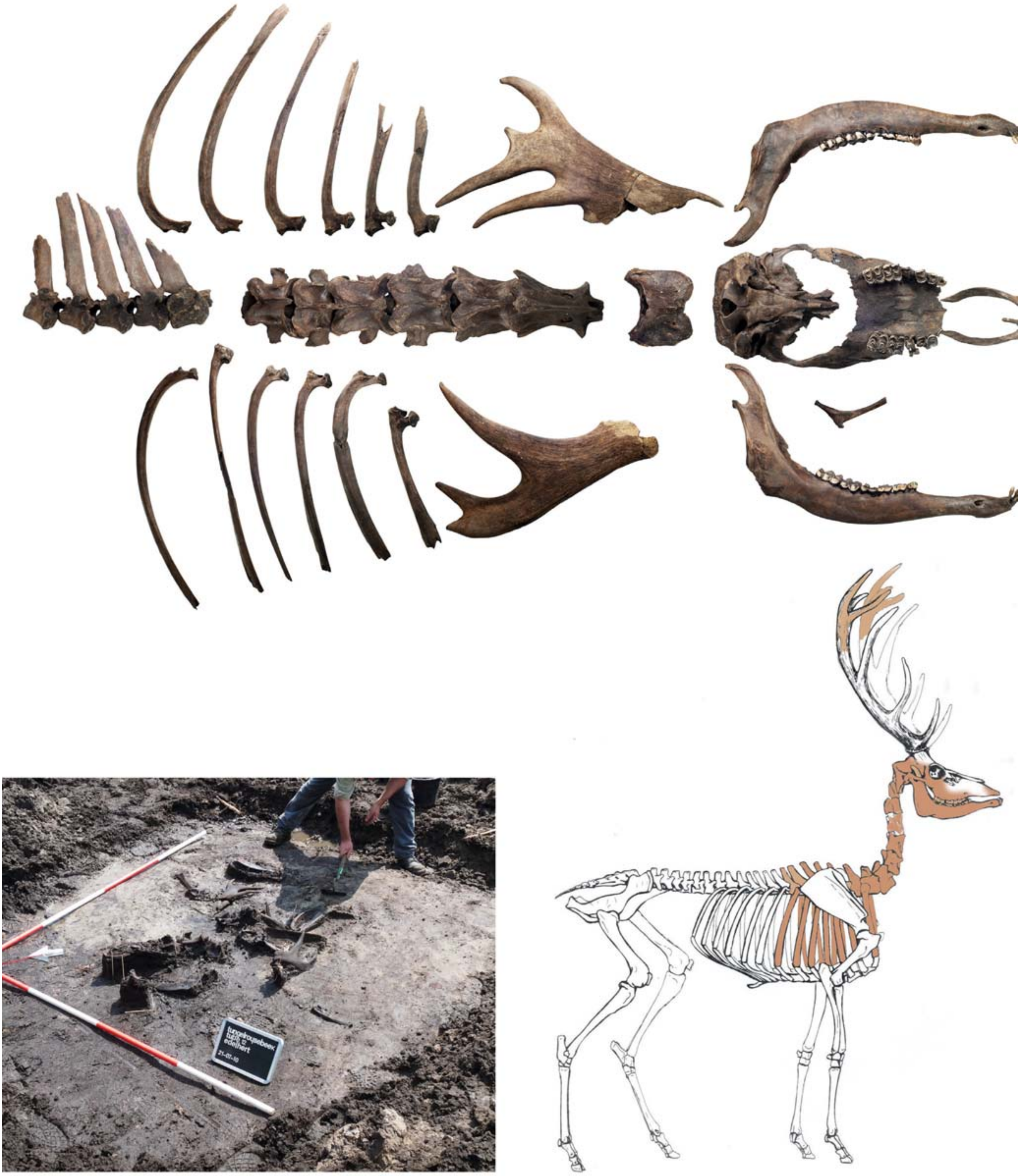


Fig 5.1 The Mesolithic red deer remains from the valley of the Tungelroyse Beek. Top: the bones in anatomical position; bottom left: the skeletal remains during excavation; bottom right: schematic representation of the bones uncovered (from appendix II: PUBID 395).

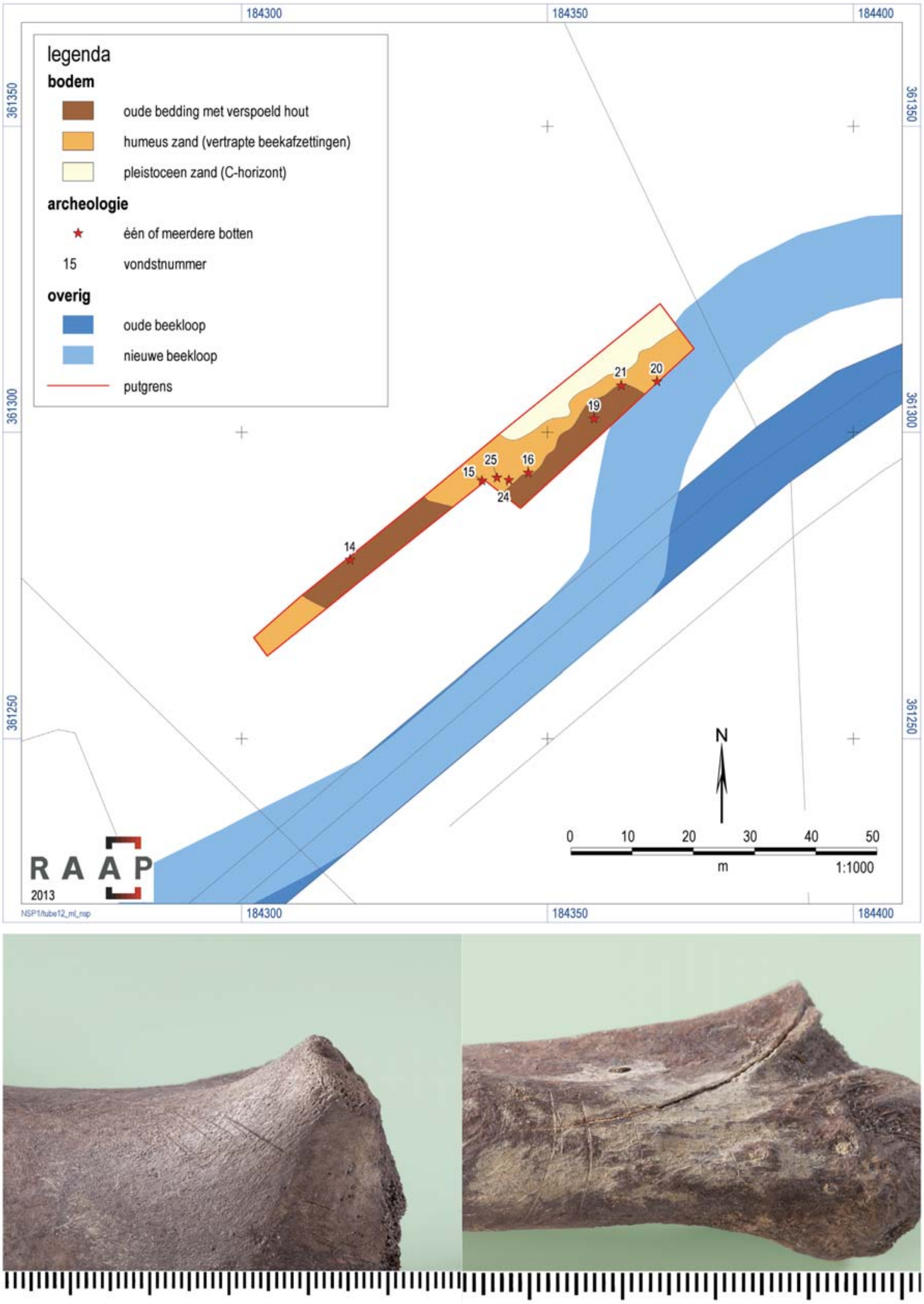


Fig 5.2 Find locations in the valley of the Tungelroyse Beek nearby the find location of the red deer skeleton. On the right, two bones with clear cut marks are shown (from appendix II: PUBID 395).

nearby location (fig. 5.2). Together with other artefacts – flint tools, pottery – these bones point to long-term use of the stream valley from the Mesolithic to Roman times. A chisel made out of an aurochs metatarsus, as well as a red deer antler crown tine, have been ^{14}C-dated to the Late Mesolithic.[394] Bones belonging to domesticated animals indicate more recent occupation as well. Several bones of red deer and horse – probably wild – show cut marks, attesting to human activity. Despite the impossibility of confirming an anthropogenic origin for the partial skeleton, the various observations in this zone of the stream valley attest to long-term exploitation of animal resources. This picture fits observations in stream valleys elsewhere in the country, notably the Tjonger valley in the northern Netherlands, where Late Mesolithic aurochs remains with butchery marks have been collected at several locations.[395]

A fossil stream valley near Emmen provides another glimpse at the long-term use of such landscape zones.[396] One location (SCH1500) only yielded an isolated fragment of a red deer antler, but, interestingly, several wooden stakes returned ^{14}C-dates that indicate Late Mesolithic and Middle Neolithic activity.[397] Another location (SCH2600) yielded two clusters of stakes. Their ^{14}C-dates correspond to the Early Neolithic and the Middle Neolithic. Yet another cluster of stakes at location (SCH1200) returned ^{14}C-dates corresponding to the Middle to Late Bronze Age. It is, however, not clear what activity the stakes may relate to, but it is very well possible that they are connected with fishing.

Hunting and fishing activity is certainly to be expected in stream valley landscapes. Running water attracts many different terrestrial animals and of course provides habitat for semi and fully aquatic animals. In a way, stream valleys provide a rather predictable food procurement environment. Together with, for instance, the Early Mesolithic context of Zutphen-Ooyerhoek,[398] the above examples illustrate that archaeological evidence for the exploitation of these environments is probably not as rare as one might expect. The problem is first of all that the resolution of phenomena related to activity in such areas is low, involving diffusely spread finds in and along former gullies. Archaeological watching briefs in stream valleys are the only way to ensure, to some degree, the discovery of such phenomena.

Equally, we must bear in mind that evidence for the procurement of animal food resources outside stream valleys, or outside wetland contexts in general, is extremely sparse and basically a consequence of preservation conditions. Not surprisingly, the great majority of reports make no or only marginal mention of animal remains, as most sites investigated connect to dryland settings. This does not necessarily mean that no faunal remains were found. Our survey of reports shows that finds of small quantities of burnt (calcined) bone are not necessarily rare (table 5.1), but that little attention is paid to them due to an assumed lack of (potential) information.[399] We argue that this negative attitude is unwarranted.

As can be concluded from table 5.1, the possibilities for taxonomic identification are restricted, but not absent. Clearly this sets limits to the information potential of such assemblages, but it is important to note that both animals and humans may be represented. In the particular case of Rotterdam-Beverwaard, the identification of the human remains was based on morphological characteristics. Techniques such as bone histology and mass spectrometry permit researchers to distinguish between human and animal material when identification based on morphology is not possible.[400]

394 6570 ± 40 BP (lab.nr. not given in source publication).
395 Prummel & Niekus 2011.
396 Project Emmen-Olieveld Schoonebeek (Appendix II: PUBID 482).
397 Appendix II: PUBID 482.
398 Groenewoudt *et al.* 2001.
399 Lauwerier & Deeben 2011.
400 Histological analysis is applicable to calcined bone remains (see e.g. Cuijpers 2006). Mass Spectrometry requires collagen and thus unburnt bone.

Table 5.1 Sites with (exclusively) calcined bone.

Site	Characterisation	Context
Duiven-Ploen Zuid	Calcination degree IV-V (650-800 °C); mostly fragments of diaphysis, some epiphysis; no clear evidence for human material.	Mesolithic; infill of a natural (?) feature.
Finsterwolde	Small number (29) of fragments; one fish bone.	Mesolithic (?); diffuse distribution.
Fluitenberg	Small number (15) of fragments; not analysed.	Mesolithic; infill of pit hearths.
Hasselo	Two fragments; not analysed.	Mesolithic; infill of pit hearths.
Rotterdam-Beverwaard	Calcination degree IV-V (650-800 °C); human and animal remains; skeletal elements determined when possible; age indication; incidental gender assignment.	Mesolithic; most material from three pits (graves); some remains from find layer.
Emmen-Olieveld Schoonebeek	Six small fragments; not analysed.	Mesolithic – Neolithic; from find layer.
Dronten-N23	Heavily fragmented; one species assignment (*Sus*), further mostly large – medium size mammal; no evidence for human material.	Mesolithic; diffuse distribution in finds layer, but slight clustering close to flint concentrations.
Rotterdam-Yangtze Harbour	Large assemblage (> 12,000) of fragments (not only calcined); many mammal, bird, fish species identified, as well as reptiles.	Mesolithic; material sampled from finds layer.
Epse-Olthof	Some heavily fragmented remains; no species assignment possible.	Mesolithic (?); possibility of post-depositional intrusion in pit hearths.
Hoogezand-Sappemeer Vosholen	Two fragments; one possibly rib or shoulder blade; medium-size mammal. Further mention of very small fragments from charcoal samples from pit hearths: not collected.	Mesolithic; from finds layer.
Wijchen-Alverna	Small number (23) of fragments; not analysed.	Mesolithic; possibly from a surface hearth, associated with charred hazelnut shell and burnt flint.
Ede-Kernhem	Small number (107) of fragments; not analysed.	Mesolithic (?); partly from disturbed context, but maybe some original context.
Leeuwarden-Hempens	Limited number (204) of fragments; one species assignment (*Ovis/Capra*).	Mesolithic (only 4 fragments) and Middle Neolithic (TRB); Neolithic assemblage from a surface hearth.
Rotterdam-De Zwanen Rietpark	High number (c. 450) fragments; some species identified (*Sus*; *Lutra lutra*) in addition to assignment to large, medium, small-sized mammal.	Early Neolithic (Swifterbant); collected from finds layer.
Emmeloord-Ens	High number (c. 450) of fragments; some fish remains (*Anguilla*; Cyprinidae); *Ovis/Capra* (dental elements).	Neolithic; collected from find layer.
Groningen-Helpermaar	Small number (79) of fragments; some species identified (*Sus*; *Bos*; *Ovis/Capra*) in addition to assignment to large and medium-sized mammal.	Middle Neolithic (TRB); most material collected from finds layer.

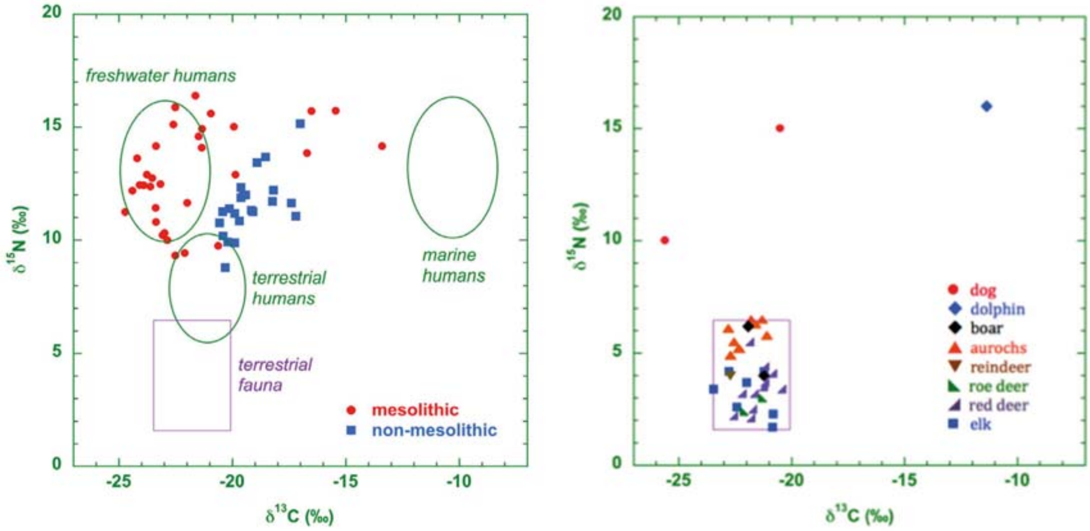


Fig 5.3 Stable isotope data of human remains (left) in comparison with those of terrestrial mammals remains (right) from the North Sea (from Van der Plicht *et al.* 2016).

Apart from the distinction between human and animal remains, it is also important to consider the potential of calcined bone, even if heavily fragmented.[401] For instance, fish vertebrae, which are important for taxonomic identification, continue to be identifiable, even when calcined and fragmented; in fact, they often remain intact. Good examples are known from both Mesolithic and Early Neolithic sites, notably from Rotterdam-Yangtze Harbour and Hoge Vaart-A27.[402] Fragments of bones belonging to small mammals and birds also have a fair chance of being identified if represented in an assemblage of calcined bone; due to their small size, they tend to fragment into fewer pieces, and their taxonomically distinctive morphological characteristics often remain preserved. In the case of Rotterdam-Yangtze Harbour and Hoge Vaart-A27, for instance, calcined remains of weasel, squirrel and small songbirds provide examples of animals that are hardly ever found in bone assemblages. The analysis of the assemblages from these sites has revealed a surprising range of species, because the material received the attention required. In the case of Rotterdam-Yangtze Harbour, even though the total number of bone fragments identified to the species level was not that high (17 for mammals, 84 for birds, 316 for fish), the absolute number of species identified was high (8 for mammals, 19 for birds, 14 for fish).

The information value of assemblages such as the one from Rotterdam-Yangtze Harbour is high when considered in a long-term regional context. Hunter-gatherer activity at this site spans a considerable part of the history of the submersion of Mesolithic Doggerland, i.e. the southern North Sea. During the Early Mesolithic, the site was located far inland, on a high sand dune in the Rhine-Meuse valley. Gradually, however, the coastline moved eastward, and the site became located in the Rhine-Meuse estuary, and eventually on the coast. The faunal assemblage does, however, show only sparse evidence of an increased importance of marine food resources. The activities came to an end when the sand dune was inundated by the sea by 6300 cal BC. Stable isotope analyses of Mesolithic human remains from the North Sea also show restricted evidence for a marine component in the diet of people who inhabited the gradually submerging land of Doggerland (fig. 5.3).[403] There is a clear aquatic signal, yet also one of freshwater food resources (mostly fish, water plants?). The picture fits that of the people who were buried on the sand dunes of Hardinxveld-Giessendam Polderweg and De Bruin, in the Rhine-Meuse estuary.[404]

401 Lauwerier & Deeben 2011.
402 Zeiler & Brinkhuizen 2015.
403 Van der Plicht *et al.* 2016.
404 Smits & Van der Plicht 2009.

Where it comes to our insights into the exploitation of animals in the Mesolithic to Early Neolithic landscape, the picture is still highly fragmentary, and it is scattered over many published sources. This is also the case for the Middle Neolithic, despite the availability of relatively well-preserved sites, such as Schipluiden and Rijswijk-Ypenburg.[405] What becomes clear from these two coastal sites is that the contribution of animal foodstuffs to the diet is first of all a continuation of hunter-gatherer traditions, but with the addition of domesticated animals. The entire environmental range in the sites' surroundings was exploited for animal resources: the beach plain and coast, the estuaries and rivers, but also the back-barrier freshwater marshes (fig. 5.4).[406] At Schipluiden, no fewer than 45 species of mammals, birds and fish either were on the menu or were caught for their fur (e.g. marten, otter and beaver) or their feathers (e.g. white-tailed eagle).[407] The spectrum at Rijswijk-Ypenburg is comparable to that at Schipluiden. At both locations, aquatic environments are well represented by fish and fowl. Animal husbandry seems to have been more important than hunting wild animals where it comes to meat procurement. Nonetheless, the hunting of aurochs, wild boar, red deer and a range of fur-bearing animals, as well as predators, such as

405 Appendix II: PUBID 732, 775.
406 Koot *et al.* 2008; Louwe Kooijmans 2006.
407 With regard to the possible significance of eagle feathers, see Amkreutz & Corbey (2008).

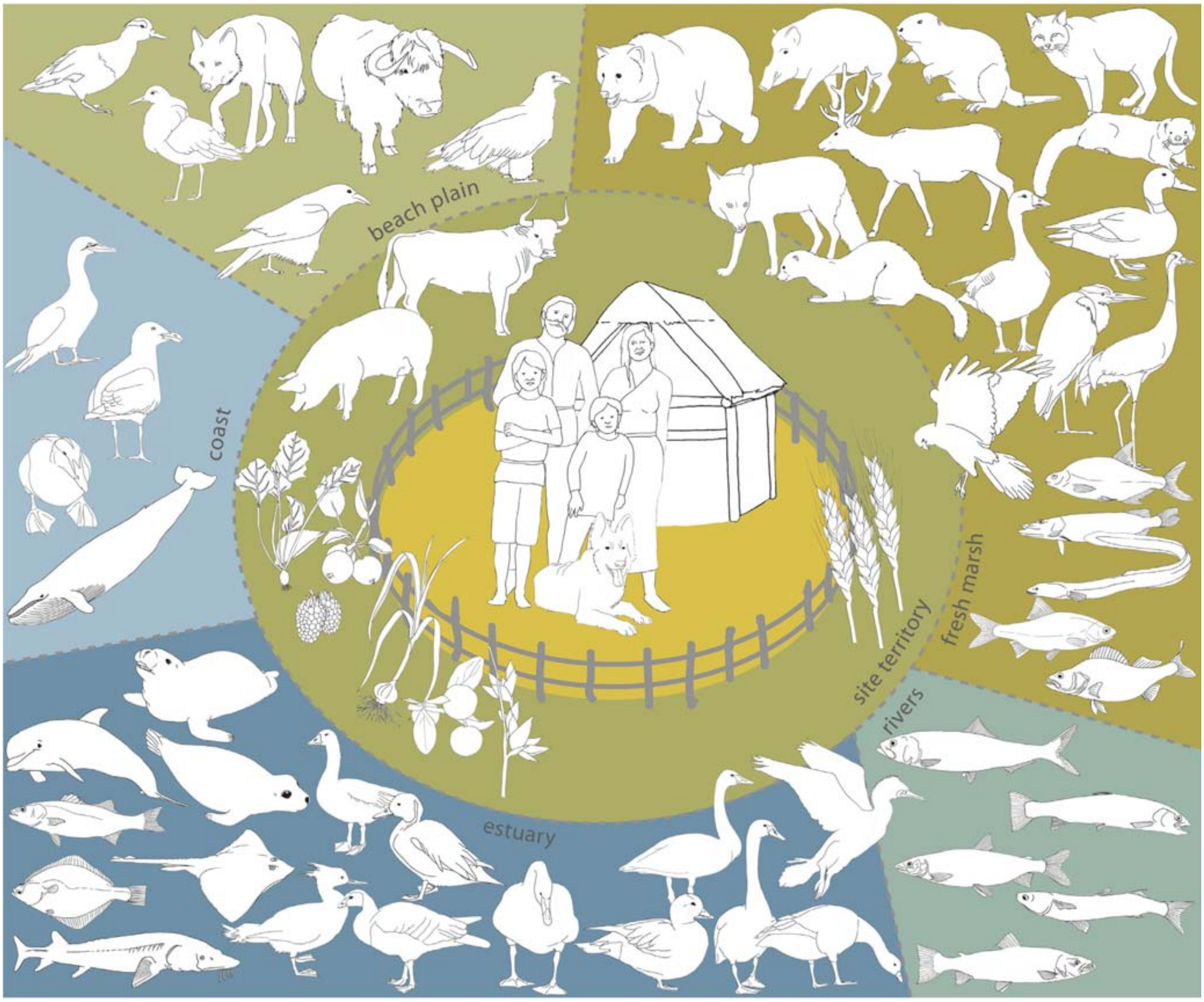


Fig 5.4 Schematic representation of the economic range of the Schipluiden household in relation to environmental zones (from appendix II: PUBID 732).

Figure 5.5 Two molars of Lynx from Schipluiden (from appendix II: PUBID 732).

wolf, brown bear and fox, was more than incidental. A broadly comparable picture comes from the Vlaardingen site of Hellevoetsluis-Ossenhoek.[408]

So, despite the coastal location of these sites, people did not turn their back on the back-barrier landscape. However, how this compares with exploitation strategies during the Middle Neolithic farther inland remains mostly a guess due to the absence of well-preserved assemblages. The site of Wijchen-Oosterweg yielded only highly fragmented bone from a Vlaardingen context, amongst which only cattle and pig/wild boar could be identified.[409] To what extent connections existed between the coastal Hazendonk and the inland Vlaardingen settlers in terms of, for instance, the exchange of animal resources remains an open question. In this context it is important to refer to the Hazendonk site of Schipluiden, where three molars of at least two lynx were found (fig. 5.5). There exists no archaeological and historical evidence that lynx was indigenous to the Low Countries, but it cannot be excluded that these animals did live here. Today, the closest habitats are in the Ardennes.[410] If this was also the case in early prehistoric times, it is likely that the Schipluiden specimen reached the coastal area through contacts with groups farther inland, for instance, in the upstream areas of the Meuse and Rhine.

A final problem that needs to be addressed is the (probably) biased picture of what constituted the animal landscape in its totality, and how this may have changed over time. Our reference framework is based on what the archaeological record shows in terms of exploited animals, but not on what other animals inhabited the landscape. Of course, actualistic models of ecosystems and biotopes provide some reference, but they do not tell us what the actual situation was. In this respect, the Pleistocene record may have an advantage over the Holocene record, as palaeontologists have dedicated much work to the reconstruction of animal communities under varying climatic conditions. For the Holocene, such palaeontological work is basically lacking; one can notice a clear emphasis on the investigation of anthropogenic impact on the environment, notably on vegetation. Current developments in the analysis of ancient DNA in sediments offer exciting new possibilities of filling (part of) the gap. Where bones are lacking, aDNA that survived in sediments – notably quickly covered and saturated sediment layers and soils – can provide unexpected insight into animals that left their traces in the landscape through, for instance, excrement.[411] Development-led research in areas where such conditions can potentially be expected (e.g. deeply buried palaeosols in the western Netherlands?) could foster the development of such new methods, and make a serious contribution to archaeologically relevant environmental reconstruction. The question should be not only which animals were exploited by people, but also which animals were not.

408 Appendix II: PUBID 87.
409 Appendix II: PUBID 600.
410 We must bear in mind that the present-day habitats of lynx in north-west Europe are refugia.
411 Slon *et al.* 2017; Smith *et al.* 2015.

Plant food resources

In contrast to early prehistoric animal food resources, for which no recent overviews are available, early prehistoric plant subsistence and the reconstruction of the vegetation has seen much work, particularly in connection with the Dutch wetlands during the Late Mesolithic to Middle Neolithic.[412] A central theme in this research concerns the impact of human activity on vegetation and the integration of crop cultivation in the food economy. The latter topic is one that has received lots of attention for decades, and has been extensively discussed in recent years in connection with academic and development-led research at the Late Mesolithic to Early Neolithic sites of Hoge Vaart-A27, Hardinxveld-Giessendam Polderweg and Hardinxveld-Giessendam De Bruin, as well as the type site locations at Swifterbant.[413] The evidence places the introduction of crop plants – emmer and naked barley – in these wetland areas by 4400/4300-4100 cal BC. The evidence consists of charred cereal grains and chaff, of pollen in sampled peat sequences, and of soil features that can securely be interpreted as a field tilled by means of a hoe (fig. 5.6). If the suggested dates are correct, the introduction of crop cultivation in the Dutch wetlands took place at least 600 years later than the disappearance of LBK farmers in the south-eastern part of the Netherlands. The results of development-led research, insofar as these had not already been included in the recent studies mentioned above, do not argue for a different perspective. But it should be noted that sites dating to the Early Neolithic and that are not attributed to the LBK are very much the exception (Leur-Hernense Meer, Rotterdam-Groenenhagen, Rotterdam-Beverwaard).[414]

Plant foods are not restricted to cultivated crops. A wide variety of vegetative (potential) food resources was available in many parts of the landscape. Although pollen is informative on vegetation at various spatial scales, it does not inform us directly about which plants were exploited for food. For this, we are largely dependent on macroremains, and, as is the case for animal remains, preservation is highly influenced by local circumstances. Outside wetland environments, only charred plant remains will normally be found, with the exception of specific contexts that favour good preservation, such as wells. In wetland environments, both uncharred and charred remains may be found, but the interpretation of uncharred remains in connection with food procurement is more difficult because these may represent natural accumulations.

The application of high-resolution SEM techniques to the identification of potential plant food resources, as an adjunct to the analysis of morphological features, is a step forward. Much attention is given to species identification of charred parenchymatous remains (the tissue that makes up the cortex and pith of the stem, the internal layers of leaves, and the soft parts of fruits). This has significantly broadened the picture, which used to simply show charred hazelnut, acorn, wild apple and exceptionally a berry. Important results were obtained from the Early to Middle Mesolithic site of Rotterdam-Yangtze Harbour (fig. 5.7).[415] Amongst the charred remains, edible parts of nine species could be identified: oak (acorns), hazel (nuts), hawthorn (berries), lesser celandine (tubers), sedges (rhizomes, seeds), dogwood (berries, seeds),[416] common club-rush (rhizomes), yellow water-lily (seeds), and water chestnut (nuts). Lesser celandine, sedges, common club-rush, and yellow water-lily are additions to the list of charred food plant remains identified at Mesolithic to Middle Neolithic wetland sites in the Netherlands and Belgium (table 5.2).[417] The species represented at Rotterdam-Yangtze Harbour relate to various habitats: woodland, forest margin, scrub, moist woodland, marsh/water edge, and shallow to deep water.

412 Out 2009; Schepers 2014.
413 Bakker 2003; Brinkkemper *et al.* 1999; Cappers & Raemaekers 2008; Huisman, Jongmans & Raemaekers 2009; Out 2009; Peeters 2007.
414 Appendix II: PUBID 340, 463, 468.
415 Kubiak-Martens *et al.* 2015.
416 Fruit-stones of dogwood are rich in non-volatile oil that can be used as fuel or for the purpose of impregnation. Large numbers of crushed fruit-stones from the sites of Bökeberg and Tågerup (Sweden) suggest oil extraction in the Mesolithic (Regnell 2012; Regnell *et al.* 1995).
417 Out 2009, 349, table 9.5.

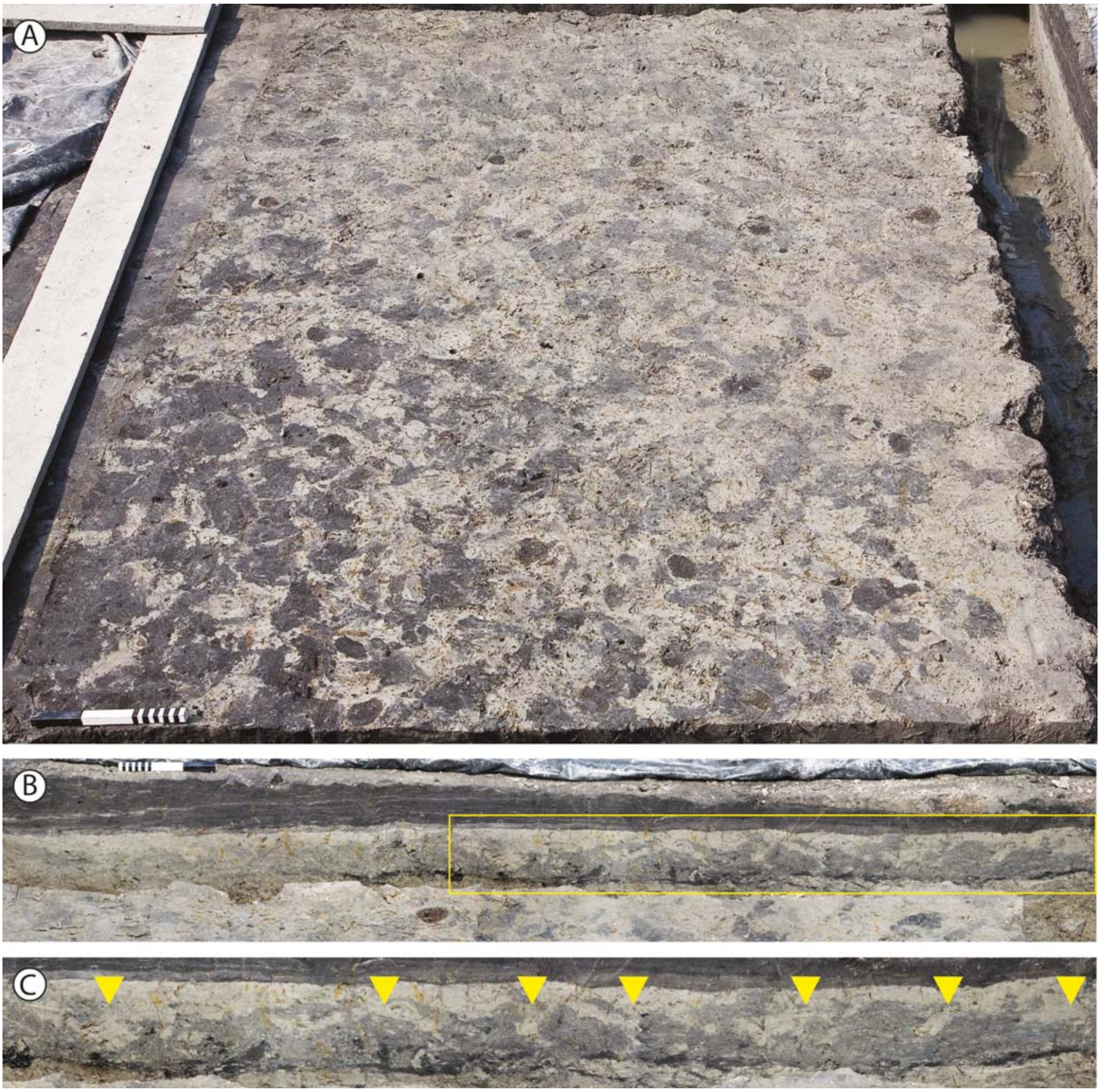


Fig 5.6 A: Plane view of the tilled horizon at Swifterbant-S4. The patterning of dark- and light-grey patches is interpreted as tillage marks made with some sort of hand tool. B: photograph showing a more or less regular pattern of tillage marks that become increasingly vague towards left of photograph. The dark layer on top is the lower part of a midden deposit. Square indicates image C. C: Detail of B, with tool marks indicated by triangles (from Huisman & Raemaekers 2014).

Fig 5.7 Plant food resources identified at Rotterdam-Yangtze Harbour (from appendix II: PUBID 462). a: living yellow water-lily with fruit capsules; b: charred seed of yellow water-lily; c: water chestnuts with spines (present-day); d: water chestnut charred spine; e: living dogwood plant with berries; f: dogwood charred and broken fruit stones; g: lesser celandine SEM cross section showing polygonal parenchyma cells; h: lesser celandine SEM concentration of solid tissue; i: damp undergrowth covered by lesser celandine; j: tubers of lesser celandine; k: hawthorn charred fruit-stone; l: hawthorn living plant with berries.

Table 5.2 Carbonised macroremains of food plants (from Out 2009, table 9.5).

Region	Central river				Western river		Coastal				Eem	Vecht				Other
Site	Polderweg	De Bruin	Brandwijk-Kerkhof	Hazendonk	Randstadrail CS	Bergschenhoek	Ypenburg	Schipluiden	Wateringen 4	Rijswijk-A4	Hoge Vaart-A27	Urk-E4	Schokland-P14	Swifterbant-S3	Schokkerhaven-E170	Doel-Deurganckdok-sector B
Taxon																
Cornus sanguinea	-	+	+	+	+	-	-	+	-	-	-	-	-	-	-	+
Corylus avellana, nut shells	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+
Crataegus monogyna	-	+	-	+	-	-	-	+	-	-	-	+	-	+	-	+
Malus sylvestris	-	+	-	+	-	-	-	+	+	-	+	+	-	+	-	+
Malus sylvestris, parenchyma	+	-	-	+	-	+	-	+	-	-	+	-	-	+	-	-
Prunus spinosa	-	-	-	+	-	-	+	+	+	-	-	-	-	-	-	+
Quercus sp.	-	+	-	+	+	-	-	-	-	-	+	-	-	-	-	+
Quercus sp., cupulae	-	-	+	-	-	-	-	-	-	-	-	+	+	-	-	-
Rosa sp.	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
Rosaceae	-	+	-	+	-	-	-	-	-	-	+	-	-	-	-	+
Rubus fruticosus	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Rubus idaeus	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Rubus sp.	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Trapa natans	+	+	+	+	+	-	-	-	-	-	-	-	+	-	-	-
Viburnum opulus	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+

+ present
- absent

So far, little is known about how these plant food stuffs were prepared and consumed. Lesser celandine, for instance, is poisonous when eaten raw. Amongst the more frequently echoed potential functions of pit hearths is the preparation of plant food. Serious attempts to gain insight into this aspect date back to the 1990s, through pioneering work on charred parenchymatous remains from Mesolithic pit hearths in the northern Netherlands.[418] This analysis provided evidence for the presence of a wide range of vegetative organs of nutritional value, notably, high frequencies of aquatic tissue, of taxa such as bulrush, club rush and wild beet, but also buckler fern. If these represent remains of food, the charred wood in these pits should most likely be interpreted as fuel. In the context of development-led research, explicit attention has been paid to the presence of parenchymatous remains of potential plant food. In the case of Dronten-N23, for instance, no remains of potential plant food – other than charred fragments of hazelnut shell – were found in any of the analysed samples.[419] The same is true for Hanzelijn-Drontermeer and Scheemderzwaag.[420] One Late Mesolithic pit hearth at Knooppunt Hattemerbroek yielded a charred root fragment of bracken.[421] As yet, the evidence for a function of pit hearths in the context of plant food preparation is extremely limited indeed. We have to keep in mind, however, that the chances of finding direct evidence may be small by definition. After all, in general, any cooked plant food was removed from the pit in prehistory.[422] Of course, overheated (charred) parts may have remained in the pit occasionally, but most probably in minor quantities; hence, the probability of recovering parenchymatous remains from samples taken from such pits will be extremely low.

418 Perry 1997, 2002.
419 Kubiak-Martens *et al.* 2012, 343.
420 Kooistra *et al.* 2009; Kooistra *et al.* 2013.
421 Kubiak-Martens 2011, 468.
422 Peeters & Niekus 2017.

The question arises whether the varying results relate to different preservation conditions or reflect prehistoric reality. There is no demonstrable reason to explain the differences in terms of preservation conditions. Although they are fragile, even small charred parenchymatous remains have a fair chance of being recognised. Another explanation may be more likely: differences in context. Samples with no or minimal parenchymatous remains of a single species from Knooppunt Hattemerbroek and Dronten-N23 were taken from pit hearths; samples taken from the finds layer at Knooppunt Hattemerbroek contain slightly more species. The samples from Rotterdam-Yangtze Harbour were taken from the finds layer on the slope of the sand dune. It is possible that remains of plant food are mostly represented in layers that correspond to the ancient land surface and to waste dumps. Typically, higher frequencies of charred hazelnut shell seem to be associated with surface hearths. As systematic analysis of surface hearths dating to the Early Neolithic at Hoge Vaart-A27 has shown, charcoal samples from these contexts also contain a broad range of plant species.[423] It is therefore possible that observed differences relate to behaviourally distinct contexts.

5.2.2 Mesolithic pit hearths: wood for fuel and tar

The only non-food use of organic material that almost always features in the examined reports concerns the use of wood for fuel, evidently present as incompletely combusted wood (i.e. wood charcoal). It is tempting to relate charcoal found at archaeological sites to the deliberate firing of wood, but this does not always need to be the case. Accidental burning as a result of human activity or natural phenomena (i.e. lightning) also leads to the deposition of charcoal. In addition, wood may have been burnt or heated for purposes other than fuel. Tar production is one of the possibilities that may have been overlooked in past studies. Development-led research has made a significant contribution to several of these issues, in particular in the context of the discussion about the function of Mesolithic pit hearths.

Prior to discussing the use of pit hearths, we should note that the anthropogenic nature of these features has recently been called into question: the 'pit hearths' have been interpreted as collapsed, burnt ant nests.[424] The main arguments put forward are the absence of evidence for in situ fire; the near absence of artefacts in the infill of pits; the 'collapse' of soil horizons due to faunal burrowing activity; and geochemical profiles that are explained in terms of nutrient enrichment due to the accumulation of plant and faunal debris transported by ants. Without dismissing the possibility that collapsed, burnt ant nests are present in the archaeological record, we do not support this hypothesis in these particular cases, for several reasons: (a) the infill of many pits indicates digging activities post-dating the burning event; (b) several pits contain charred tree logs arranged on the pit floor; (c) pits that show evidence for in situ fire do exist; (d) pits with straight walls are frequent; (e) more pits contain artefacts than is generally assumed; (f) the majority of artefacts from pits are microliths; and (g) pedological and geochemical phenomena can be explained in various ways.[425] Hence, the picture is far more complex than suggested in the ant nest hypothesis.

Pit hearths are a common phenomenon on Mesolithic sites north of the Rhine (fig. 5.8), where they occur as 'isolated' features, as well as in concentrations of several tens to hundreds.[426] Concentrations of pit hearths are absent south of the Rhine; and isolated pit hearths are rather exceptional in this area. In contrast to surface heaths, which mostly consist of scatters of charcoal associated with heat-exposed to heavily burnt lithics, charred hazelnut shell and bone (provided preservation conditions are favourable), pit hearths are of U- or bowl-shaped features with an infill of charred plant remains and sand. About 3500 examples from c.175 sites have been recorded to date, and about 750 radiocarbon dates make clear that pit hearths are almost entirely restricted to the Mesolithic.[427] Both at the site and the regional level, patterns of spatio-temporal differentiation can be observed that appear to have behavioural meaning. We will discuss these aspects in section 5.3.1. Despite their common presence on many Mesolithic sites, we are, however, still poorly informed about the function of these pit hearths.[428] Nonetheless, some development-led

423 Visser *et al.* 2001.
424 Crombé *et al.* 2015.
425 Niekus *et al.* in prep; Peeters & Niekus 2017.
426 Niekus 2006; Peeters & Niekus 2017.
427 Peeters & Niekus 2017.
428 Groenendijk 1987; Groenendijk & Smit 1990; Jansen & Peeters 2001; Kooistra 2011, 2012; Kubiak-Martens *et al.* 2011; Kubiak-Martens *et al.* 2012; Peeters & Niekus 2017; Perry 1997.

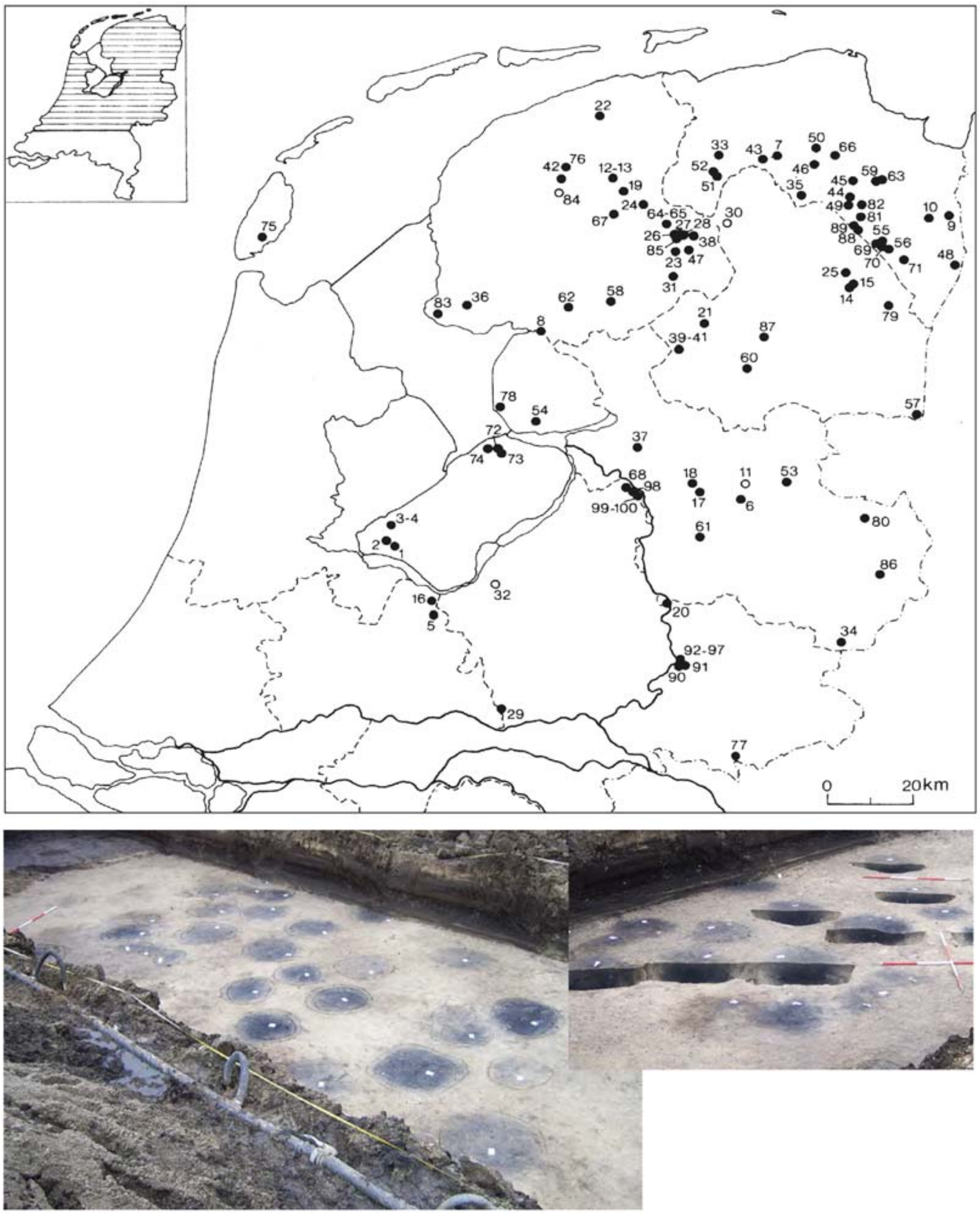


Fig 5.8 Geographical location of Mesolithic sites with pit hearths (from Niekus 2006; the map does not show the sites that have been discovered since), and pit hearths under excavation at Knooppunt Hattemerbroek (from appendix II: PUBID 259).

Fig 5.9 Type A pit hearths at Dronten-N23 (from appendix II: PUBID 538).

projects have included targeted investigations and the development of fresh hypotheses, which we will discuss below.

Within the broad category of pit hearths, several types can be distinguished on the basis of pit size, shape and infill. At the site of Dronten-N23, no fewer than 772 pit hearths were recorded. These were classified into three types[429] (A, B and C) that are also described from other sites. Type A, which could be called the 'classic' pit hearth, typically has a circular to oval outline with a bowl-shaped cross section. Occasionally, somewhat flatter bottoms and straight walls occur (fig. 5.9). The diameter varies from 25 to 160 cm, but most measure between 50/60 and 110/120 cm; the depth varies between 30 and 135 cm, but is mostly between 50 and 90 cm. This variability in size and depth is partly related to differential preservation, due to surface erosion. Erosion effects seem to occur at Knooppunt Hattemerbroek, where a slight correlation between diameter and depth has been observed.[430] The infill of Type A pits usually consists of a charcoal-rich layer in the lower part and a layer of clean sand in the upper part; there is no evidence for burnt sand. Although occurring in dense clusters, Type A pits hardly ever intersect. Type B pits have a circular to rectangular shape, and often have flat floors and straight walls, but bowl-shaped and funnel-shaped cross sections also occur (fig. 5.10). Their diameter varies from 80 to 160 cm, and their depth from 60 to 120 cm. The infill of these pit hearths is more complex and chaotic, with charcoal occurring in several layers. Small to large, angular lumps of charcoal are present in all layers, and charred logs are sometimes encountered on the pit floor. A band of orange-red burnt sand is frequently observed. Type B pits can occur as intersecting series, which can make the delimitation of individual pits difficult. Finally, Type C pit hearths have a circular shape, with a diameter ranging from 40 to 100 cm, and a bowl-shaped cross section, with a depth of up to 45 cm. The infill consists of a chaotic mixture of sand and charcoal (although it is not charcoal rich). A thin band of orange-red burnt sand surrounding the pit is frequently observed. Although it has been questioned whether Type C pits should be interpreted as pit hearths,[431] the bands of burnt sand on their perimeter argue in favour of such an interpretation (fig. 5.11).

429 Opbroek & Hamburg 2012.
430 Knippenberg & Hamburg 2011.
431 Opbroek & Hamburg 2012, 132.

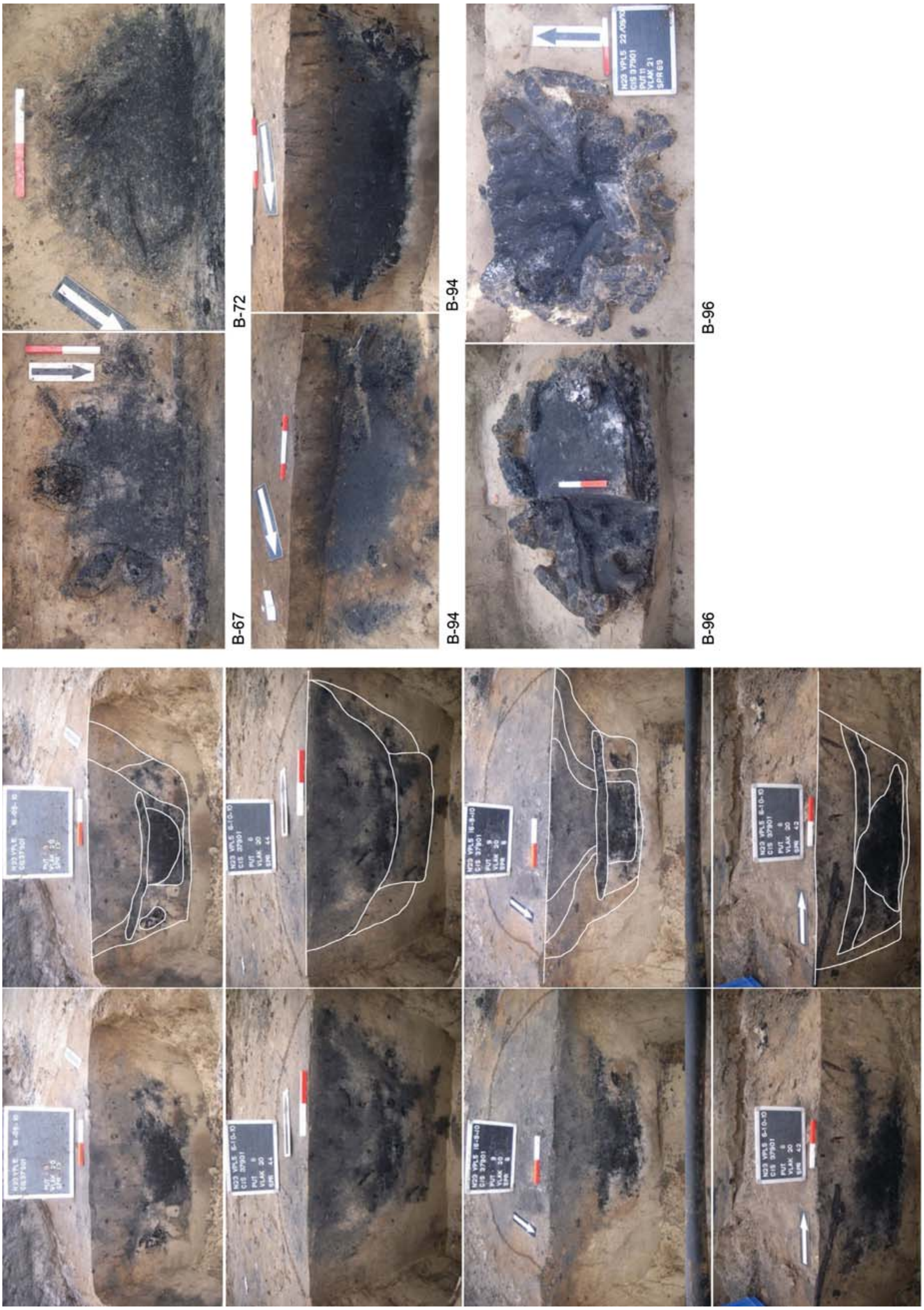


Fig 5.10 Type B pit heaths at DrontenN23 (from appendix II: PUBID 538).

Fig 5.11 Type C pit hearth at Dronten-N23 (from appendix II: PUBID 538).

The many ^{14}C-dates available indicate that Type A pits occur throughout the Mesolithic, whereas Type B pits are of Late Mesolithic age. Type C pits are mostly of Late Mesolithic age; as yet, only one of Middle Mesolithic date is known, from Dronten-N23. The younger, Type B pits at Dronten-N23 are generally wider and deeper than the Type A pits. Also, at Knooppunt Hattemerbroek there seems to be a tendency for pits (it is not clear whether all are of Type A) to become wider and deeper in the course of time. As yet, there is, however, no reason to argue for a general trend, since at other sites the younger pits (e.g. Scheemderzwaag-Scheemda) are more shallow than the older ones (e.g. Scheemderzwaag-Opdiep).[432] Indeed, in the case of Leeuwarden-Hempens, pits that were identified deeper in the sandy subsoil appeared to be older; this can be explained by either periodic deposition of wind-blown sand, or older pits simply having been cut more deeply into the subsoil when they were constructed.[433] Nonetheless, we may have to consider the possibility of chronological differences in the occurrence of the various pit hearth types, and, in view of their variable infill, also functional differences.

The overarching term 'pit hearth' suggests that these features are connected with one or more functions that require the burning of fuel as a source of heat. Experiments conducted in the 1980s showed that temperatures up to 1000 °C can be reached in an open pit.[434] The analysis of charcoal sampled from pit hearths at the sites of Knooppunt Hattemerbroek, Dronten-N23, Tunnel Drontermeer, Leeuwarden-Hempens, Epse-Olthof, Scheemderzwaag and Siegerswoude returned mutually comparable pictures with regard to a dominance of the wood of pine and oak. Similar observations had been made earlier, for instance, at sites in the Groninger Veenkoloniën (Groningen peat colonies), Mariënberg and Hoge Vaart-A27.[435] It is generally assumed that this wood was used as fuel, because pine was dominant from the Preboreal to the Mid-Atlantic. Oak occurs throughout the Boreal to the Late Atlantic, but is always accompanied by pine in the earlier phase. In most cases, charcoal of these taxa is found as smaller fragments in the lower half of the pits. Occasionally, larger lumps and logs are found in configurations that clearly show that wood was carefully placed in the bottom of pits (Type B; see above). At Dronten-N23, for instance, larger

432 Appendix II: PUBID 472.
433 Noens 2011.
434 Groenendijk & Smit 1990.
435 Groenendijk 1997; Van Rijn & Kooistra 2001; Verlinde & Newell 2006.

lumps and charred logs were particularly present at the outer limits of the pit floor (fig. 5.10). In one case, large lumps and logs appeared to have been stacked against the wall of the pit but not in the central part. This could indicate a specific mode of firing and heat control, for a purpose which remains, as yet, unknown. In more general terms, the function of pit hearths is believed to have been connected with the preparation of food stuffs, for instance, the braising of meat, roasting of hazelnuts, and cooking of starchy roots and tubers (see section 5.2.1).[436] It has also been suggested that pit hearths were used for the heating of cooking stones (so-called pot boilers) or heat treatment of flint (thermo-preparation).[437]

An important step towards the investigation of pit hearth function in the context of development-led projects involves the SEM and physico-chemical analysis of charcoal and tar-like substance collected from pit hearths. Following up on the initial suggestion concerning the potential use of pit hearths for the production of wood tar at Hoge Vaart-A27,[438] various researchers have made serious attempts to investigate this further. Evidence for such use has been found at Knooppunt Hattemerbroek,[439] Dronten-N23,[440] Hanzelijn-Drontermeer[441] and Scheemderzwaag.[442] Typically, 'glassy matter' is frequently present amongst and/or attached to charcoal remains (fig. 5.12). This 'glassy matter' is highly reflective and rich in graphite, and has a porous structure. In several cases it has been observed that this structure 'emerges' from the wood cells and pores, which suggests that this is the result of liquefaction. In addition, gas chromatography-mass spectrometry and infrared spectroscopy have provided evidence (in the form of phenanthrene) for thermal degradation of pine wood through distillation, a process called pyrolysis (fig. 5.13). Tar-like globules have been shown to result from the heating of wood or bark under relatively high temperatures (c. 400 °C) and oxygen-poor conditions. Because tar production requires temperatures below c. 400 °C, the glassy matter should be interpreted as a by-product, namely, wood that was overheated, to temperatures between 450 and 600 °C. The tar-like globules can be viewed as 'leftovers', and the charcoal as the remains of fuel.

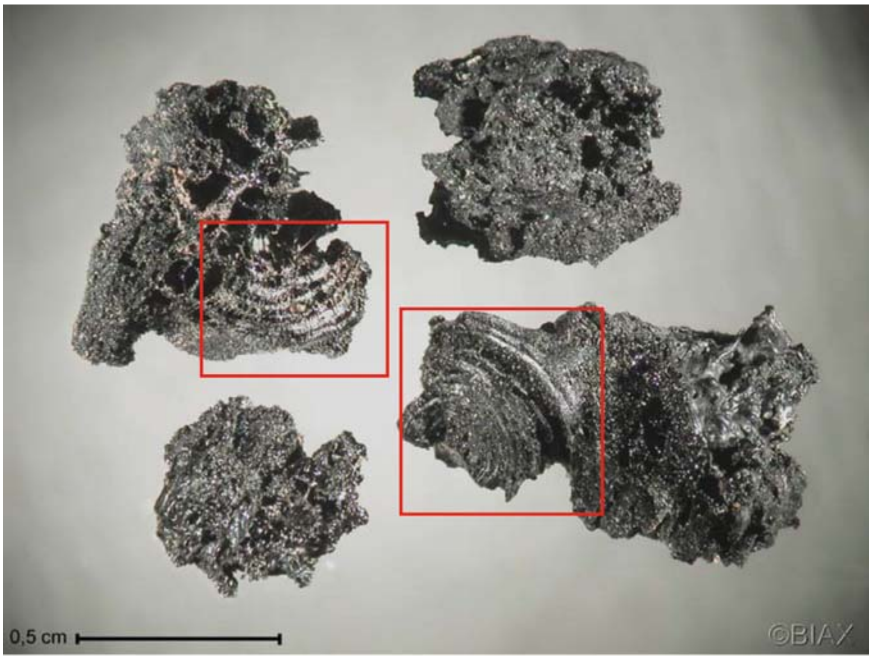


Fig 5.12 Charred fragments of a glassy substance from Dronten-N23 (from appendix II: PUBID 538). Two fragments are stuck to wood charcoal that shows anatomical features of pine (red boxes).

436 Groenendijk 1987.
437 Groenendijk 2004. However, there is no evidence for thermo-preparation of flint (or any other siliceous rock) in the Dutch Mesolithic, nor in the Neolithic (Peeters 2001; Peeters, Schreurs & Verneau 2001).
438 Jansen & Peeters 2001.
439 Kubiak-Martens *et al.* 2011.
440 Kubiak-Martens *et al.* 2012.
441 Kooistra *et al.* 2009.
442 Kooistra *et al.* 2013.

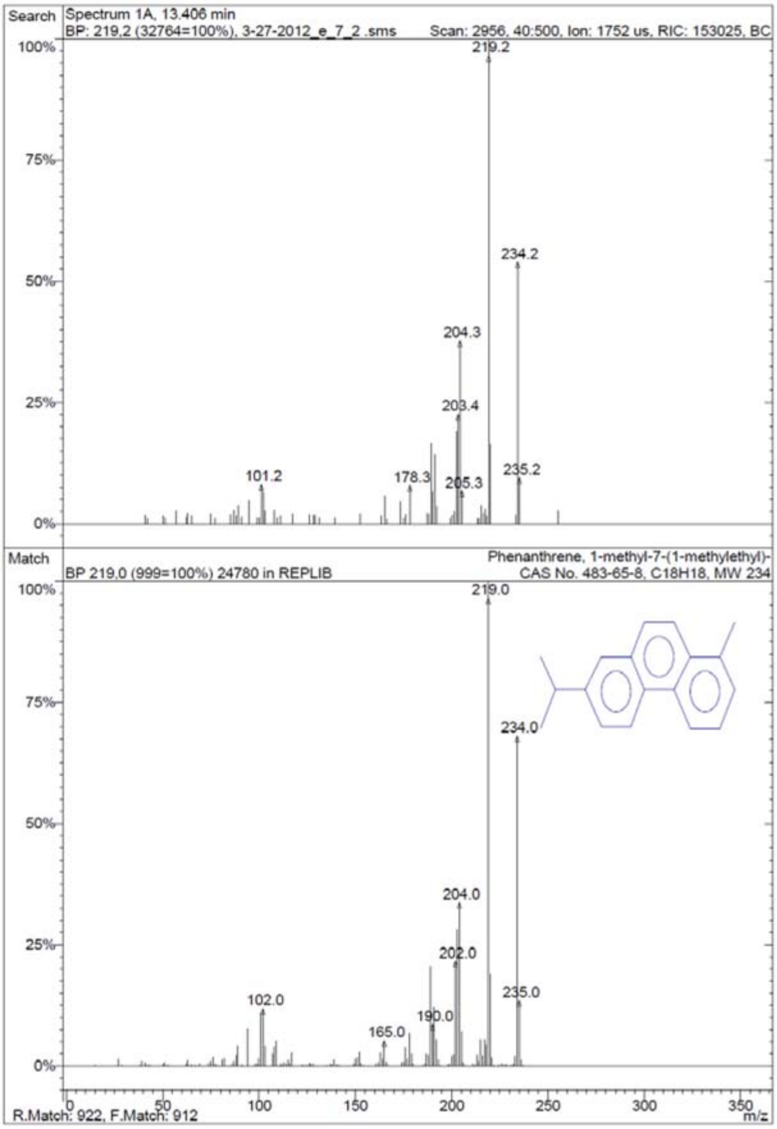


Fig 5.13 Gas chromatography spectrum of a sample of glassy matter from a pit hearth at Dronten-N23 (from appendix II: PUBID 538). The spectrum indicates phenanthrene and derivates, which result from thermal degradation of pine wood through distillation.

The scenario of pit hearths having been used for the purpose of tar production is certainly plausible. Wood tar is known from the archaeological record, and has been used for tool production (e.g. hafting of microliths in the Mesolithic) and possibly medicinal purposes.[443] The fact that relatively few archaeological examples of, for instance, flint tools with attached tar remains are known, should in itself not be a surprise. Wood tar is vulnerable to chemical (oxidation) and biological (microorganisms) degradation, and is best preserved under oxygen-poor or oxygen-free conditions.[444] On the other hand, a word of caution is needed: unintended formation of tar can occur under favourable conditions. Slow cooking of large quantities of meat, for instance, requires low temperatures to prevent charring or carbonisation. Ethnographic examples of such slow cooking involve the heating of meat in closed pits.[445] Furthermore, we have to be careful not to connect pit hearths with a single function. Tar production is one possibility amongst several, and it may just be the one that is more easily identified archaeologically. However, if pit hearths should indeed be interpreted in the context of tar production, an important question that arises is how all this connects with the chronological occurrence of the three types of pit hearths described above. Does the appearance of Type C and Type B pit hearths reflect technological changes in production? And what is the potential connection with changes in the dominant wood taxa represented in the charcoal remains? Did oak merely serve as fuel, and was pine preferentially selected as the resource for tar? Or was pine replaced by birch in the absence of pine?[446]

Although the obtained results with regard to the Mesolithic pit hearths are far from conclusive, it must be recognised that development-led research has made a considerable contribution to the discussion about the function of these enigmatic features. The hypothesis about tar production can be tested further by extending requirements for scientific analysis of samples that are to be collected in the field. Experimental work is necessary to explore the conditions under which particular phenomena occur, in order to be able to (potentially) identify the range of interpretive possibilities. Clearly, this is not feasible in the context of development-led projects.

5.3 Environmental dynamics and behavioural diversity

The relationship between the dynamics of the environment and human behaviour is amongst the themes that have traditionally received a lot of attention in Dutch archaeology. The role of biology and physical geography has been prominent in much research ever since the early days of Dutch archaeology, and continues to be so today. Of course, this is not only the case in the Netherlands. Approaches in Britain and southern Scandinavia are very similar, and, not surprisingly, these countries share many research themes. In this section we will focus on two themes to which development-led projects have made a contribution, notably, (dis) continuity of occupation and behaviour, and human influence on the environment.

443 Aveling & Heron 1998; Baumgartner *et al.* 2012; Bokelmann 1994; Larsson 1983.
444 Regert 2004; Weiner 2005.
445 Jansen & Peeters (2001) reported on the geochemical analysis of charcoal and sediment samples from Mesolithic hearth pits at Hoge Vaart-A27, and have indicated a possible use of these pits for the preparation of animal-derived food. However, no further chemical analysis has been executed since; the results must therefore be approached with caution.
446 Bear in mind that our reference to long-term changes in Holocene vegetation is still based on over-generalised models of vegetation succession, which do not take in consideration (sub)regional variability.

5.3.1 Continuity and discontinuity of occupation and behaviour

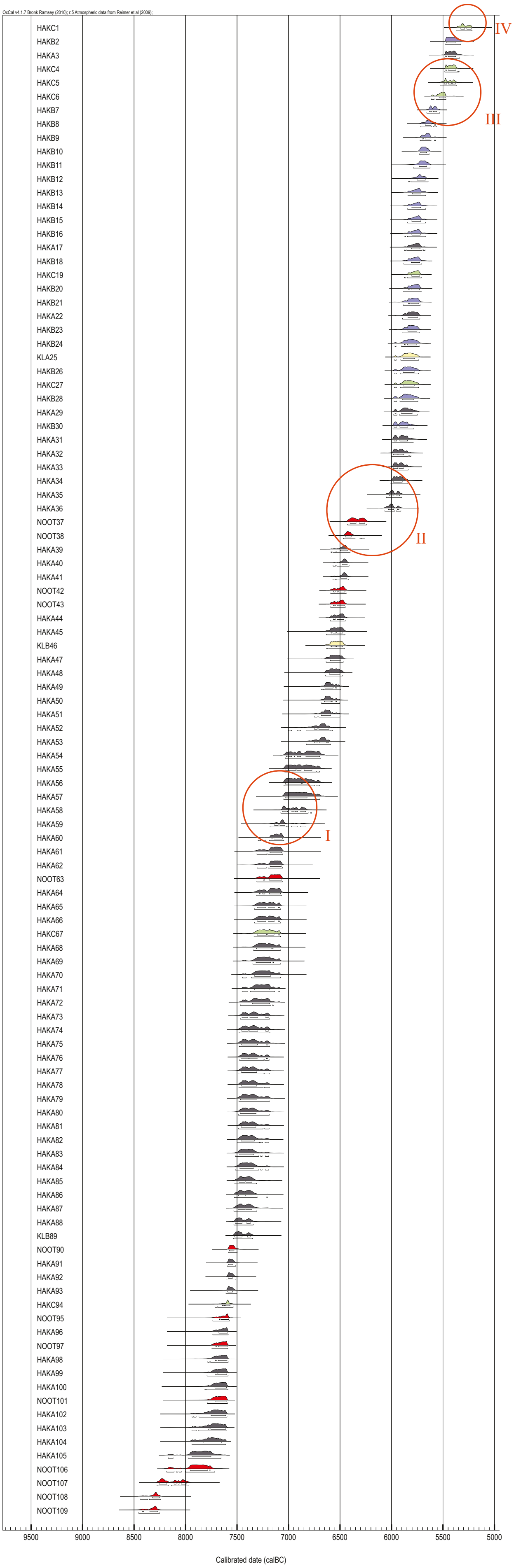
The use of space at a wider geographical scale is reflected in the use of particular spots in the landscape. At this scale, one would preferably investigate inter-site variability in terms of the particular use or function of locations in the landscape and in terms of location choice. The short-term/regional scale corresponds to the cultural geography of a defined region, whilst a long-term/regional perspective corresponds to cultural landscape history or biography (see section 1.2.4). As outlined in the foregoing sections, this scale can barely be investigated on the basis of the results of development-led projects without falling back onto prevalent models of landscape use. Novel information needs to come from the investigated sites themselves. And to obtain this, it is useful to take a look at how particular locations have been used over time. What time-depth is involved in the use of locations? Have locations always been used for the same purpose, or can we observe changes or alternations? In other words, what does information about (dis) continuity in occupation and behaviour at the site level learn us about what role particular places played in the broader use of landscapes?

Of particular interest in this respect are several Mesolithic sites (some of which were used into the Neolithic) for which considerable numbers of ^{14}C-dates are available, notably, Dronten-N23, Knooppunt Hattemerbroek, Epse-Olthof and Leeuwarden-Hempens. These sites principally consist of scatters of lithics and clusters of pit hearths. First, the ^{14}C-dates demonstrate vast time-depths (fig. 5.14; fig. 5.15), spanning more than 1000 radiocarbon years in each case. Second, the time span of lithic scatters does not fully coincide with that of pit hearths, as far as this can be established from the dates. We will take a closer look at these aspects below.

The long time span of use of the sites mentioned above suggest some degree of occupation continuity. At this long-term scale, however, one should not confuse occupation continuity with permanent presence of groups of hunter-gatherers, or even visits on a yearly basis. The obtained ^{14}C-dates are first of all indicative of the entire time frame within which activities took place, as represented by the sampled contexts. Although many dates from a single site can statistically be considered ‘contemporaneous’, this does not signify contemporaneity in an absolute sense. The probability distributions of the calibrated dates are generally too wide to permit any such suggestion. The highest resolution will be in the order of one to two decennia at a 1σ confidence level. What the results do demonstrate, however, is the use of specific locations in a landscape over many generations. Table 5.3 provides a (over-)simplistic estimate of the number of generations that may have visited the sites for which we have some confidence about the maximum time-depth of long-term occupation due to the availability of many ^{14}C-dates.

Table 5.3 Estimate of the number of generations of hunter-gatherers that potentially visited a site. The maximum time-depth for the individual sites is set by the calibrated extreme start and end dates at the 2σ confidence level. One hunter-gatherer generation is set at 20 years.

Site	Maximum time-depth (yr)	N generations
Dronten-N23	3100	155
Leeuwarden-Hempens	2100	105
Knooppunt-Hattemerbroek	1800	90
Epse-Olthof	1740	87



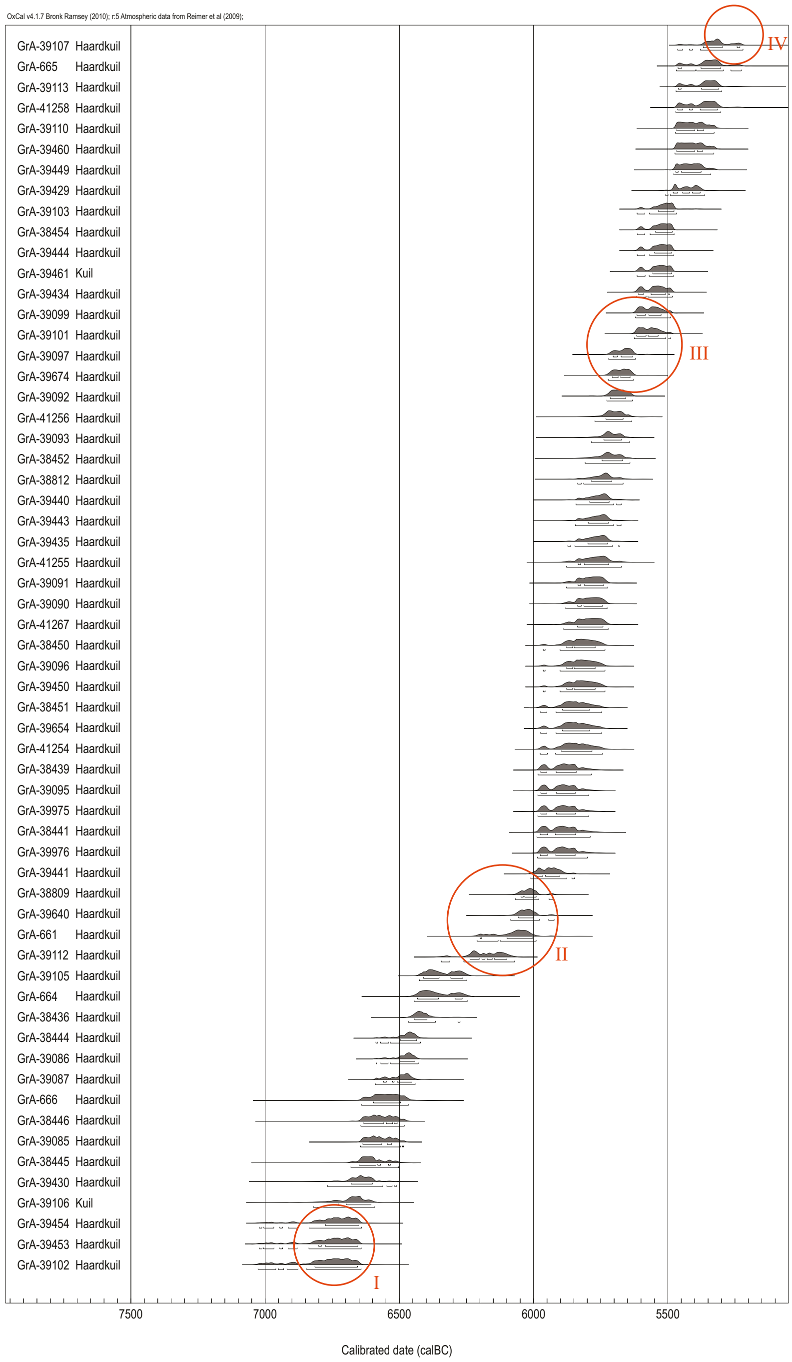


Fig 5.14 Left: calibrated ¹⁴C dates for Dronten-N23. Dates on charred hazelnut shell from the find layer are in red; all other dates refer to samples from pit hearths. Breaks within the chronological sequence are indicated with circles (from appendix II: PUBID 538). Right: calibrated ¹⁴C dates for Knooppunt Hattemerbroek. All dates refer to samples from pit hearths. Breaks within the chronological sequence are indicated with circles (from appendix II: PUBID 538).

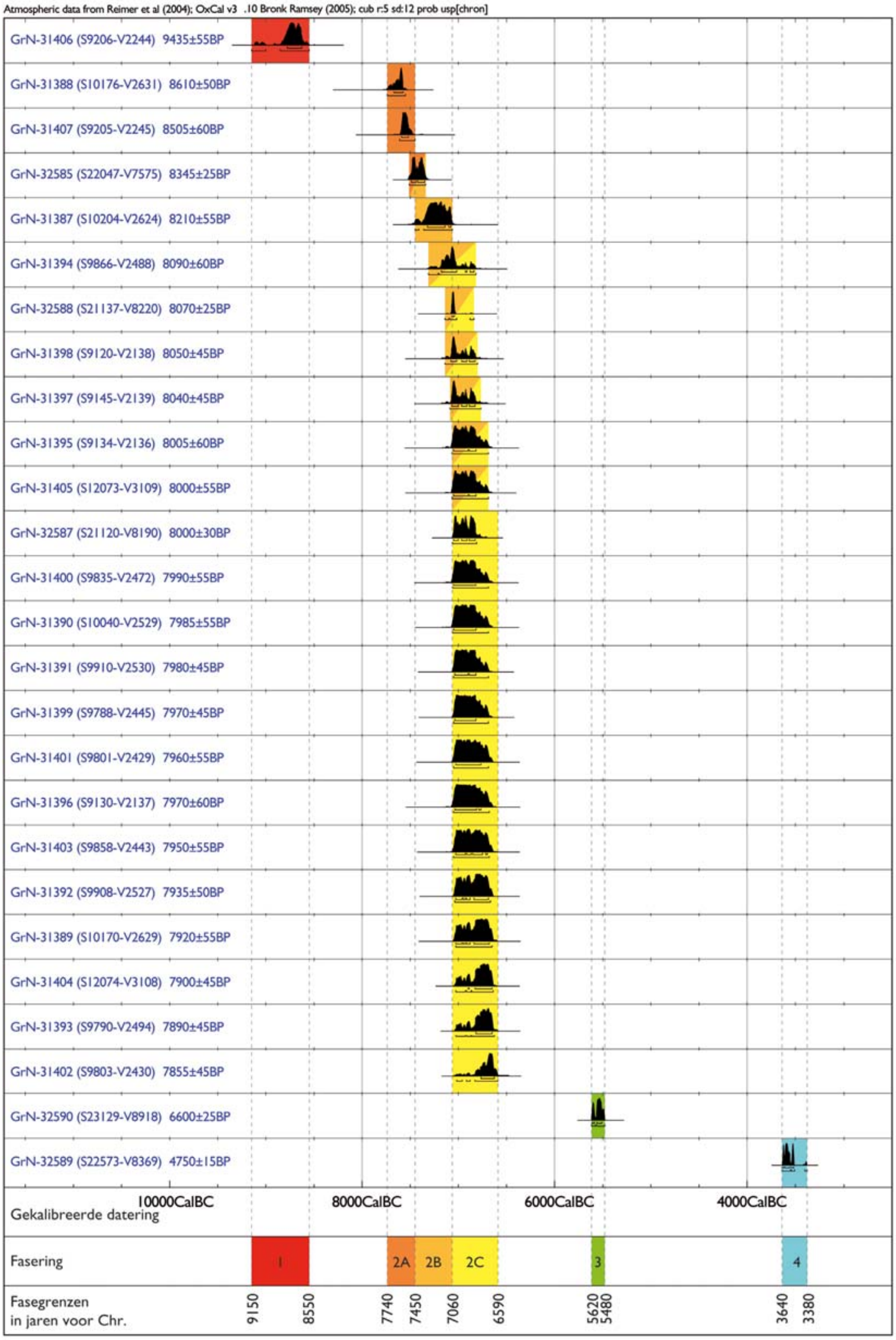


Fig 5.15 Calibrated ^{14}C dates for Epse-Olthof; all dates refer to samples from pit hearths (from appendix II: PUBID 538). The dates are presented for different parts of the investigated area and different excavation campaigns (Olfhof Noord; Olthof Zuid phase 1; Olthof Zuid phase 2); this subdivision, however, has no archaeological meaning.

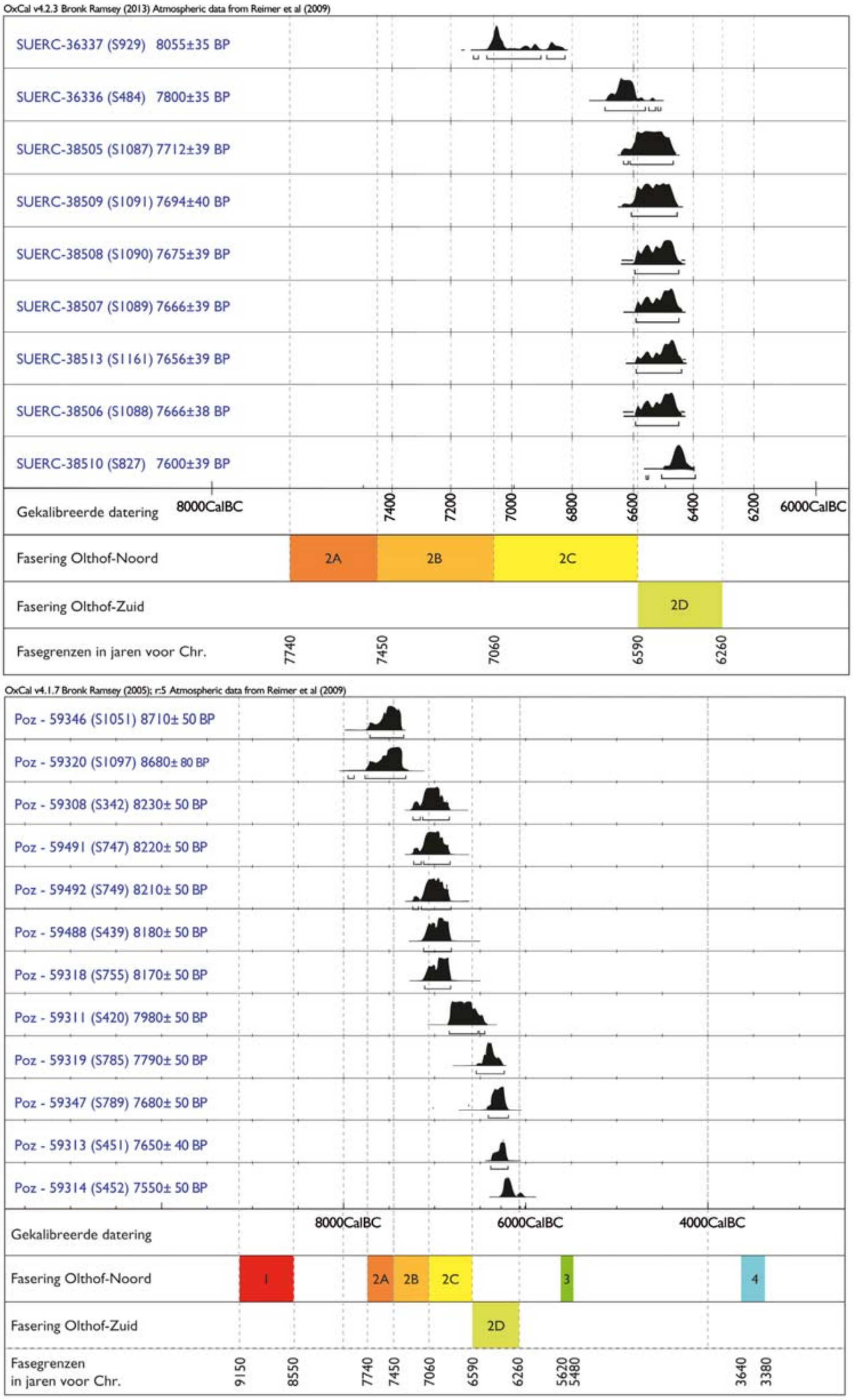


Fig 5.15 Continued.

It is impossible to tell whether representatives of each generation will actually have visited the sites. The data do not suggest the contrary, although in the case of Dronten-N23 and Knooppunt Hattemerbroek, one can observe several breaks in the overlap of calibration probabilities. The question is, what causes these breaks? Because they occur around the same moment in time at both sites, it seems improbable that this is related to chance, e.g. due to coincidental lack of samples corresponding to the time gaps. However, it is possible that the breaks are related to fluctuations in the calibration curve and are of a statistical nature. It would require in-depth statistical analysis to confirm or rule out this possibility. Yet another scenario is that the breaks correspond to interruptions in activity, or at least the sort of activity that involved the creation of contexts that are normally sampled by archaeologists for dating.

Whatever the exact nature of these breaks in the calibration graphs, the astonishing time-depth represented at these sites is all the more remarkable in the context of environmental dynamics. The Early and Middle Holocene have seen the influence of climate change on ongoing sea level rise, vegetation, hydrology and soil conditions. In the long run, environments have changed in terms of ecology and physical geography, yet particular places in this dynamic landscape continued to play a role in the cultural geography of Mesolithic hunter-gatherers.[447] The question is to what extent these people actually experienced such change at the generation scale. It cannot be excluded that a sudden drop in temperature – due to stagnating thermohaline circulation – and a sea level jump of an impressive 2 m in the southern North Sea basin caused by the catastrophic drainage of Lake Agassiz around 6300 cal BC,[448] had environmental effects that could have been experienced within one or two generations.[449] Interestingly, the timing of this event corresponds with one of the breaks in the graphs of both Dronten-N23 and Knooppunt Hattemerbroek. Data on the occupation history of the Rhine-Meuse estuary also appear to show a hiatus during this window (fig. 5.16).[450]

These important data, which were generated in the context of development-led research, also permit us to discern some other patterns at several spatial scales. In the case of Dronten-N23, it seems that there has been a change in the nature of activities over time. During the first two millennia of its occupation history, activities involved two behavioural contexts. One was associated with flint knapping, firing of surface hearths, food preparation and consumption (hazelnuts, possibly meat); the other with the use of pit hearths. The first context seems to disappear from the record in the third millennium of the site's occupation history, after which we only see the use of pit hearths. A somewhat comparable picture emerges from the data of Epse-Olthof. Although less well supported by ^{14}C-dates, here we also see flint-knapping activities and use of pit hearths during the earlier phases of the site's occupation history, but only use of pit hearths during the last phase. This suggests that generations of hunter-gatherers continued to occupy particular spots in the landscape, but for different purposes. Such a combination of long-term occupation continuity and behavioural continuity *and* discontinuity was previously observed at Hoge Vaart-A27.[451]

447 Amkreutz 2013; Peeters 2007, 2009a, 2009b.
448 These climatic effects are also known as the 8.2 Ka Event.
449 Also see Leary 2009.
450 Peeters *et al.* 2015.
451 Peeters 2007, 2009a, 2009b.

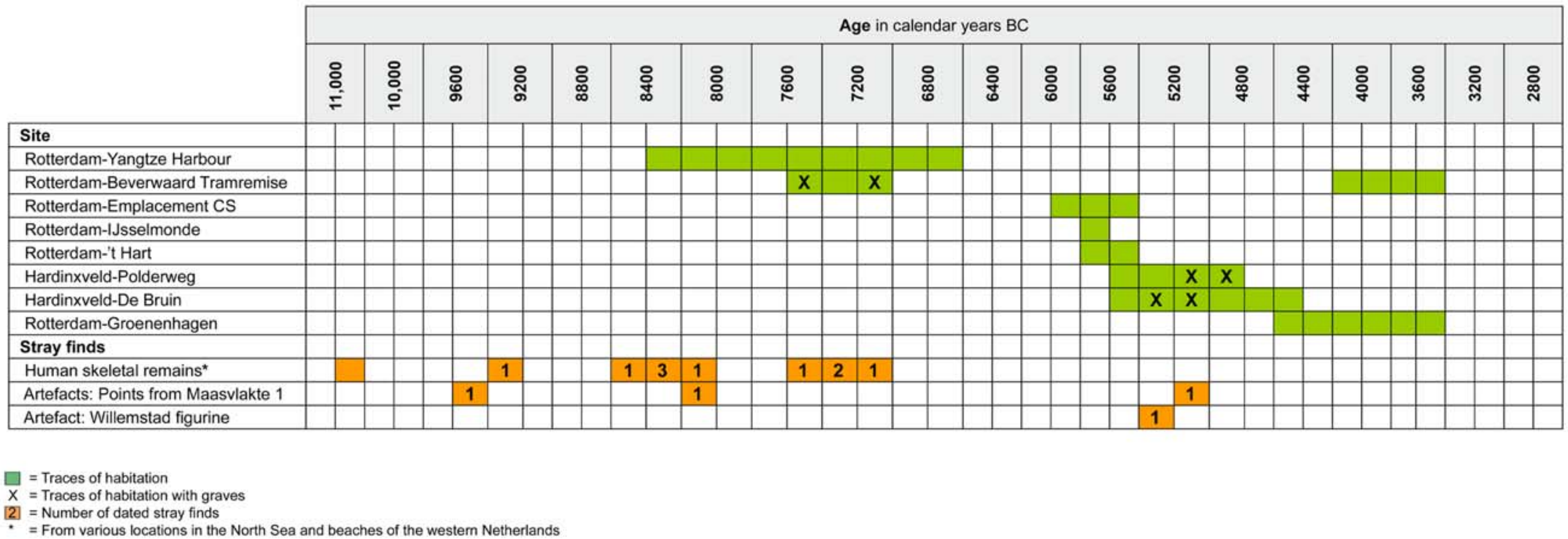


Fig 5.16 Chronological coverage of sites and isolated finds from the Rotterdam region (from appendix II: PUBID 462). Note the gap between 6400 and 6100 cal. BC, which corresponds to a phase of increasing sea level rise and the 8.2 Ky climate event, which are both related to the catastrophic drainage of Lake Agassiz. The Storrega tsunami, which variably affected the coasts of the North Sea basin, also falls within this time window. To what extent the chronological gap signals discontinuity in occupation history or represents an artefact of research intensity is as yet unclear.

Scaling up the data to a long-term regional perspective reveals another interesting pattern that may relate to changing environmental conditions. A plot of ^{14}C-dates from several Mesolithic sites along the prehistoric drainage system Hunnepe (partly corresponding to the present-day river IJssel, in the eastern Netherlands) shows differences in the temporal occurrence of pit hearths (fig. 5.17). Upstream (Deventer area) we mainly see Boreal and Early Atlantic dates, midstream (Knooppunt Hattemerbroek; Zwolle area) predominantly Early and Middle Atlantic dates and upstream (Dronten-N23) Boreal to Middle Atlantic dates. Broadly speaking, the Late Mesolithic is almost entirely lacking in the ^{14}C-evidence for the upstream region. This picture coincides with the virtual absence of Late Mesolithic flint technology in the same region.[452] Also in the Zutphen area, c.15 km south of Epse-Olthof, but situated along the Berkel drainage system, there is virtual absence of Late Mesolithic flint technology despite extensive development-led excavations and explicit attention for early prehistoric sites and phenomena. Unless the pattern is the result of insufficient data, this possibly indicates variability in landscape use.

Palaeovegetation reconstructions for the Early Mesolithic have led to the suggestion that the disappearance of human activity in the Zutphen area was mainly the result of increasing vegetation density and dryer conditions.[453] The question is whether Mesolithic hunter-gatherers indeed abandoned the area. Evidence from development-led research at various locations near Zutphen points to Late Mesolithic and Early Neolithic activity, but this activity is not associated with flint knapping or the use of pit hearths. The evidence consists of ^{14}C-dated tree trunks with chop marks and incidental fragments of red deer antler with cut marks,[454] as well as digging traces that are thought to relate to the extraction of plant roots or tubers (fig. 5.18).[455] Stray finds of isolated trapezoid points and occasionally occurring punched blades also indicate the presence of Late Mesolithic hunter gatherers in both the Berkel and the Hunnepe drainage system. This shows that people had not left the area, but used various landscape zones in different ways. At an even wider scale, shifts seem to be discernible between regions. In the north-eastern part of the Netherlands ^{14}C-dates from pit hearths predominantly fall in the late Preboreal and Boreal, whereas dates from the Flevoland region predominantly fall in the Boreal and Atlantic (fig. 5.19).

From this perspective, it is interesting to return to the use of wood in the context of pit hearths. The broad picture is one of an increase in oak wood charcoal from the Boreal into the Atlantic, and corresponding decrease in pine

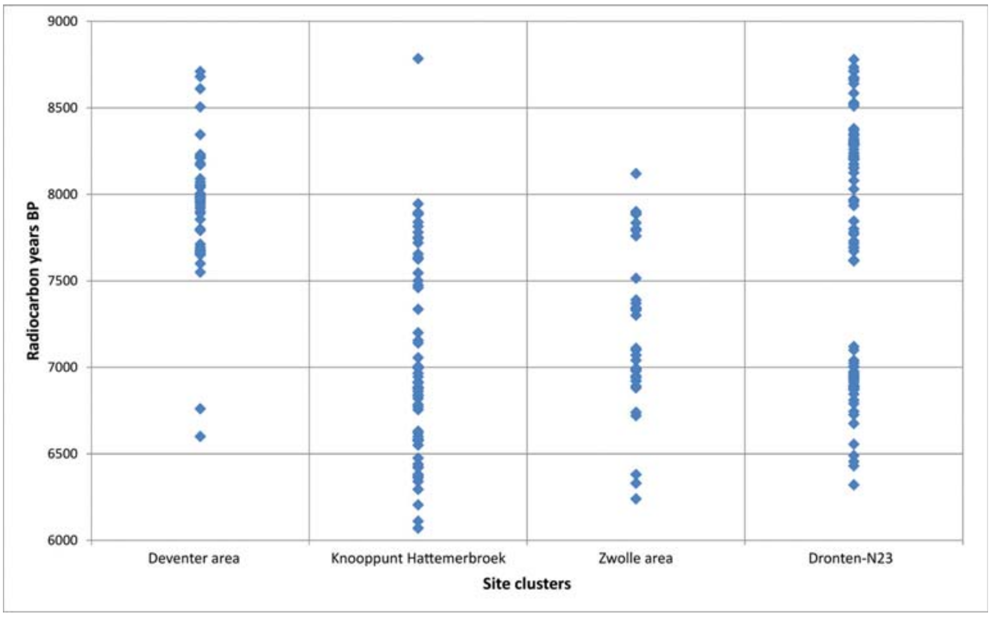


Fig 5.17 Plot of ^{14}C dates (n=243) for four clusters of sites with pit hearths along the Hunnepe drainage system.

452 Late Mesolithic technology is characterized by regular, punched blades and trapezoid points.
453 Bos *et al.* 2005. A comparable hypothesis had already been developed by Waterbolk (1985, 1999), who connected the 'abandonment' of the sandy areas in the Mesolithic with the expansion of woodland and successive decrease in game (that is, large mammals) in these areas.
454 Groenewoudt *et al.* 2001.
455 Fermin 2006.

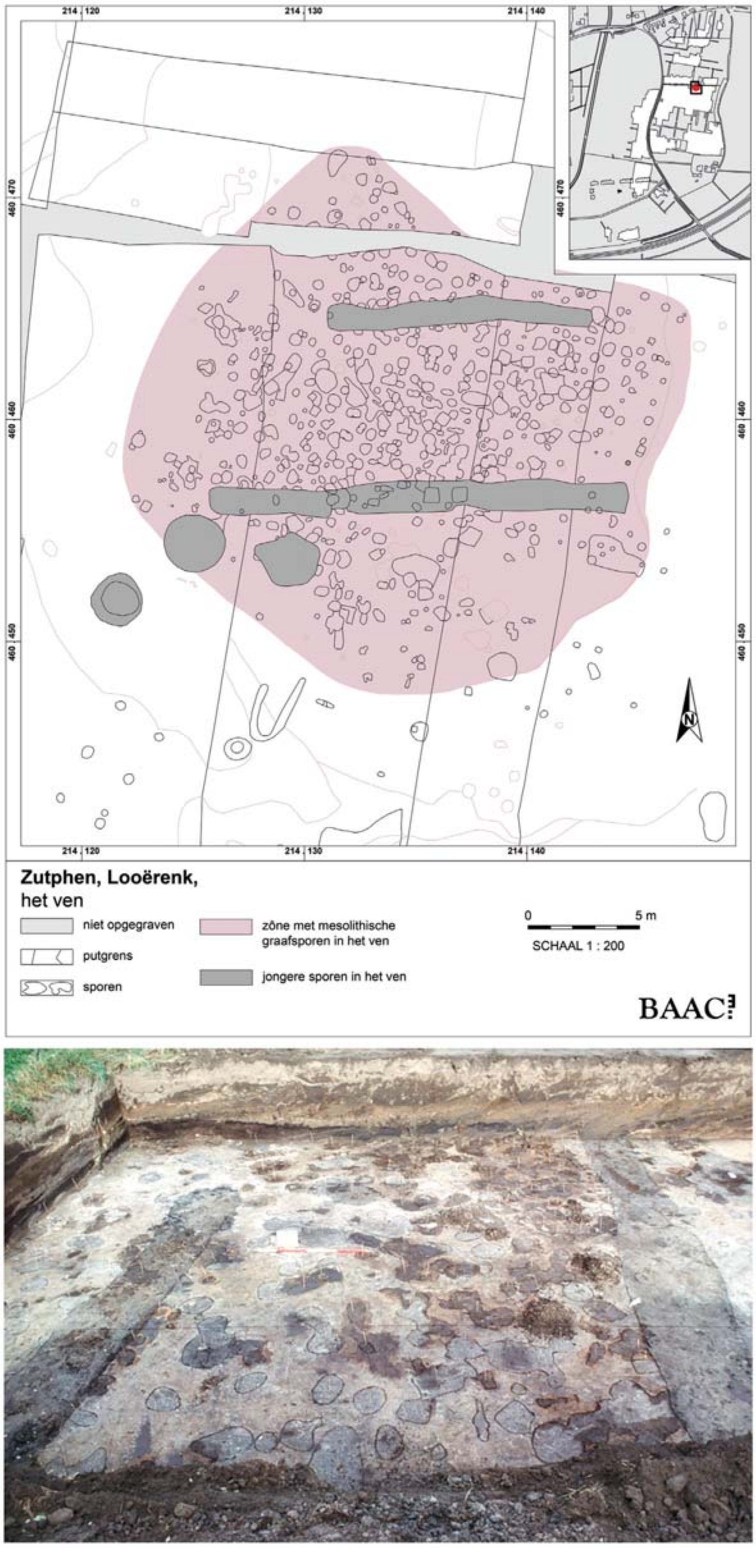


Fig 5.18 Traces of Mesolithic digging activity at the bottom of a fen (extent indicated in pink) at Zutphen-Looërenk (from Fermin 2006). These traces possibly result from the extraction of plant roots or tubers (notably arrow-grass, which has been attested to by pollen).

wood charcoal. This basically fits the overarching models of Holocene vegetation succession in connection with increasing temperature. If the availability of pine (and/or birch?) was crucial in the functional context of these pit hearths, then the inter- and intra-regional shifts in temporal occurrence of these pits may relate to spatial variability in vegetation communities. A recent evaluation of palaeovegetation data from the Flevoland area, for instance, has resulted in new interpretations, which propose that nutrient-poor soils in large parts of this region permitted pine and heather to persist for much longer, well into the Atlantic.[456] Birch also thrives well in these nutrient-poor conditions. It is only in the second half of the Early Atlantic that more demanding tree species can take advantage of improving soil conditions due to altering

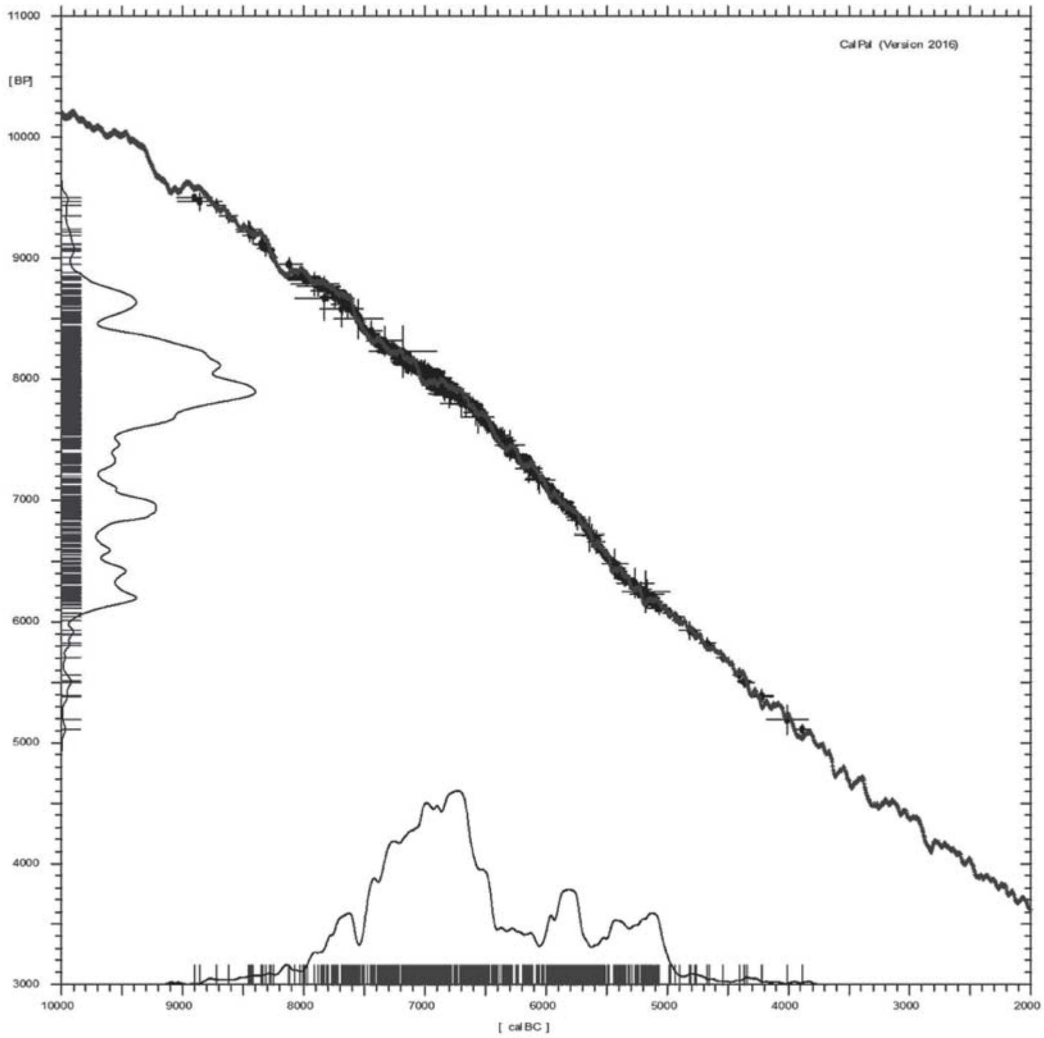


Fig 5.19 Sum probability plot (CalPal version 2016) of 756 radiocarbon dated pit hearths from the Netherlands. The dates were calibrated using the calibration curve IntCal13 (Reimer et al. 2013).

groundwater flows, which, in turn, are the result of further sea level rise.

The results from development-led work evidently permit researchers to reconsider models of hunter-gatherer landscape use. Landscape dynamics need to be understood at different spatial and temporal scales in order to be useful for archaeological purposes. Palaeolandscape data are much needed, but their interpretation requires contextualisation that reaches far beyond the site level in order to be useful.[457] The aspects discussed above do bring us back to the burnt ant nest hypothesis mentioned in the previous section. The long time-depth of the occurrence of these features has been used as a proxy for wildfire frequency during the Early and Middle Holocene, where synchronicity of ^{14}C-dates of pits with the 9.3 Ka and 8.2 Ka climate events is explained in terms of widespread and repeated forest fires due to desiccation (cold and dry climate).[458] In this scenario, the relative importance of various wood types is merely a reflection of local tree species. Fire ecology, be it natural, anthropogenic or both, is complicated, and its study requires multiproxy data (charcoal, ^{14}C, pollen, microfauna). Wildfires certainly occurred, and no doubt occurred frequently in pine-dominated landscapes, but this does not negate the interpretation of some or even most of these 'pit hearth' features as anthropogenic pits. The suggestion that 'there is no need during excavation to focus on these kind of features any longer or at least less resources can be spent on them than is currently the case'[459] is a step too far. In fact, even if excavators were to find themselves confronted with climate-related natural phenomena, we would argue that this would require serious attention from both palaeoecologists and archaeologists, since these data are crucial to the interpretation of the dynamics of human ecology. However, not all pits are similar, and as yet, an anthropogenic origin seems more likely for many, if not most, of them.

5.3.2 Human activity and environment

Prehistoric hunter-gatherers are generally supposed to have had little 'measurable' impact on the environment. It was not until intensified agriculture became established that the 'natural' environment began to be affected, principally through the clearing of woodland and the grazing of animals. Woodland clearing and intensified grazing had major impacts on the composition and spatial structure of the vegetation, but also on the development of soils, on surface stability, and on hydrological conditions. Clearly, this would also have affected the distribution and composition of the animal community.

In a contrast-and-compare of hunter-gathering and agricultural lifeways, hunter-gatherers are plainly considered to have been fully dependent on their environment. Hence, hunter-gatherers are conceived of as 'natural' beings that had to survive in the harsh wilderness.[460] This position has led to a persistent perspective of hunter-gatherers as living in an environment that was merely a quarry of foodstuffs and raw materials. Hence, it is not surprising that hunter-gatherer research became dominated by questions related to subsistence and settlement systems.

Of course, this monolithic perspective on hunter-gatherers – particularly so with regard to the Mesolithic – has not been readily accepted by all researchers. The whole idea of hunter-gatherers being people who simply functioned as passive 'receptors' in a giving environment has explicitly been challenged.[461] The central argument is that the impact of behaviour on the characteristics of a given environment can be considerable, without leaving an easily recognizable imprint on the archaeological or even palynological record. In particular the deliberate and controlled burning of vegetation would have affected the characteristics of the

456 Kooistra & Peeters in prep.
457 The required degree of contextualisation and synthesis is at the level of PhD research, and therefore far beyond the constraints of time and money in development-led archaeology.
458 Crombé 2015.
459 Crombé *et al.* 2015, 169.
460 Zvelebil & Moore 2006.
461 E.g. Mellars 1976; Zvelebil 1994; Simmons 1996.

plant community and, subsequently, the animal community.[462] Simmons goes as far as to relate the creation of the moorlands in England and Wales to Mesolithic intervention, which would have resulted in more open and wetter environments.[463]

The suggestion that hunter-gatherers managed their environment has not remain undisputed, despite historically documented evidence for deliberate and controlled burning of vegetation by hunter-gatherers to be a common practice in various parts of the world, e.g. North America, South America, and Tasmania.[464] Of course, one can argue that the behaviour of (near-)recent hunter-gatherers provides no evidence for similar practices in the past. However, there is mounting evidence from microfossil and archaeological analysis that is strongly suggestive of deliberate clearance of vegetation through fire by Mesolithic and possibly Late Glacial hunter-gatherers. Most of the evidence currently comes from Britain,[465] whereas the number of claims for clearance practices by hunter-gatherers from the continent was quite sparse until recent years.[466] Development-led projects in the Netherlands, however, have contributed considerably to this topic.

Palaeoecological analyses are classically considered to potentially provide insight into anthropogenic impact on the environment. The chance of actually detecting human impact is dependent on a variety of factors. First, as was pointed out some 20 years ago by Bos and Janssen,[467] the resolution and distribution of sampling play a key role in the potential to detect human impact. Hence, sampling strategies need to be adjusted to specifically answer this question, as illustrated by the study by Bos and Janssen; however, this is hardly ever the case. Obviously, the feasibility of such an approach is highly dependent on the constraints that every project faces in terms of research potential (in this case, palaeoenvironmental), practical approach and budget.

A second factor that influences the chance of detecting human impact involves age. In general, one could state that the further one goes back in time, the smaller the chances are of detecting human impact. This is caused by both practical restrictions, such as preservation, and the reality of the past. Various reports point out that pre-agricultural societies are likely to leave us with a considerably smaller, and thus harder to identify, environmental impact. Manipulation of plants that are part of the 'natural' vegetation is simply difficult to identify. In the context of Knooppunt Hattemerbroek, it was even stated that *"only people who permanently settle somewhere, and work the soil, leave recognizable traces in pollen profiles"* (translation ours).[468] Whilst this is, in our view, overstated, it rightly points out the problem – the key word probably being *recognizable*. Also, it must be mentioned that detecting an anthropogenic 'signal' is not necessarily the same as detecting anthropogenic 'impact'.[469]

The influence of human activity on the environment is explicitly discussed in the context of Groningen-Meerstad, Almere-Overgooi, Knooppunt Hattemerbroek, Dronten-N23 and nearby sections in the Hanzelijn railway trajectory.[470] At Knooppunt Hattemerbroek, geological indications are mentioned, notably the presence of wind-blown sand deposits, which are believed to testify to soil degradation as a result of human activities. In the Mesolithic, these disturbances were very local and of limited intensity.[471] However, the implications of this observation are downplayed by the palynological results, which show no definite sign of human impact.[472] What can and cannot be considered an anthropological indicator in pollen diagrams is a classic debate in palynology. Frames of reference are strongly linked to large-scale interventions, such as systematic forest clearance and food production as an elementary mode of subsistence. More subtle interventions, such as localised, small-scale disturbances or clearances of vegetation, are not easily identifiable. Typically, these types of interventions, whether deliberate or accidental, will have been more common in early prehistoric contexts.

Direct indicators for fire come from charcoal particles in pollen slides or burnt macroremains in natural deposits. Indirect indicators consist of remains of organisms that are considered to be fire indicators, such as *Pteridium* and *Gelasinospora*. Coprophilous fungi are becoming increasingly important as an additional argument for human presence and impact.
In addition to these, specific plant taxa are considered indicators of human presence because of their present-day ruderal growth location, such as *Plantago* spp., Chenopodiaceae, and *Artemisia*. As is apparent from table 5.4, the

462 Mellars 1976.
463 Simmons 1996.
464 Mellars 1976; Scherjon *et al.* 2015.
465 Innes & Blackford 2003; Mellars & Dark 1998; Simmons 1996.
466 Bos & Janssen 1996; Bos & Urz 2003; Bos *et al.* 2005.
467 Bos & Janssen 1996.
468 Van Haaster 2011, 461.
469 Behre 1981.
470 Appendix II: PUBID 747; De Moor *et al.* 2009; Opbroek & Lohof 2012; Woldring *et al.* 2012.
471 Van Zijverden 2011, 67.
472 Van Haaster 2011.

locations for which indications for firing have been suggested produced variable evidence. With respect to the various arguments summarised in table 5.4, it must be kept in mind that some of the authors list all taxa leading to their interpretation, whereas others make a selection. Moreover, the categories listed in the tables are not strict: various indicators of open vegetation may also be eutrophication or fire indicators.

More important is the distinction between human presence, as it is tentatively termed for Rotterdam Yangtze Harbour,[473] and human impact. In English, the term human impact is commonly used in this context, whereas the term commonly used in Dutch is '*menselijke invloed*' which arguably is better translated as 'human influence'. Without wanting to get bogged down in a semantic discussion, we feel that the degree of human involvement is not always considered when various terms are chosen. Human involvement in environmental dynamics is one of spatial and temporal and of qualitative (i.e. species composition) and quantitative (i.e. species importance) scale:

- Human presence: localised signals 'isolated' in time (single event) without qualitative or quantitative effects on the environment (charcoal);
- Human influence: localised and recurrent signals (sequential, interrupted events) with limited quantitative and no qualitative effects on the environment (charcoal, pollen);
- Human influence: widespread, single events and/or sequential, interrupted events with limited quantitative and qualitative perturbations (charcoal, coprophilous fungi, pollen);
- Human impact: localised or widespread sequence of perturbation with measurable qualitative and quantitative effects (charcoal, coprophilous fungi, pollen).

Table 5.4 Various anthropogenic indicators mentioned in the selection of reports.

		Milheeze	Zutphen-Ooyerhoek	Rotterdam-Yangtze Harbour	Groningen-Meerstad	Almere-Overgooi	Hanzelijn Nieuwe Land
Clearance	Tree drop	pine					
	Coprophilous funghi		x tentatively		x		x
	open ground vegetation	x					
Euthrophic	Several ruderals				x		
	Chenopodiaceae	x					
	Urtica	x	x tentatively				
	Artemisia						
Fire	*Epilobium*	x					
	Charcoal	x	x tentatively	x particle size	x	x	
	Melampyrum pratense					x	
	Gelasinospora retispora					x	x
	Sphagnum					x	
	Pteridium				x		
	contrast samples	x					
	Plantago	x					x
	Extensive list of anthropogenic indicators			x			

473 Kubiak-Martens *et al.* 2015, 271.

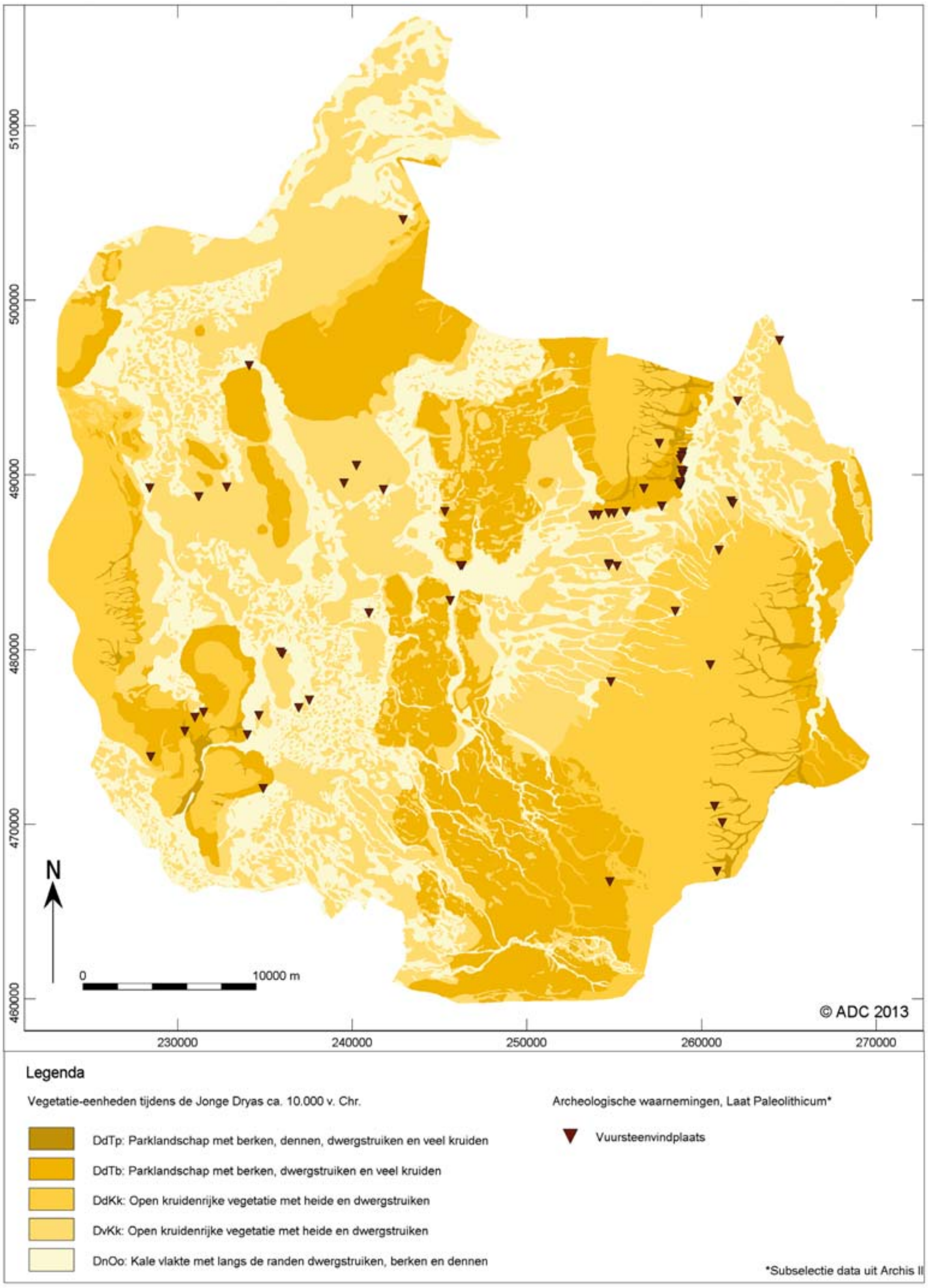


Fig 5.20 Regional vegetation maps for the Younger Dryas (from Bouman et al. 2013). DdTp: park landscape with birch, pine, dwarf shrubs and many herbaceous; DdTb: park landscape with birch, dwarf shrubs and many herbs; DdKk: open vegetation rich in herbs, with heather and dwarf shrubs; DvKk: open vegetation rich in herbs, with heather and dwarf shrubs; DnOo: open plain with dwarf shrubs, birch and pine along the edge. Triangles indicate Late Palaeolithic sites.

In this scheme, presence, influence and impact designate an increasing intensity of human involvement, which, we feel, is useful to characterise datasets in terms of interpretation. It is evident that in the context of development-led work, the evidence found will primarily be relevant at the local scale. Judging from the reports, we are inclined to speak in terms of human presence or influence at most.

As mentioned in the previous section, the interpretation of palaeoenvironmental data in terms of humans' influence on their surroundings requires a higher level of synthetic analysis. The ecological interconnectedness of plants, animals and humans is too complex to be understood on the basis of data that are interpreted at the local (i.e. site) scale. The research questions are, however, highly relevant. It is therefore important to consider methodological approaches that permit archaeologists to increase the interpretive possibilities in a better way. Notably, the inclusion and re-interpretation of existing pollen data at a regional scale may provide valuable support for the interpretation of new data. An example concerns a vegetation map of the Younger Dryas in Twente (eastern Netherlands), which shows a more differentiated picture than a generalised model would (fig. 5.20).[474] Combined with the distribution of Late Palaeolithic sites, the map gives enough insight into (potential) settlement locations and vegetation zones to permit development of new research questions and approaches that can also be integrated in development-led work.

474 Bouman *et al.* 2013; Van Beek *et al.* 2017.

6 Research agenda, fieldwork and reports

6.1 Introduction

Research agendas should primarily be concerned with the investigation of unknowns. In archaeology, which is the discipline that studies human behaviour in the past, the unknowns are about what people did and experienced under variable environmental circumstances and in equally variable socio-cultural contexts. Of course there are other unknowns and problems to address, for instance, in connection with archaeological pattern formation. Understanding post-depositional effects on the initial archaeological record is crucial for the interpretation of patterns as they are documented during fieldwork. But this is not a goal in itself: the goal is to interpret the archaeological record in terms of human behaviour, and for this it is necessary to decipher this record in order understand how it came to be.

The investigation of aspects echoed in the NOaA 1.0 is complex, and the previous chapters show that the degree of success is difficult to determine. What is the scientific gain of a decade of development-led investigations in the Netherlands? The preceding three chapters primarily focussed on the synthetic analysis of fieldwork results produced in the context of development-led archaeology. From this it becomes clear that the gain of knowledge relative to the NOaA 1.0 research questions, as well as several national reference frameworks,[475] is highly variable. In many cases we cannot take the narrative further than the anecdotal level; in some cases new insights could be gained due to the availability of abundant and clearly published data (table 6.1). The purpose of this chapter is to critically evaluate the possibilities for synthetic analysis of the research results, not only in direct connection with the NOaA 1.0 itself, but also against the background of fieldwork approaches and methodologies, as well as the practices of reporting. So why can particular aspects be synthesised to a reasonable degree, and others cannot? We will show that this is not simply a matter of critical mass.

In order to maintain a clear connection with the research framework, and as we outlined in chapter 2, we will develop our arguments under the umbrella of the overarching research themes (chapters 3, 4 and 5) and spatio-temporal dimensions, which, in combination, form different knowledge domains. This permits us to clarify in what way the research agenda, fieldwork practices and reporting conventions aid or obstruct archaeology as a discipline primarily aimed at an understanding of, and the creation of narratives about, human behaviour in the past. The outcome of this critical analysis will help us to (a) identify strengths and weaknesses of the NOaA 1.0 as a tool for development-led archaeology and (b) make suggestions for improvement.

6.2 The research agenda: knowledge domains and research perspectives

6.2.1 People and Material

Chapter 3 focussed on the relationship between people and materials. As this theme encompasses topics that are traditionally dominant in archaeological research, it is not surprising that a broader range of aspects could be addressed. We used three headings, namely, craft activities, socio-cultural meaning and frames of reference, to discuss several topics to which development-led research has made a contribution, and in some cases has resulted in new insights. In many cases, however, we come to the conclusion that insights are somewhat incidental, and this may leave the impression that this analysis consists of a haphazard collection of examples. When we categorize the results into the knowledge domains defined in section 1.2.5, it becomes clear that the gains of our exercise are strongly determined by the presentation of research results in reports.

When considering the spatial scale of investigation, we were confronted with problems of representativeness. Mostly, results from development-led research can only be assessed at the local scale. The sites that have been subject to development-led excavation over the past 10-15 years were selected on the basis of what one might call ‘anticipated successes’. Basically, this involves the selection of sites for which, in consideration of survey data, chances are high of finding the expected. Hence, the results from projects that were concerned with the investigation of ‘familiar’

475 Presented in the edited volume *De steentijd van Nederland* (Deeben *et al.* 2005) and in a chapter in *The Prehistory of the Netherlands* (Van den Broeke, Fokkens & Van Gijn 2005).

Table 6.1 Contribution of reports to the themes and topics discussed in the chapters 3, 4 and 5. Reports which have not delivered any useful information are not listed. + minor contribution; ++ medium contribution; +++ major contribution.

	People & Material						People & Space			People & Environment			
PUBID	Production, use & discard of lithic tools	Organic resources for artefacts	Materiality	Death & ritual	Typochronology final Palaeolithic and Mesolithic	Chronological & regional trends pottery	Lithic resources & Mobility	Find scatters & arctivity areas	Dwellings & other structures	Subsistence & food processing	Mesolithic pit hearths	Occupation (dis)continuity	Human impact
1										+			+
7					+		+					++	
15		+						+					
43		+									++		
49					+						++		
53	++		++			+	++		++				
61						+							
65							+			+			
74						+							
104											++		
105	+				++								
122						+							
126							+						
142											++		
143											++		
147											++		
161		++									+++		
163					+					+			
170											++		
174											++		
194						+			++				
210	+									+			
211										+	++		
216	+												
219	+					+	+		+				
240						+							
253	++					+	+	++					
255	++				++			+++			++		
258										+	++		+++
259	+++	++			+++	++	++	++		+	+++	+++	+++
260	+++					++	++	++		+	++	+++	
265							++						
272	+++	++	++			++	++		++	+			
308	++						+						
309	++						+		++				
330											++		
338	++					+	+			+			
340						+					++		
351							+						
365					+						++		
373						+							
392							+				++		
395		+					+			+			
407					+	+					++		
462	+++		+		+++		++			+++		+++	++
463	+++			+++	+++	++	++	++		+++	+++		

	People & Material						People & Space			People & Environment			
PUBID	Production, use & discard of lithic tools	Organic resources for artefacts	Materiality	Death & ritual	Typochronology final Palaeolithic and Mesolithic	Chronological & regional trends pottery	Lithic resources & Mobility	Find scatters & arctivity areas	Dwellings & other structures	Subsistence & food processing	Mesolithic pit hearths	Occupation (dis)continuity	Human impact
467		+											
468	++					++	++	+		+			
475					++						++		
482										+	++		
483	+				++		+			+	++		
485					++						++		
492							+						
504		+							+				
515													
516							+						
524											++		
528	++		++			+	++		++	+			
537						+							
538	+++	+++		+++	+++			+++		++	+++	+++	+++
542						+		+					
554								+					
561											++		
562					+		+				++		
567							++						
599	++												
600						+				+			
617											++		
651						+							
725						+	+						
731											++		+
732	+++	+++	+++	+++		+++	+++	+++	+++	+++		+++	
733	++						++	++		+	+++	+++	
737	++				+					+			
738								+					
739	++					+		+		+			
740	++	++		+		++							
741	+	+				+	+	+++		+	+++	++	
742	++				+		+			+	+++		
744						+				+			
745	++				+++		+	+++		+		+	
747													+++
750	+		++			+	+	+++		+			
752	++					+	+	+++					
754							+						
755											++		
758							+						
760											++		
762					+								

contexts have produced insights that mostly fit or confirm the existing picture. Situations in which the outcome is uncertain are preferably avoided, which leaves little scope for the evaluation of expectations or predictions. In other words, the outcome is representative of the known, but there is no way to tell how representative it is for the unknown or the poorly known. This makes any inter-site or regional investigation difficult. Aspects of geographical differentiation in, for instance, the use of flint tools at a short-term scale remain difficult to investigate due to the lack of enough assemblages analysed in sufficient detail that date roughly to the same period. There are too many gaps. Nonetheless, the use-wear studies conducted to date, although they are as yet relatively few in number (section 3.2.1), have demonstrated considerable variability in tool use (flint and other rock) and have also provided evidence for the working of materials that themselves were not previously known from the archaeological record (shell and jet in the Mesolithic). In addition, these use-wear analyses give archaeologists much to think about concerning the relationship between tool typology and tool function; drawing inferences about site function based solely on tool typology is not straight forward.

However, despite these problems of representativeness, there have been gains in knowledge at the regional and long-term scales. With regard to long-term regional trends in Mesolithic tool types – microlithic components in particular – development-led projects have generated enough critical mass to deepen insights into typo-chronological developments (section 3.4.1).[476] Partly, this has resulted in the confirmation of the established phasing of the Mesolithic. At the same time, it is also evident that there is considerable geographical variability, with technological developments in the northern Netherlands following a different trajectory than appears to be the case in the central and southern Netherlands, at least during the Early and Middle Mesolithic. This may mirror different technological traditions, a hypothesis that connects to the distinction made between the Northwest Group and the Rhine-Meuse-Scheldt Group on the basis of typology many decades ago.[477] The dataset available today provides a more solid basis for such a distinction, although it still shows gaps. The technological modes of production that seem to be connected with these two groups – and perhaps other too – have received little attention. Yet, socio-cultural transmission of technological knowledge and practical expertise must underlie the persistent existence of these technological traditions, which themselves will have been subject to variation and change. It is more than worthwhile to consider just these aspects in future analyses. Many projects have yielded suitable material, but for this type of analysis, it will be necessary to return to the finds since the reports do not provide the information needed.

Along the same lines, there is still much to gain regarding ceramic technological traditions (section 3.4.2). Even more so than lithic studies, ceramic studies seem to be imprisoned in automatism, leading to untransparent classifications, which only seem to serve relative dating purposes. It will require a major shift for archaeologists to step beyond this superficial approach to ceramics, and move towards an understanding of socio-cultural meaning of pottery production and use. Research questions focussed on ceramics need to be more explicit regarding modes of production and use, the study of which can rely on various methods and techniques that are readily available. Because such data are as yet barely available, use of these techniques will allow archaeologists to gain knowledge not only in the local and short-term domains, but also in the regional and long-term domains.

The possibility of increasing our insight into the socio-cultural meaning of material (materiality) is not restricted to lithics and ceramics in terms of utilitarian objects. Several development-led projects have provided information with regard to ritual or cultic dimensions of objects and burial practices (section 3.3). Generally speaking, the manifestation of belief systems through the treatment of objects and of the deceased are disconnected in archaeological studies, and development-led projects are no exception herein; in many cases, finds categories are decontextualised. The interpretation of particular finds contexts as ritual depositions may appear less straight forward than the identification of burials, but this is certainly not (always) the case. In the example of Rotterdam-Beverwaard, the Mesolithic cremation graves

476 The publication of the reports on Well-Aijen and Kampen-Reevediep will probably lead to further detail being available.
477 Gob 1985.

were only identified as such thanks to the analysis of the small number of calcined bone fragments. The presence of a perforated cobble mace head alone would not have led to the same conclusion. However, it makes one wonder about comparable finds contexts where bone remains are lacking. Hence, there is a need to pay particular attention to finds context, even when objects could just as easy be explained as having been left in a secular setting. The line between the secular and the sacred is probably not as hard and fast as we tend to assume. Indeed, depending of the cosmological context, there may be no line at all.

6.2.2 People and Space

The relationship between people and space was addressed in chapter 4. In contrast to the situation with people and materials, the situation here is somewhat ambivalent regarding the gain of knowledge. The regional dimension of space appears to be one which can barely be addressed. We cannot reasonably asses knowledge gain in relation to research questions related to variability in landscape use at the short-term and long-term scales, no matter how valid these questions are. As indicated in section 1.2.2 and section 4.2, potential new insights into such topics as settlement location choice and settlement systems can only be evaluated when hitherto underrepresented landscape zones and geographical regions (including the North Sea basin) are investigated. However, because survey strategies largely build on the known archaeological record through predictive models (section 4.2.1), and sites selected for excavation fit those models, underrepresented zones and regions are simply not investigated. In addition, deeply buried sites are rarely excavated, and thus underrepresented. Hence, we are faced with a systematically biased record.

Nonetheless, to some extent, we can draw inferences with regard to regional aspects of landscape use in connection with mobility. Development-led projects have permitted archaeologists to gain insight into long-distance transport of raw materials, notably red Heligoland flint (Late Palaeolithic), Wommersom quartzite (Mesolithic), and possibly flint from other sources along the coast of northern France and southern Scandinavia. Although the data are scanty and observations are incidental, they show that identification of potential raw material sources provides new insights into the geographical sphere of interaction in various time periods. Importantly, such insight draws our attention to the degree of mobility of groups and to the social interaction between groups. In the case of Heligoland flint in a Hamburgian context, for instance, it begs the question about the origin of the particularly high-quality flint that is found in many Hamburgian assemblages. New research will be needed to get a better grip on these matters. However, it also demonstrates the importance of expertise.

Under the umbrella of the theme people and space, most of the acquired results relate to the local use of space, that is, the intra-site level. Spatial information about finds distributions and features is provided in all of the reports included in this study, but analysis of data and subsequent interpretations of patterns remain superficial. Standard research questions regarding the nature of activity areas and the presence of built structures appear to be addressed in only a basic manner. Efforts to increase our understanding of site-formation processes and palimpsests are an exception, despite the fact that the overwhelming majority of sites excavated manifestly result from long occupation histories and complex depositional and post-depositional processes.

The main reasons for the present situation are not related to the research question themselves, nor to how data were collected during excavation; in fact, many sites have produced datasets that are potentially suitable for rigorous analysis (table 6.2). Instead, the reasons are as follows: first, the majority of sites investigated are palimpsests, which complicate the deciphering of the archaeological record at the site level; second, there is a lack of application of suitable spatial methods and techniques. The two reasons are related to some extent: palimpsests are difficult to unravel, and there is no clear-cut analytical approach. In most cases, spatial patterns within finds distributions are mostly only subject to visual inspection of maps that present various attributes of finds categories. Statistical approaches are almost lacking, as are multiscalar techniques, which permit archaeologists to investigate spatial

Table 6.2 Methodological approaches to spatial aspects in reports and suitability of datasets for future analysis.

PUBID	Focus of Spatial questions	Answers the questions	Applies statistical/ spatial methods	Excavation method	Excavation units	Suitability	Future analysis possible	Remarks
15	Flint concentrations in relation to borehole and grid excavation	Superfically	Statistical testing for varience	Corings and grid excavation	1 m squares (0.5 m segments)	Unsuitable	Limited due to the methodology	Focus given to the central borehole
253	Artefacts concentrations in relation to possible structures	Superfically	Interpolation of artefact distributions	Grid excavation	1 m squares (0.5 m segments)	Unsuitable	No due to sampling strategy	
259	Artefact concentrations in relations to activities	Superfically	interpolation (kriging – with standard deviation)	Sampling every 5m. Block 7 continuous area excavation	1 m squares	Unsuitable	Yes	Interpolation applied on a continuous dataset
260	Artfeact concentrations in relations to activities	Yes	Interpolation	Grid excavation (sampled)	1 m squares	Unsuitable	Limited due to sampling	
732	Artefact concentrations in relations to activities	Yes	Moving Average Windows	Grid excavation	1 m squares	Suitable	Yes	The use of MAW keeps interpretations on a general level
752	Chaine operatoire of lithic production, site formation processes, palimpsests	Yes	Interpolation	Grid excavation	0.5 m squares	Unsuitable	Yes	Interpolation applied on a continuous dataset
745	Artefacts concentrations in relation to possible structures	Superfically	Interpolation	Grid excavation (sampled)	1 m squares (0.5 m segments)	Unsuitable	Limited	No incorporation of evaluatation data
468, 738, 739	Artefacts concentrations in relation to possible structures	Yes, but only because the questions are limited	Undetermined	Boorholes, test trench and grid excavation	1 m squares	Undetermined	Undetermined	Applied mehods not described
538	Finds distribution and assessment sampling strategy	Partially	Nearest Neighbour and Moving Average Windows	Grid excavation (sampled)	1 m squares (0.5 m segments)	Unsuitable	Limited	Misuse of sampling and interpolation
543	Artefacts concentrations in relation to possible structures	Not possible due to the methodology	No	Grid excavation (sampled)	1 m squares (0.5 m segments)	Not available	No	
463	Artefact concentrations in relations to activities	Yes, but only because the questions are limited	Visual inspection	Grid excavation	1 m squares	Not available	Yes	

patterning amongst different finds categories. As a result, in the majority of cases, spatial interpretations are built on plain descriptions of clusters of materials. Connecting finds distributions to features and the identification of built structures equally suffer from a lack of thorough analysis. Here, too, we see the use of visual inspection of distribution maps (see section 6.3.4).

This is not to say that more elaborate spatial methods and techniques will lead to new insights by definition. The nature of spatial patterns in the archaeological record is highly complex, and the application of elaborate analytical techniques is equally beset by problems of interpretation. Statistics-based and multiscalar approaches produce new output through the transformation of input data, but then again, this new output requires interpretation. Without interpretation, this data is not necessarily less 'impressionistic'. Although visual inspection of distribution maps is a useful first step towards archaeologically meaningful interpretations of spatial patterns, only in-depth analysis of reliable excavation data will help us to develop a deeper understanding of the interrelationships of data and can potentially lead to the discovery of other meaningful patterns that would otherwise remain hidden in the data. The approaches are complementary, for which reason we favour the application of multiple techniques – visual, statistical, multiscalar – to potentially increase insights into short- and long-term dimensions of the use of locations. Hence, the research questions in the NOaA 1.0 remain topical.

6.2.3 People and Environment

The third and final theme, addressed in chapter 5, concerns the relationship between people and environment. Again, this theme is covered by several research questions and topics in the NOaA 1.0. Evidently, the chances of archaeologists acquiring new insights are directly dependent on the availability of environmental proxies and materials, which for uncharred organic matter is determined by preservation conditions. Clearly, there will be a bias towards wetlands, as far as these have been subject to excavation at all. The number of data points is restricted, and this hampers any effort to progress our knowledge. Archaeobotanical remains have been subject to synthetic analysis in recent years,[478] whilst few archaeozoological assemblages have become available during the period under review. Nonetheless, some aspects have been shown to deserve attention, notably with respect to the use of animal and plant resources (section 5.2.1).

Bone, tooth, and antler, mostly calcined and mostly in small numbers, appear to be found more often at Mesolithic and Neolithic sites than one tends to think. Although the information that can be extracted from these small assemblages is relatively restricted, the evidence adds useful information to the overall still poor record dating to early prehistoric times. Furthermore, animal bones whose anthropogenic origin is questionable can still provide information about the composition of the 'animal landscape' in terms of species diversity. This is a much needed source of information, as reference frameworks for subsistence strategies are largely founded on actualistic models of animal behaviour and communities. Yet other phenomena, such as arrangements of wooden stakes in stream beds, provide information about food procurement techniques, notably fishing techniques. ^{14}C-dates of such stakes point to surprisingly significant time depths (see section 5.2.1).

Development-led research has made a considerable contribution to our knowledge about hunter-gatherer plant (food and non-food) resources. Here we see that the application of modern techniques of analysis by specialists in the field leads to exciting results. Such apparently dull categories as charcoal and other charred plant remains can provide information that was not easily accessible until recent years. Although the number of assemblages is still small, insight into the exploitation of a range of plants for food has increased considerably, most notably with regard to wetland species, the remains of which have been found in charred condition. Research regarding the use of Mesolithic pit hearths has resulted in the development of a new hypothesis, notably their potential function in the process of wood-tar production.

Notwithstanding the fact that several potential interpretations of the pit hearth data are possible, the importance of the reported results carries further than just the possible use of the enigmatic Mesolithic pit hearths. Because these features are prominently present on many sites north of the Rhine throughout the Mesolithic, the question arises how differences in time and space can be explained, for instance, in connection with climate-driven models about vegetation succession. Other related questions refer to the time-depth of locational use – this can span more than 2000 years – in connection with such pits. Analysis of this type of feature at the site level thus significantly adds to the investigation of questions at various spatio-temporal scales.

The same holds, to some extent, for research into human impact on the environment. Traditional models about the restricted influence of early prehistoric people, mostly hunter-gatherers, on their environment are now being questioned. Development-led research again has made a considerable contribution to this debate, mainly because of an open-minded involvement of specialists. The methods applied are traditional, but the frameworks of reference have changed under the influence of an international debate. In fact, development-led work in the Netherlands is at the forefront of these new developments. Therefore the fascinating results should not remain hidden in grey literature reports. The publication of such results in scientific papers by professionals who work in development-led archaeology is, however, frustrated by the dictates of commercial continuity.

478 Out 2009.

It is important to note that recent years have seen the development of innovative techniques that use data sources that also are (or can be) found in the Netherlands. Analysis of ancient DNA is potentially possible; both the extraction and the analysis of aDNA from fossil bones have witnessed great technological improvements. A recent study of skeletal remains from Bell Beaker contexts in Europe – including the Netherlands – demonstrates the potential for genetic studies.[479] Equally, the potential presence of aDNA in buried palaeosols – sediment aDNA – may shed light on animal, plant and human populations in 'extinct landscapes', which are so far only partly represented in the fossil physical record.[480] Another source of information concerns stable isotopes – notably ^{15}N and ^{13}C (the latter of which is normally measured for the purpose of ^{14}C-dating). Although it has been known for a considerable time that stable isotope analysis can yield important information about human and animal diet and habitat,[481] such analysis is not conducted in the context of development-led research. Often not even the ^{15}N and ^{13}C values are provided. A recent study of isotope data from Mesolithic human remains has shown that even contextless finds, in this case from the North Sea, can provide meaningful information about human diet.[482]

6.3 Connecting to development-led research in practice

The preceding sections make clear that a decade of development-led archaeological research concerning the early prehistory of the Netherlands has yielded limited gains and that we often remain stuck at the anecdotal level. Returning to the title of this report, it appears that paradise is, indeed, lost. The hopeful expectations around the NOaA 1.0 with regard to safeguarding archaeological heritage and making considerable contributions to our knowledge about the early prehistoric past of the Netherlands have not come true. Nonetheless, there is much potential, which means that part of paradise is still waiting to be discovered. Especially reports on the more extensive projects make clear that in-depth study of finds categories and excavation data can contribute to the answering of research questions in the NOaA 1.0. This potential can still be tapped, but only by returning to the finds and the primary data, which is far beyond the scope of the present study. Hence, for the most part, it is not so much the research questions themselves that are the problem, but, rather, their embedding in project outlines and strategies. In this section, we identify the most pressing issues that, in our opinion, need to be addressed if the next decade of research is to provide new insights. We will do so by following the various steps of the research process (fig. 6.1) to identify where problems exist. Each section includes a brief description of the standard procedure, a description of the problem, and a proposal to solve the problem.

Often the solution needs to be found in the first step of the research process, namely, the project outline. Within an archaeological 'market' in which competition is primarily expressed in financial terms, commercial firms are evidently hesitant to do more than is required. The quality of the project outline therefore determines the quality of the research project to a large extent.[483] We feel that it is the shared responsibility of the archaeological community to determine acceptable qualitative baselines for development-led research. As we express in our introduction (section 1.1), the purpose of archaeology is to develop insights about human behaviour in the past from a unique but vulnerable source of information. It is not about solving a 'problem' for economic development today. Hence, the quality of the project's project outline should be the first concern, and this requires the adequate involvement of expert knowledge right from the beginning.

Step	Product
Step 1. Research plan	Prediction of archaeological values
Step 2. Prospection	Presence of archaeological site
Step 3. Excavation	Data characteristics
Step 4. Analysis	Interpretation
Step 5. Report	Registration

Figure 6.1 Schematic representation of the research process within the context of development-led archaeology in the Netherlands.

479 Olalde *et al*. 2017.
480 Recent examples involve the question of the introduction of cereals in Britain (Smith *et al*. 2015), the interplay between foragers and Neolithic farmers (Bollingino *et al*. 2013), and the co-existence and/or presence of Neanderthals and Denisovans on sites, e.g. in the absence of fossil bone remains (Slon *et al*. 2017).
481 For an example from the Netherlands, see Smits & Van der Plicht (2009). Other examples concerning Mesolithic populations in Europe have been published since the beginning of the twenty-first century (e.g. Schulting 2005, 2010; Schulting & Richards 2001, 2002).
482 Van der Plicht *et al*. 2016.
483 More than a decade ago, Bazelmans *et al*. 2005 (2005; see also Lauwerier *et al*. 2006) published a report on the quality of the PvE. His conclusion was that project outlines were chary in their research ambition. This still appears to be the case.

It is important to note that archaeobotanical research did not raise any serious problems that we feel to be necessary to address here, neither in terms of applied methodologies and techniques nor in terms of the quality of analysis itself. It is our impression that archaeobotanical contributions to development-led research do not suffer from the flaws that contributions relating to other groups of materials suffer. The high quality is attributed to the fact most contributions are produced by a relatively small community of highly qualified specialists, who tend to easily share ideas and expertise. This community may serve as an example for other specialists, who, like, archaeobotanists, are required to meet the formal standard of training and experience.

6.3.1 Predictive models

One characteristic of development-led archaeological research in the Netherlands is the use of predictive models, which are based on the idea that people did not behave randomly in the landscape. The rationale is that resources were exploited using various strategies and technologies based on (expected) availability, experience and tradition. Many landscapes offered a rich reservoir of potential resources, but this does not mean that the entire range actually was exploited. The landscape as it was known to one or more groups of people was fundamentally different from the reconstructed 'landscape' into which we project our early prehistoric people. Differences, which we cannot even define, concern aspects of geographical scale as well as 'contents'. Which parts of the geographical space that we have defined as researchers were actually known by groups of people? And what can we actually say about variability in resource availability in time and space? What drove people to exploit particular resources, or to not exploit them? Cosmological and ideological considerations, for instance, may have directed the choices that were made. Hence, with regard to the archaeological knowledge about how people behaved in the landscape, we face many uncertainties.

In addition, the archaeological record is like a Swiss cheese, full of holes, and extremely biased where it comes to our knowledge about the organisation of cultural space at a landscape scale. We do not have a confirmed representative record – a quantitatively and qualitatively sound sample – of spatial behavioural systems (i.e. the range of behaviours) in early prehistory. This is not only the case in the Netherlands, but also elsewhere, indeed, anywhere in the world; it is inherent to the nature of the archaeological record.[484] In the Netherlands, however, predictive models of site location provide important input for the design of research strategies in the context of development-led archaeology. Straight forward translation of model expectations easily leads to self-fulfilling prophesies, since models are mostly built on statistical correlations between archaeological observations (a biased dataset) and derived palaeolandscape characteristics (geomorphology, soil characteristics and hydrology). As a consequence, new data points will primarily confirm the model. A site containing, among other things, flint microliths on a relatively pronounced sand ridge next to a low-lying area that is assumed to have carried water will end up in the report as 'a Mesolithic hunting camp', full stop.

The problem of correlative or inductive modelling for heritage management purposes has been discussed extensively over the past 15 years or so.[485] It has been argued that such models generally lack the 'cultural factor' needed to account for spatial and contextual variability that is only partially trapped in the archaeological record. Hence, deductive models, based on hypotheses of human spatial behaviour, should be given priority.[486] So the basic idea is to 'predict' where archaeological remains of some particular nature are potentially present, in consideration of a landscape model and some aspect of behaviour,[487] for instance, the hunting of large mammals. However, both approaches bear the problem of inherent uncertainty, an issue that hitherto has received little attention.[488] This uncertainty is partly related to the biased nature of the archaeological record. However, other sources of uncertainty relate to systemic interrelationships of variables, parameter settings and the theoretical baseline for a model. Any theory (read: hypothesis) about how people behaved in any sort of landscape setting is built on prior archaeological knowledge (which is biased) or makes assumptions about what

484 Brouwer Burg, Peeters & Lovis 2016; Lovis 2016; Whitley 2016.
485 Several volumes have been published on this topic, by Van Leusen & Kamermans (2005), Kamermans *et al.* (2009), and Verhagen (2007). For an in-depth review, see Verhagen & Whitley 2012.
486 Verhagen 2007; Verhagen & Whitley 2012.
487 Peeters 2007; Verhagen 2007; Whitley 2000.
488 See papers in Brouwer Burg, Peeters & Lovis 2016.

people would decide to do under certain circumstances. Hence, for the purpose of heritage management, deductive models are not necessarily better than inductive models.[489]

From the above, it could be concluded that the use of models – be it formal (computational) or informal (as narrative) – for the development of research strategies in development-led archaeology should be avoided. However, this does not need to be the case. Predictive models can be useful as a source for archaeological theory building if fieldwork is actually considered to be a form of model validation. In this perspective, research should not only focus on acquiring information that fits or confirms the model, but should also consider 'negative' outcomes. In other words, absence of evidence also calls for explanation; it may very well be that our underlying assumptions are wrong. Going back to the 'inevitable' hunting camp, for instance, the model may predict that a location to be excavated has a good chance of bearing remains of such a campsite, and often this will prove correct. However, if such remains are not found, contrary to what was predicted, this requires explanation. At the individual site level, we cannot expect to find such an explanation, other than, for instance, post-depositional effects on site preservation. Reporting on 'negative outcomes' in reference to expectations is, nonetheless, valuable for the purpose of model evaluation. Models quickly become too generic, due to generalised ideas about how early prehistoric people operated in the landscape, and what drove them to act. As a result, variability is barely considered. However, the sheer number of potential behaviours underlying the initial formation of the archaeological record is almost endless,[490] as is the range of post-depositional processes, including research methods and strategies.

Hence, if archaeologists would like to use results from development-led research in connection with research questions that refer to a landscape scale of people's behaviour, it will be necessary to make expectations more explicit. Next, we will need to establish to what extent results fit these explicit expectations. Diverging results can involve absence of the expected or presence of the unexpected. The latter readily causes problems if identified during fieldwork, as a change of strategy and methodology is often needed, which in turn normally has implications for the overall planning and budget. These factors in particular frequently lead to decisions that turn early prehistoric remains into 'by-catch', which is reported on to only a minimal extent. Yet it is precisely this by-catch which may represent low-resolution phenomena (low-density finds scatters, isolated pit hearths, isolated projectile points) which are otherwise underrepresented in the archaeological record.

6.3.2 Prospection: augering depth and sampling grid

In many projects, and in many parts of the Netherlands, preliminary stages of research include surveying by means of augering. Augering is often manual, unless potentially interesting layers are known to be present at several metres below the present-day surface. In theory, the augering depth is limited to the depth of the proposed spatial development, that is to say, the anticipated depth of disturbance.[491] As a result, to minimise costs, augering will not reach much deeper than that. In addition, within the strict context of the development plan, it is not considered relevant to know if archaeological remains are present at a deeper level. Furthermore, surveying by means of augering is largely focussed on deposits dating from the Holocene, and sampling will only include the top of underlying deposits from the Pleistocene, which, in the Netherlands, are mostly coversand.

As a consequence of this standard procedure, one specific group of archaeological remains systematically receives too little attention: Middle and Late Palaeolithic remains covered by younger Pleistocene sediments. Sites dating to these early periods of human activity are perceived as too difficult to detect. This, however, does not need to be the case when experts on these matters are consulted. Two projects (Den Bosch-Vonk en Vlam, Amstenrade-Buitenring Parkstad Limburg) demonstrate that Palaeolithic sites can be found during development-led archaeology.[492] As yet, anticipated attention for Palaeolithic sites remains exceptional, and as a consequence, finds fall systematically in the category 'by-catch'. Many development plans do, however,

489 It should be noted that formal modelling (i.e. computational modelling) for the purpose of exploratory research offers a powerful tool with which to investigate sources of patterning in the archaeological record (Peeters & Romeijn 2016).

490 Van der Leeuw 2016.

491 Disturbance is not restricted to physical disturbance due to (machine) digging. Lowering of the groundwater table, for instance, also involves disturbance, notably of the hydrological and geochemical conditions.

492 Both fall outside the time range that was to be analysed within the present project; also, the reports are not yet available.

result in the disturbance of Pleistocene deposits, for instance, due to piling for foundations of buildings. Any Middle and Late Palaeolithic sites that are present are thus disturbed and inaccessible for archaeological research.

In order to improve the situation with regard to the Palaeolithic, any project outline related to development that is expected to involve disturbance (piling, trenching, dredging) of Pleistocene deposits should explicitly include prospection for Middle or Late Palaeolithic sites, depending of the geological situation at hand. Hence, the project outline should make explicit that surveys, whether by means of augering or by means of trenching, should include Pleistocene sediments to a depth that can reasonably be expected contain archaeological material and be disturbed. A good starting point may form the mapping of palaeosols, such as those encountered in loess deposits and Late Glacial coversands.

Similarly, the detection of early prehistoric sites of Mesolithic and Neolithic age by means of auger surveys faces many problems.[493] Various statistical studies that have considered discovery probabilities of sites characterised by finds scatters have demonstrated that only high-density scatters of at least a medium-sized horizontal extent – that is, palimpsests covering more than 1000 m² – can reasonably be detected in a 20 × 25 m sampling grid (table 6.3). Scatters with lower densities of material and of smaller size require denser sampling grids (4 × 5 m). Detection of scatters <50 m by means of auger sampling is almost impossible. But the reality shows that even the detection of larger sites is difficult, particularly because materials are distributed unevenly over a surface; average or random distributions do not exist.[494] Therefore auger sampling as part of a standard prospection strategy is a disadvantageous starting position for the discovery of the kinds of smaller, high-resolution sites (e.g. low-density 'single event' scatters) that we would like to have more information on in order to answer many research questions in the NOaA 1.0. The only way to increase the chances of locating such sites is to anticipate their potential presence (e.g. based on palaeolandscape information) in situations where terrestrial deposits dating to

Table 6.3 Recommended survey strategies for Stone Age sites (adapted from Verhagen et al. 2013).

Type	Core sampling grid	Auger diameter	Observation technique
Very small (<50 m²)			
Low find density (40-80 per m²)	-	-	-
Very low find density (<40 per m²)	-	-	-
Small (50-200 m²)			
Low find density (40-80 per m²)	4 x 5 m	15 cm	3 mm sieving mesh
Very low find density (<40 per m²)	4 x 5 m + test pits	-	-
Medium-sized (200-1000 m²)			
Medium-high find density (>80 per m²)	13 x 15 m	12 cm	3 mm sieving mesh
Low find density (40-80 per m²)	8 x 10 m	15 cm	3 mm sieving mesh
Very low find density (<40 per m²)	4 x 5 m + test pits	-	-
Large (>1000 m²)			
Medium-high find density (>80 per m²)	20 x 25 m	12 cm	3 mm sieving mesh
Low find density (40-80 per m²)	13 x 15 m	12 cm	3 mm sieving mesh

493 Tol *et al.* 2004; Verhagen 2005; Verhagen *et al.* 2011, 2013.
494 Verhagen *et al.* 2013; also see Kattenberg *et al.* 2008; Peeters 2007.

the Pleistocene or Early-Middle Holocene are reached. In practical terms, the use of mechanical shovels – which are almost always used in the Netherlands – should be controlled in such a way that encounters with such sites do not lead to instant destruction. Furthermore, consultation of specialists remains important.

6.3.3 Excavation: phased strategies

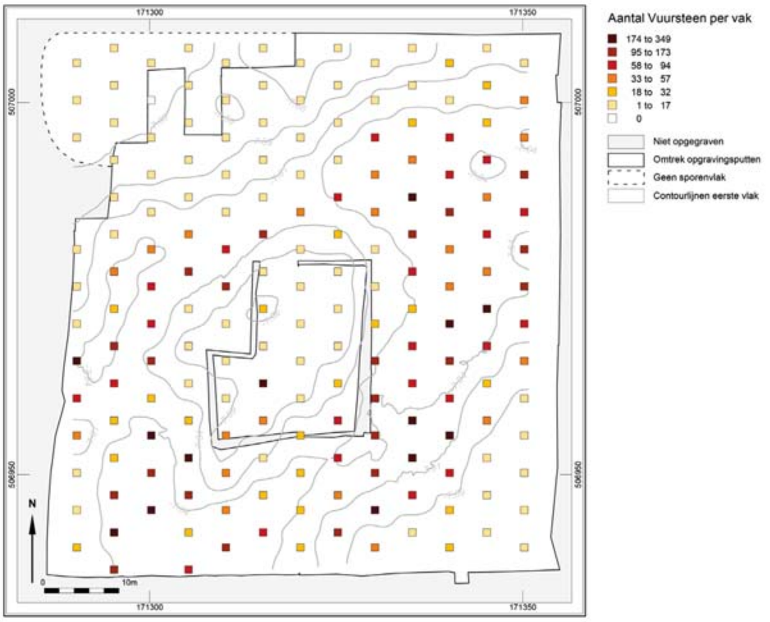
Stone Age sites are characterised by the presence of a scatter of finds, in contrast to younger sites, where features are encountered more often and are the dominant focus of fieldwork. By definition, finds scatters comprise zones with higher and lower densities of materials. Within development-led projects, the focus is often on excavating the high-density zones, and not 'wasting' time and money on relatively empty zones. To maximise the outcome of the excavation, apparently defined in terms of quantity of finds, a phased excavation strategy has become common in Dutch archaeology. In this strategy, excavation starts with the excavation of a small grid cells with a relatively large distance between them; clear examples are Dronten-N23 and Ede-Kernhem (fig. 6.2). This sampling strategy has replaced sampling by means of a large (12 or 15 cm) auger, a practice which had become part of Dutch field methodology.[495] Differences in finds numbers are used to delineate finds-density clusters. Low-density zones are mostly excluded from further research. This appears to be an efficient strategy if maximisation is a function of numbers of finds relative to the budget available. Unfortunately, research results are not by definition optimised when price per find is minimised: research quality is not based on the number of finds but, rather, on the quality and information value of the data. In this respect, two concerns need to be addressed.

The first concern is that the use of grid-cell densities to predict variation in the density of the finds scatter is methodologically problematic. We must remember that finds scatters are of a fundamentally different nature than distributions of soil or geological units, for which point observations can be interpolated relatively securely by means of geostatistical techniques.[496] Whilst soils and geological units, such as sediment layers, are continuous three-dimensional phenomena, artefacts as composite elements of sediment layers are not. Archaeological find-scatters are most often approached as two-dimensional patterns, whilst in reality they are three-dimensional. Indeed, each and every artefact can only take up as much space in a sample volume as the volume of the artefact itself. Hence, if one wants to take a purely quantitative approach, the finds density of a sample unit is better expressed in terms of volume (whereby weight can be used as a proxy). Also, it is important to note that Stone Age sites that have been extensively excavated (e.g. Hoge Vaart-A27, Dronten-N23, Ede-Kernhem and Schipluiden) demonstrate substantial quantitative variation regarding the number of finds within high- (or low-)density zones, even at short distances. This implies intrinsic uncertainty with regard to quantitative interpolation of archaeological sample data – uncertainty that is not easily accounted for. And because, by definition, relatively empty zones are left unexcavated, there is no check to determine whether our selection was correct. This problem was made explicit for Dronten-N23, where the finds densities predicted on the basis of the interpolation were compared with the finds densities from the subsequent excavation (fig. 6.3). Although the differences between expected and observed grid-cell values roughly average out, the distribution patterns are different.

This implies that quantitative variability within sites can be significant and also difficult to predict.[497]

The second concern is of a very different nature, but does build upon the first. The quantity-driven selective approach to excavation results in patchy and discontinuous excavation plans (see fig. 6.3), in which clusters or concentrations of finds are often only partially excavated. This leaves little potential for the investigation of spatial aspects, even though these are explicitly part of several research questions in the NOaA 1.0. Therefore, it is important to carefully consider the consequences of choices made with regard to the collection of spatial data: which avenues are kept open, and which are cut off. Many techniques for spatial analysis are available, and could be used, but their applicability requires continuous areas of fully excavated grid cells,

495 There is no fundamental difference between sampling in small grid-cell units and auger sampling in terms of information value regarding find density, as long as similar sampling depths are used.
496 Isaaks & Srivastava 1989; Chilès & Delfiner 2012.
497 In the recent case of Kampen-Reevediep (Mesolithic), a different approach was chosen. Instead of selecting delimited concentrations for excavation, several transects were investigated, which also included 'empty' zones. The preliminary results are very promising.



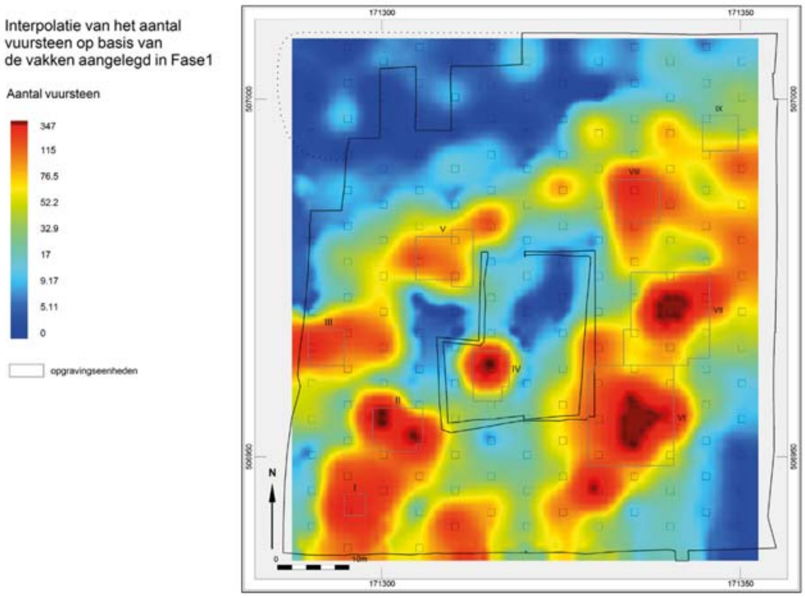


Figure 6.2 Left: sampling grid and extrapolation of the quantity of flint for Dronten-N23 (from appendix II: PUBID 538). Right: sampling grid and extrapolation (inset top right) of the quantity of flint for Ede-Kernhem, and the clusters recorded during subsequent excavation (from appendix II: PUBID 745).

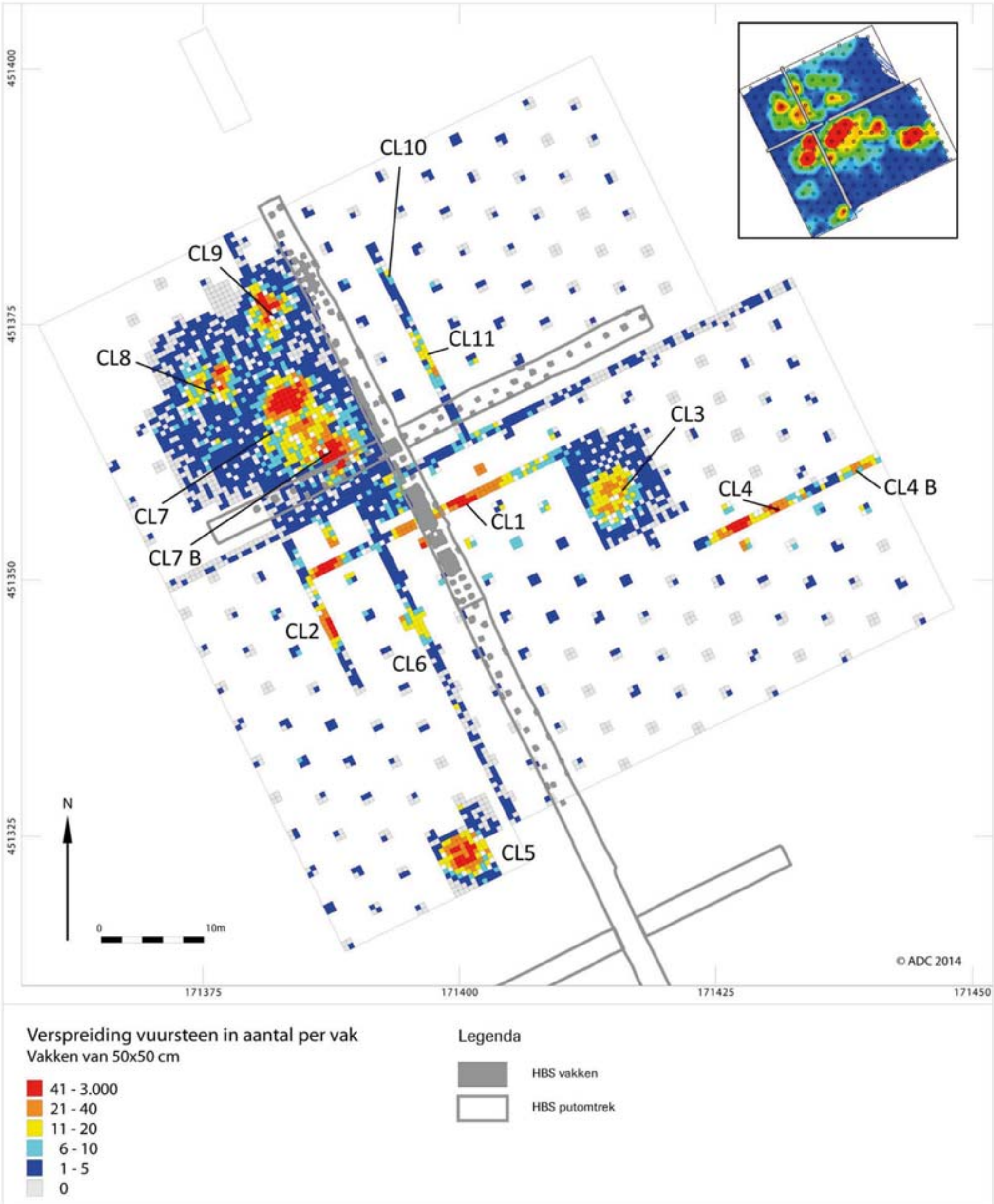


Figure 6.2 Left: sampling grid and extrapolation of the quantity of flint for Dronten-N23 (from appendix II: PUBID 538). Right: sampling grid and extrapolation (inset top right) of the quantity of flint for Ede-Kernhem, and the clusters recorded during subsequent excavation (from appendix II: PUBID 745).

preferably including empty zones to minimise edge effects. The meagre gain from development-led projects regarding questions about the spatial organisation of early prehistoric sites may partly be a consequence of this 'fragmentation' of spatial data. Furthermore, the tight delimitation of zones that are selected for excavation seems to involve a simple calculation of the number of allocated grid cells within the constraints of time and money, instead of a calculation based on potential information value.

Whilst a phased excavation strategy remains smart, it is proposed here that the above concerns may be addressed by changing two aspects of the strategy. First, in order to account for localised variability in finds densities, the first phase should be intensified so

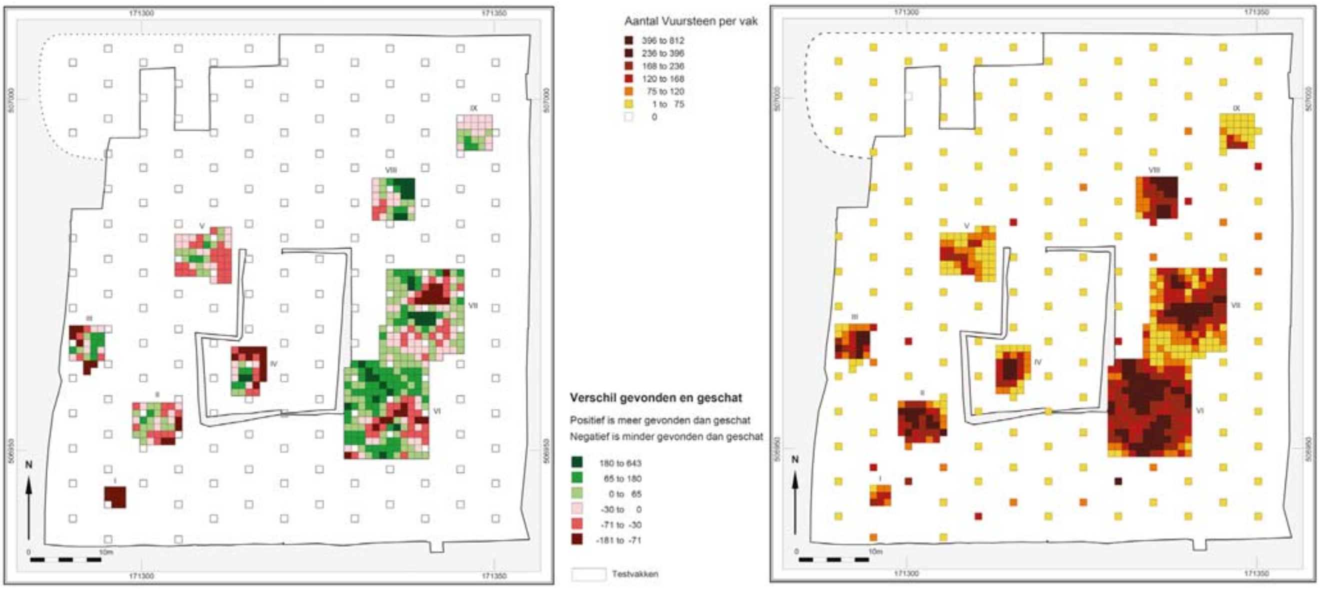


Figure 6.3 Differences between expected and recorded quantities of flint for Dronten-N23 (from appendix II: PUBID 538).

as to increase the predictive value of interpolation models. The intrinsic uncertainty is related to uneven distribution of finds within isolated grid cells – finds that also occupy variable volumes within a unit of sediment. Second, within large projects, such as Dronten-N23, it may be wise to focus the excavation on some finds clusters and excavate them 'fully' instead of excavating more clusters, but only 'partially'. However, making decisions about which clusters to excavate and how should first of all be a concern about potential information value: Which research questions have the best chance of receiving an answer with data expected to be obtained from the area to excavate? And where do we potentially have the opportunity to obtain new insight into questions that are less easily answered?
With respect to questions requiring spatial data, a well-thought-out strategy for the collection of those data in consideration of methodological prerequisites remains important. The use of 50 × 50 cm grid cells as a basic unit for finds collection potentially enables high resolution analysis.[498] Coarser grid-cell units, such as 1 × 1 m squares, do not permit fine-grained interpretations of spatial patterns, e.g. in terms of activity areas and post-depositional processes.

6.3.4 Analysis

The phase following the excavation involves the analysis of the collected data and finds categories. Our analysis of results from development-led projects has identified several issues that need further attention in this post-excavation phase.

Standards in material culture analysis
The description and analysis of cultural material is not standardised, which is a serious hindrance when one intends to use the results of an analysis for new research. For a part this is the result from the fact that the categorisation of cultural remains is subject to variability due to specialists who may use different classification frameworks and definitions. As a result, definitions of cultural groups may change through time. This situation is complicated further by the absence of a national forum to discuss standards in the description and analysis of ceramics, flints and other stone finds.[499] These problems lead to the conclusions that (a) the reports under study are strongly influenced by the author's personal choice in terminology and (b) reports from different authors are difficult to compare.

[498] Peeters 2007; Spikins *et al.* 1995.
[499] Initiatives to overcome this situation have been undertaken recently by the foundation Specialisten Archeologisch Materiaal Platform (SAMPL), a platform for specialists in archaeological materials. Its objectives are the improvement of the quality of material culture studies; knowledge dissemination (towards professionals and the public); and protecting the interests of specialists. Several guidelines have recently been published with regard to inorganic materials (https://www.sikb.nl/archeologie/kna-leidraden).

Some examples may help to understand the effect of these problems. A first example is that of the categorisation of stone tools. Whilst some authors prefer to talk about querns, others use the term grinding stones. There is no way to know whether they describe the same type of object and are, in fact, synonymous. Because most of these tools are not depicted in the reports, the only way to use the reports for further study would be to extract the finds from the repositories. A second example concerns the terminology related to Lanaye flint. In some publications, the author distinguishes between the Rijckholt and Banholt subtypes, whereas in others is the author only uses the term Rijckholt. Is this then used as synonym for Lanaye, or is the author of the opinion that the Banholt subtype is absent? A third example relates to the use of the terms Vlaardingen, Stein and Vlaardingen/Stein, and the discussion about the application of 'culture' or 'group' as ordering principle. All three feature in the reports studied, without any reference that makes clear why one particular term is used, or what the arguments are for a preference for a particular option.[500]

The above are merely examples – the lack of any standards concerning typology, technology and raw materials makes comparison and synthetic analysis of the results very difficult.

Stimulating the experts to develop standards will help to overcome many problems. Differences in opinion will, however, always exist to some extent. These standards should include all aspects (typology, technology, raw material) and lead to consistent and mutually comparable datasets for analysis, and provide a basis for standardised data presentation in reports. In addition, expert meetings provide a venue for exchanging ideas and discussing analytical aspects; eventually this may lead to shared approaches and best practices.

Functional analysis

Functional analysis of ceramic, flint and stone tools is almost absent in develop-led archaeology in the Netherlands. Pilot studies are sometimes undertaken as part of the larger projects, but it appears that this is only an appetiser, and never develops into a main course. Possibly this is the result of the fact that the results of such studies are uncertain, and by the time the pilot results come in, little time (and money) remains to expand the study without hindering the two-year term for finalising the report.

Whilst this situation is understandable from a managerial and a financial perspective, it means that in most projects relating to earlier prehistory, site function is determined on the basis of lithic tool typologies, without questioning the correlation between tool typology and tool function. As a result, typological classifications still dominate our understanding of the past. Functional analysis of pottery and stone tools is even rarer. Whilst many projects consider site function an important research topic, potential information sources are largely left understudied.

To improve the situation and make it possible to tap the enormous potential, it is important to design projects that include more specialist research on finds. Clearly, this needs to be realised within the constraints of time and money, and will require archaeologists to make different choices, in favour of post-excavation analysis. The drawback is that less money is then available for fieldwork, which is not desirable, since excavation can only be done once. Ideally one would like to see strategies where the analytical potential of the different finds categories is assessed in the early stages of the project, e.g. the first excavation phase of spatial sampling, so as to provide a qualitative basis for decisions to be taken. During excavation, the concern should not be to collect as much material as possible, but to collect enough material accompanied by good contextual data to enable meaningful analysis. Pilot studies on the function of ceramic, flint and stone tools need to become full-fledged. Now that they have shown sufficient success, they should be expanded to add relevant and new insights.

Spatial analysis

Research questions concerning intra-site patterns are standard on many Stone Age research projects. As a consequence, spatial information is presents in most reports, in one form or another. The general lack of dedicated chapters or sections for spatial analysis appears to suggest that spatial analysis is, in general, underrepresented and undervalued in Dutch development-led archaeology.

[500] Compare Beckerman & Raemaekers 2009.

Occasionally, spatial analysis is conducted by material specialists, but in fact this mostly concerns no more than visual inspection of plain distribution maps, instead of the application of spatial techniques. However, many of the spatial questions from the NOaA 1.0 are more difficult to answer than one would think, requiring in-depth analysis and assessment of interpretive possibilities. Much of the observed work is superficial, and merely leads to suggestions or indications of patterns, without further discussion of how the patterns can be understood in terms of human behaviour and post-depositional formation processes. Indeed, clustering of material may indicate activity areas, but how does this relate to everyday life, to the social use of space? What is the relationship between artefact distributions and features (individual features, feature groups, structures, settlement)? These are questions that are, on the whole, lacking in the reports under study.

When so many research questions relate to the use of space, opportunities to improve current practices are easily found. First of all, it is best to incorporate a dedicated chapter or section on spatial analysis in reports, allowing all spatial data to be analysed in an integrated manner. Furthermore, the integration of a specialist in spatial analysis, next to specialists on material culture studies, provides a sound basis for interaction and development of interdisciplinary interpretive frameworks.

Expertise on early prehistory

Development-led projects strive for the best research results within a framework defined in terms of time and budget. Where early prehistory is explicitly the subject of their research, it is evident that researchers involved have ample experience with the investigation of sites dating to this period. Choices are of course made within the constraints of time and money, but they are nonetheless based as much as possible on scientific considerations. In contrast, projects in which early prehistoric remains are found as a by-catch, it is in a way logical that little effort is spent in making the best out of these remains, as the expertise of researchers involved is often limited or non-existent. It is no surprise, then, that in the context of our study, we feel compelled to make critical remarks on missed opportunities. We will present three examples where considerable contributions could have been made with a relatively small investment.

First of all, it has to be acknowledged that there is little expertise on the Middle Palaeolithic within the Dutch companies. Few archaeologists in the Netherlands are trained in recognising artefacts dating to this period, and even fewer are capable of assessing the potential information value in a broader geographical and chronological context. As an example, we refer to the project Oentsjerk, for which two Middle Palaeolithic artefacts were reported, and registered as such in the national database Archis.[501] Both finds are, however, of natural origin and represent pseudo-artefacts. Consultation with a specialist would not have been time consuming, and would have prevented an erroneous dot on the map.

The second example comes from section 5.2.1, where Mesolithic faunal remains are discussed. The overview makes clear that on many occasions these remains have not been analysed, whilst they often provide the only evidence of animal food and/or natural habitat. Animal remains dating to the Mesolithic – and Palaeolithic – are extremely rare, and every opportunity to extract information from even the scantiest remains should be taken if we want to obtain new insight into hunter-gatherer subsistence and exploitation. It appears that the scientific relevance of this somewhat unimpressive-looking finds category is underestimated.

The third example comes from section 5.2.2, where the use of pit hearths is discussed. This landmark feature of the Dutch Mesolithic does receive ample attention in the context of the bigger projects, such as Dronten-N23 and Knooppunt Hattemerbroek, where specialists in early prehistory are involved. Typically, the interaction amongst specialists on these projects demonstrably leads to sound sample assessment and selection procedures, in particular for the purpose of ^{14}C-dating. Such opportunities are mostly missed on projects where early prehistory is less the focus of research; samples for ^{14}C-dating are taken without prior assessment of their suitability. However, relatively small steps in the organisation of the research could lead to a major contribution to our knowledge of the period. For example, project managers should

501 Appendix II: PUBID 771.

consider involving archaeobotanists, who are able to determine wood species in an easy way, at little cost. Not only will this lead to more reliable sample selection, because ^{14}C-dates remain a high-cost item on project budgets, but it will also add to studies on vegetation and wood selection.

Regional comparison

Several questions in the project outline entail comparison of the finds and features under study with those from other sites. For research questions on regional occupation, this is self-evident, but it may even be argued that such comparisons should be made to determine site function. No matter the specific aim of any inter-site comparative analysis, the availability of digital datasets is important. The Dutch regulations demand deposition of datasets in the national repository DANS-EASY, which implies that relevant data are, in theory, available to the community.

Unfortunately regional analysis is almost absent in the reports under study due to the incompatibility of many datasets (the result of a lack of standards; see above). Moreover, comparative studies cannot be executed for the simple fact that datasets are often not available in the digital repository, in contravention of the regulations. This is clearly a great flaw in Dutch development-led archaeology. One way or another, guarantees are needed that all data will be digitally preserved for future reference. We propose two options. The first is to include verification of this obligatory data archiving in the work of the Dutch heritage inspection agency (Erfgoedinspectie). The second option is to create an explicit link between DANS-EASY and Archis and force the uploading of datasets – each of which should receive a unique ID linked to the Archis registration code – as part of the registration process; this is the only guarantee that specialist datasets are digitally available when the Archis registration is finalised.

6.3.5 Reporting

Above, we proposed that the analysis of material culture could be improved by developing standards. This improvement should also be reflected in the reports, which are currently highly diverse in terms of data presentation. Standards are often considered as undesirable straitjackets, but they should only be seen as a way to share information in a structured fashion, so as to allow for comparative analysis. The use of standards and conventions in reports should be considered a basic precondition for research, and is no different from the requirements for publication of research results in scientific journals. This should not be restricted to the reporting on material culture remains, but extend to all aspects. Particular attention is required for reporting the results of spatial analysis, which often lack explicit information about the use of methods and setting of parameters, and hence leave the critical reader with an unreadable black box.

6.4 Conclusions

This section provided several avenues for improving the quality of development-led archaeology in the Netherlands concerning early prehistory. At a more abstract level, these recommendations relate to three areas for improvement. First, many recommendations need to be addressed in the earliest research phase, when the project outline is drafted. This is the best guarantee that specific improvements will be carried out, rather than being lost sight of due to budget constraints. This recommendation is related to augering depths, phased excavation strategies, functional analysis, spatial analysis and the use of expertise on early prehistory. Second, changes need to be made so that the availability of datasets through digital repositories is guaranteed. Third, the development of standards for the analysis and publication of the various categories of cultural material and other aspects of research needs to be stimulated.

7 The national research agenda and future perspectives

In this study we have tried to demonstrate to what extent development-led archaeology, in the period 2005-2014, has made a contribution to answering research questions regarding the early prehistory of the Netherlands. These questions derive from the NOaA 1.0, and were considered to be of importance in the context of Dutch archaeology when it was drafted more a decade ago. It has recently been stated that NOaA 1.0 resembles a regional research framework much like those developed in Britain.[502] Indeed, there is a strong tendency to address issues at a regional scale. In the Netherlands, we have witnessed the increase of research agendas at a smaller-than-national scale: provincial (n=3), regional (n=2) and municipal (n=20). On the one hand, we can look at this as a positive development, as it makes more explicit what the archaeological potential is to decision makers and the wider public. On the other hand, we can look at this as a negative development, because it bears the risk of knowledge fragmentation, since research agendas can potentially differ between two neighbouring regions or municipalities. Since research agendas are strategic instruments, choices could be made from very different perspectives, and potentially lead to missed opportunities to make a significant contribution to archaeological research questions because decisions are made by local authorities. This conflict of interests could represent a major threat to the archaeological heritage.

7.1 Significance assessment and scientific knowledge gain

So what does this mean when we focus on the early prehistory of the Netherlands? Let us first and foremost state that choices have to be made. We cannot salvage everything, simply due to the fact that resources are not infinite. But we never did investigate 'everything'. Choices have always been made, and will always be made. And we should be honest: not everything needs to be investigated. Judging from the reports selected for our study, a large number of projects have not contributed anything other than a dot on the map, labelled 'early prehistory' (this is not specific to early prehistory; it applies to all other periods of Dutch prehistory and early history[503]). However, the decision of what to investigate, and what not, is not straight forward. We feel that the assessment of research potential in terms of scientific gain could use a more solid basis. A research agenda forms a good starting point, but that's not where preparations should stop. As for all research, in order to be able to answer a question, information or data are required, and it must be clear by which means these can be collected and analysed. Hence, the assessment of the research potential of archaeological sites should not only involve the establishment of, for instance, the variability in features and finds categories, and probable dating, but also an explicit evaluation of which information sources connect to research questions, and what possibilities exist to obtain the data that is actually needed.

Let us first return to the research agendas. In broad terms, the younger we get in time, the smaller the geographical scale on which archaeological phenomena can be interpreted within a socio-cultural (socio-economical, socio-political) context. Local communities during early medieval times operated in a smaller geographical space than did hunter-gatherers during the Mesolithic. And Mesolithic hunter-gatherers probably operated in a smaller geographical space than Late Palaeolithic hunter-gatherers. And within the Late Palaeolithic, Hamburgian and Ahrensburgian hunter-gatherers may have operated in a wider geographical space than those of the Federmesser Gruppen. However, one thing is for certain: early prehistoric communities actively organised their life on a spatial scale that exceeds that of modern-day administrative units in the Netherlands. From this perspective, research questions concerning the early prehistory of the Netherlands need to be defined on a national scale, and in various respects even on an international scale. In contrast, in a context of 'community archaeology', it can be argued that "*local research, whether guided by local agendas or not, provides detailed, but local information, for the focus is generally on the local. The sum of in-depth 'scientific particularism' does not automatically contribute significantly to efforts to address supralocal questions, or generate supralocal theories.*"[504] The second part of this quote we can endorse; our study provides a good illustration of this situation. The first part is more problematic where it comes to early prehistory.

[502] Groenewoudt *et al.* 2017, 183.
[503] Compare studies on the Late Neolithic and the Bronze Age (Fokkens, Steffens & Van As 2016) and the occupation history of the western part of the province of Noord-Brabant (Ball & Van Heeringen 2016).
[504] Groenewoudt *et al.* 2017, 192.

Inhabitants of any town in the Netherlands – take Zeewolde in the Flevoland polders, for instance – are easily surprised when scraps of a Mesolithic hunting camp are found in their backyard, so to speak. But from a scientific perspective, this may not be exciting at all, and certainly not when preservation is limited. This creates a dilemma: in such cases, should one decide to excavate if destruction cannot be prevented, or leave the site to be destroyed? After all, excavation involves money coming from developers and eventually taxpayers.

The question is to what extent scientific knowledge gain should weigh in decision making. Indeed, because academics in archaeology are paid by the state, one could argue that scientific knowledge gain concerns issues of national significance. If the assessment of the information potential of archaeological sites is connected with a national research agenda, and this assessment does play a role in decision making, then scientific knowledge gain is given weight. In that case, we want to argue for expert-based, more rigorous choices with regard to the question of whether or not a site needs to be excavated. The argument that archaeological heritage will be lost when excavation or, indeed, in situ preservation is not possible does not suffice. Both excavation and in situ preservation have consequences in terms of spatial planning (e.g. development of industrial zones or urban districts) and resources. It has to be made clear, insofar as this is possible, what the expectations are about potential knowledge gain. This should be done through a research strategy that outlines which data that are required for the answering of specified research questions need to be collected, and by which methodological and analytical means this can be achieved.

Of course there is always a factor of uncertainty. Archaeological reality is often different than expected, and it would be a mistake to leave the unexpected aside because it was not part of the significance assessment. The unexpected always leads to knowledge gain, and should always receive attention in any context of development-led fieldwork. Another issue involves the fate of sites that are expected to have too little potential for knowledge gain from a scientific perspective, and should therefore be deselected for excavation. Such sites can possibly play an important role in the context of community archaeology, but can also serve educational purposes.[505] Where development-led projects are required to follow strict protocols[506] and have to work within tight constraints of time and money, there is little to no room for the involvement of non-professionals or for the training of, for instance, students in archaeology. Although regulations already make it possible to leave the investigation of deselected sites to amateur archaeologists, we have the impression – which may, of course, be wrong – that this does not often happen.

7.2 The National Archaeological Research Agenda and research questions

While we were conducting our study, the National Heritage Agency launched the National Archaeological Research Agenda 2.0 (NOaA 2.0). It differs from the NOaA 1.0 in its ambition: the NOaA 2.0 intends to include, as Groenewoudt *et al.* put it, "*only the most important national (supraregional) archaeological questions, focusing specifically on development-led (Malta) archaeology*".[507] Groenewoudt *et al.* also point out that the compilation of this new agenda did not involve current academic research ambitions, in order to enable a balanced set of research questions that cover a broad range of themes, and to "*serve the management of the archaeological heritage as a source of knowledge of our collective past now and, above all, in the longer term*".[508] At the same time it is recognised that a research agenda intends to enhance scientific quality, which requires that it be used, and that quality and costs are a concern of those who have to make choices. Somehow, all this leaves us with the impression that knowledge gain in a development-led context differs from that in an academic context. We cannot see, however, that one can be disconnected from the other. Development-led work needs to be anchored in scientific approaches in the same way as academic work does, and there is no reason to assume that academic research ambitions – no matter whether these are vulnerable to change or not – do not contribute to knowledge of our collective past. Hence, it is not an easy task to please all parties in archaeology, and further dialogue will be necessary.[509]

505 We are aware of the fact that this brings with it other problems, but that is not a reason to avoid the dialogue.
506 Namely, the archaeology quality standard (PvE) and archaeology quality standard (KNA; Willems & Brandt 2004).
507 Groenewoudt *et al.* 2017, 185.
508 Groenewoudt *et al.* 2017, 185.
509 This is also expressed by Groenewoudt *et al.* 2017, 192.

The definition of the NOaA 2.0 research questions involved a number of basic restrictive principles (A-F below), the most important of which, in the context of our study, we list below,[510] and briefly comment upon within the context of our study and in reference to the NOaA 1.0.

A) Questions concern essential knowledge gaps and promising directions for research from an (inter)national perspective.
Our study demonstrates that the knowledge gain with regard to NOaA 1.0 questions is limited and that many gaps remain. Typo-chronologies of lithics have received considerable attention, but there are various problems to tackle: it is crucial to pay attention to 'clean' (single-phase) assemblages associated with independently datable material (botanical macroremains from surface hearths). Promising directions for research involve the study of Mesolithic pit hearth function by means of scientific methods (SEM, micromorphology and physico-chemical analysis), and based on targeted sampling strategies in the field. Reliable sourcing of lithics (use of good reference collections, thin-section analysis, physico-chemical analysis) from all socio-cultural contexts in the Palaeolithic, Mesolithic and Neolithic is important to enable research into geographical scales of landscape exploitation and socio-cultural interconnectedness.

B) Only archaeological (cultural heritage) questions are included, with the exception of historical cultural landscapes (biotic and abiotic) for which anthropogenic activity is considered to have significantly impacted upon the landscape.
Many questions in the NOaA 1.0 concerned material culture, notably, the production, use, discard and socio-cultural meaning of tools and other objects (e.g. ornaments/jewellery), but also dwelling structures, the use of pit hearths, and the exploitation and sourcing of various raw materials. Our study shows that limited progress has been made, but that there is much potential. Insight into the functional aspect of lithic tools is improving, but altogether there is restricted knowledge about tool type–related functional variability and assemblage variability because of insufficient sample size. Larger samples should be analysed in an early stage of research (during fieldwork). Technological aspects of lithic tool production and pottery production are given too little attention, but could be analysed by means of targeted morpho-technological studies and scientific methods (clay source analysis). Insight into the social use of space is still restricted, but could possibly be enhanced through the application of more rigorous spatial analytical techniques. The identification of Mesolithic dwelling structures needs particular attention during fieldwork, through continuous mapping of finds densities and awareness about the potential presence of (even quite heavy) post features underneath finds scatters. Structural features also need to be analysed from a more integral perspective, which includes distributions of material remains. The extent of human influence on the nature/character of prehistoric cultural landscapes in hunter-gatherer and early farmer contexts has received limited attention, but could be addressed by means of multiproxy approaches (despite analytical and interpretive difficulties).

C) Questions reflect scientific ambitions, as well as aspects of field practice, notably the rare focus on early prehistory.
Some NOaA 1.0 questions of higher scientific ambition refer to the archaeological significance of 'empty' space and the understanding of palimpsests. Both aspects – which are, in fact, strongly related – have only sporadically been addressed in development-led work, despite their scientific pertinence. The focus on high-density concentrations of materials (clusters) restricts any possibility to take our knowledge a step further, whilst the high-density concentrations themselves are poorly understood in terms of formation processes. Strategies to investigate 'empty' zones (i.e. those with meagre finds) in effective ways need to be developed. Despite methodological complexities, enhanced spatial analytical approaches are needed to develop further understanding of the spatial structure that now remains 'hidden' in finds distributions. Archaeologists need to do this not only to increase our understanding of the socio-cultural meaning of space, but also to be able to develop field practices that can be adapted to the variable conditions (constraints of time and money, logistical and technical constraints) under which development-led work is conducted.

[510] From Groenewoudt *et al.* 2017, 187-188.

D) Questions are as independent as possible of theoretical views or principles.
Although many research questions in the NOaA 1.0 appear to be theoretically 'neutral', theoretical views or principles cannot be eliminated from archaeological research. Apparently straight forward questions about tool type and tool function can instantly be placed in the perspective of a processual theoretical debate about style and function. A question about the socio-cultural (indigenous, emic) 'meaning' of objects can be cast in the context of processual/post-processual/ phenomenological debate. As yet, there is still much to learn with regard to many of these aspects, notably, burial practices and the socio-cultural significance of objects. In order for archaeologists to have the opportunity to identify aspects of past human behaviour beyond, for instance, the strict function of tool types, there is pertinent need for rigorous field documentation of finds contexts and awareness amongst field crew about the potential presence of archaeological phenomena that may tell us more about how people were connected with materials and the environment.

E) 'Specialist' questions (e.g. bioarchaeology, physical geography, absolute dating) are excluded, as these are considered to be related to questions on cultural heritage (specialist input defines fieldwork quality).
The NOaA 1.0 addresses many 'specialist' questions, which focus on particular aspects of research themes. We have seen that, in many respects, the gain from development-led work is of an incidental nature. The most progress has been made in the field of archaeobotanical research on charred parenchymatous remains (plant foods), and the functional interpretation of pit hearths based on SEM charcoal analysis and physico-chemical analysis of organic substances. More substantial work along these lines is needed to test the hypotheses that were generated from this pioneering research. Specialist input for the development of a project outline is a *conditio sine qua non* to ascertain such approaches, which are proven to result in knowledge gain.

F) 'Why' questions (cause-and-effect; processes of change) are excluded, as these require a level of synthesising analysis that reaches beyond the purpose of site-focussed development-led research.
More complex question about the origin and spread of cultural phenomena and the long-term dynamics of socio-cultural behaviour and environment featured in the NOaA 1.0. Such questions, not surprisingly, appeared to be beyond the possibilities of development-led research, and are not addressed in the reports. Questions in the 'why' category are in the domain of academic research. However, the building blocks – in other words, data – do have to come from development-led work, at least for a big part, since universities only have restricted means and resources to collect data themselves. It is therefore important that there is a stronger involvement of academia in development-led research. From our study it has become clear that those development-led projects that were more closely connected with the academic environment generated most of the knowledge gain.

Despite the principles followed for the development of the NOaA 2.0, much remains to be done. The research questions are connected with 'research fields',[511] which are basically themes or focal points. Consultation of the online NOaA 2.0, which functions as a search engine,[512] shows that the research questions concerning the archaeology of the Stone Age number 39, of which only 32 are relevant for early prehistory (table 7.1). The focus of these questions is highly unbalanced in terms of themes, and is inconsistent with regard to the principles of question definition. The list in table 7.1 includes many questions that do not meet the restrictive principles, the most important one being the exclusion of 'why' questions that involve cause-and-effect, long-term perspectives, and analysis on a regional, or even national/international, scale.

511 Groenewoudt *et al.* 2017, 188.
512 www.noaa.nl

Table 7.1 NOaA 2.0 research fields and questions (translated from Dutch) queried for 'Stone Age'. Several questions appeared irrelevant for early prehistory (e.g. the evolution of ship construction; the colonisation and layout of unembanked tidal flats and peat marshes), and have been omitted.

Areas where little is known of the archaeology
When and in which way were areas that are now submerged used by humans, and how does this compare to our knowledge about the terrestrial record?
The dynamics of the Netherlands' cultural landscape
Did humans before to the Neolithic have influence on the landscape and/or vegetation? If so: where, in what way, for which purpose(s) and on what scale?
Occupation and adaptation in the rivers area and along the coast
Which connections exist between physical-geographical change, land use and occupation patterns along the coast?
Which connections exist between physical-geographical change, land use and occupation patterns in the rivers area, including the IJssel?
The archaeology of ritual
How are 'sacrificial landscapes' situated and structured, and what is the time-depth?
What are the nature, context and meaning of intentional (ritual?) depositions in and around house and yard?
Funerary practice and grave monuments
What are the characteristics and context of mortuary practices in Early Prehistory?
What are the nature and context of variation and change in burial practices?
What are the archaeological and landscape context of isolated graves or diffuse groups of graves?
How are graves and cemeteries situated relative to rural settlements, and how does this relationship change?
To what extent and for what purpose were pre- and early historic cemeteries and grave monuments reused?
What are the context and meaning of stray human skeletal elements in and outside settlements?
The earliest occupation in the Netherlands
What are the origin, mobility and territory size of Neanderthal groups, and connections with other areas outside the Netherlands?
Where, in which phases of the Pleistocene and under which climate conditions did early hominids stay in the Netherlands?
Late Palaeolithic – Early Mesolithic transition
In which way were (which species) of plant and animal resources used for subsistence, and raw materials for objects and items of exchange and trade?
When, where and under which climate conditions appear Late Palaeolithic cultures and cultural traditions? What is their geographical and chronological extent, and how are they interrelated?
Neolithisation process
How dis subsistence change during the Late Mesolithic through middle Bronse Age?
How do buildings and settlements show before the middle Bronze Age B (1500 BC)?
Which landscape zones were used for settlement, hunting, crop cultivation and animal husbandry in the Late Mesolithic and Early Neolithic?
Which changes and diversification occurred in the late phase of the LBK?
To what extent does (dis)continuity in the Neolithic occupation occur after the LBK?
Consolidation of farming
Which changes take place in methods, intensity and location of food storage?
How were houses internally structured and functionally partitioned?
The role of natural food resources since the introduction of farming
How has fishing evolved in terms of technology and economy?
Which role did the exploitation of natural resources (including hunting and fishery) have since the introduction of farming?
Dynamics of land use
What indications exist for seasonality and specialisation of settlements?
What economic functions had periferal areas ('marginal' landscape zones), and how does this this show archaeologically?
Which influence had farming (crop cultivation and animal husbandry) on vegetation and fauna?
When, where and to what extent did aeolian and slope erosion occur, and to what extent is this (directly or indirectly) related to (which?) human activity?
To what extent does (inter)regional and diachronic variability exist in frequency and the distance over which settlements, fields and pastureland were relocated?
Human-material culture relationships
What is the nature and meaning of utilitarian objects of organic material in material culture?
How was waste dealt with?

Although the NOaA 2.0 is intended to highlight the most important themes and to foster operationalisation in the field by means of practical suggestions, many questions implicitly have a high degree of complexity. Take, for instance, the following question: “Did humans before to the Neolithic have influence on the landscape and/or vegetation? If so: where, in what way, for which purpose(s) and on what scale?” (translation ours). To determine whether or not humans had influence on the landscape/vegetation, rigorous but methodologically complicated analysis of multiproxy data is required. How human activity influenced the landscape/vegetation involved the question of agency. And to establish for what purpose humans influenced the landscape/vegetation, one has to rely on theory-based interpretive frameworks. The final aspect, scale, can only satisfactorily be investigated by means of sampling well beyond the site level to which development-led work is usually bound.

Furthermore, empirical aspects are interwoven with interpretation, which complicates their day-to-day use in the practice of development-led work. To take another example: “What are the nature, context and meaning of intentional (ritual?) depositions in and around house and yard?” (translation ours). The aspects ‘nature’ (what is the phenomenon?) and ‘context’ (association, location, sedimentary embedding?) involve empirical evidence, that is to say, archaeological field observation. The aspect ‘meaning of (intentional?) depositions’ involves interpretation, since it is impossible to excavate ‘meaning’. Whether or not depositions are intentional is also a matter of interpretation. And what is meant by the term depositions? In Dutch archaeology, the term implicitly refers to single objects or groups of objects that have been deliberately placed at a location. Such placement is intentional by definition. Of course one cannot exclude that an object or group of objects may have been accidentally lost, but this is not a deliberate action. The characterisation of a context as deposition or loss is a matter of interpretation.

7.3 What’s next?

Of course it is possible to draft a new set of research questions based on our analysis of reports resulting from development-led work. After all, we have shown in the preceding chapters what development-led research has contributed to the answering of research question from the NOaA 1.0. Since this contribution is rather limited, we could satisfy ourselves by stating that all questions remain relevant. In a way they do, and some more specific questions could be added – but this would be in conflict with one of the selective principles given above. But it is equally clear that several NOaA 1.0 question surpass the scope of the development-led context of research, notably, questions in the ‘why’ category. Indeed, we feel that such questions should be omitted, at least as questions which should be the direct concern of development-led research.

We are, however, of the opinion that this is not the right time or place to propose a new set of questions for the NOaA 2.0. The issues addressed above lead to a more fundamental question: What should be the role of development-led and academic research in the broader context of archaeological fieldwork (which should be aimed at the collection of data that can stand at the basis of question-driven knowledge gain), as well as analysis and interpretation? The answer to this question should set the baseline for the improvement of the NOaA 2.0, which certainly should and can serve a purpose in quality control. We are convinced that a more balanced and targeted set of research questions can come from the dialogue between the development-led community and the academic community, and for which the present study may well form the starting point. To this end, two example research topics are discussed.

Mesolithic pit hearths

Pit hearths are a characteristic feature of the Mesolithic of the Netherlands north of the river Rhine. As these features are known in large numbers, the NOaA 1.0 addresses their function (albeit with some caution): "are there surface hearths, pit hearths and other fire places and what are their characteristics?" Section 5.2.2 made clear that significant knowledge gain has been realised with regard to the function of pit hearths. Perhaps this gain has led to the absence of any research questions on pit hearths in NOaA 2.0, although this type of research may have been perceived as being too specialist (see restrictive principle E in section 7.2) and not of national relevance (see restrictive principle A in section 7.2).

The knowledge gain derives from detailed work conducted at some of the larger development-led projects in the period under study. The analysis has gained a lot from the fact that a small number of dedicated researchers were involved. The following is a summary of the knowledge gain as described in Section 5.2.2. There is now a morphological typology comprising three types (A, B and C) that allows for inter-site comparison of available data. The large number of ^{14}C dates suggests that these types may have a chronological meaning as well. The combination of ^{14}C dates and charcoal analysis shows that wood from pine and oak was burned. Pine was dominant from the Preboreal until the Mid-Atlantic, while oak occurs throughout the Boreal and into the Late Atlantic. SEM and physico-chemical analysis gave more insight into the function of the pits. There are strong indications for tar production, but of course other – yet unknown – functions need to be considered as well.

While much progress has been made, the interpretation of these features as anthropogenic has been challenged recently.[513] It is proposed that the pit hearths should be interpreted as collapsed burnt ant nests. This dichotomy in interpretations makes perfectly clear that more research is needed to understand this phenomenon. How can development-led archaeology contribute to its study? Importantly, the issue needs to be addressed as a regional/national research ambition with a set research methodology to ensure a consistent approach to the answering of relevant questions. The following subquestions are proposed:

- Do newly discovered pit hearths fit the existing typochronology? In order to get to an answer it is necessary to clearly describe morphological aspects of pits and to obtain ^{14}C dates for all morphological types and identified types of wood. This involves the collection of basic information for all pit hearths (or a substantial and representative sample of the pit hearths when found in large numbers).
- What is the correlation between pit morphology and wood species, and to what extent might the observed differences result from technological changes in function (notably tar production)? As it requires a quantitatively sound set of data, this question can be directly addressed on sites with large numbers of pit hearths; data from sites with few pit hearths add to synthetic research at the regional scale.
- What is the (variation in) function of pit hearths? SEM and physico-chemical analysis point to tar production, but it is equally clear that further analysis is needed to test this hypothesis, while the evidence does not necessarily fit all pit hearths. The continuation of this type of research, in combination with soil micromorphology, is needed to gain more insight into the function of pit hearths.

The end of the Linear Bandkeramik

One of the research questions in the NOaA 1.0 is related to the seemingly abrupt end of the Neolithic occupation in the Dutch loess area at the end of the LBK: "is there a continuity or discontinuity in the occupation after the LBK? If there is a discontinuity, what is the duration of the hiatus in occupation?" In the NOaA 2.0, this question is maintained although rephrased as "to what extent is there (dis)continuity in Neolithic occupation after the LBK?" Apparently, there is a lack of knowledge gain with regard to this aspect on the basis of development-led archaeology in the Netherlands, while at the same time it is considered of national relevance (see restrictive principle A in section 7.2).

To address this question, a small excursion needs to be made to discuss the concept of discontinuity. The implicit use of the term above encompasses two aspects of discontinuity. First of all it embodies discontinuity in spatial terms. In general, continuity in occupation may be based on discontinuity of settlements: with shifting occupation within a small region we might still uphold occupation continuity. A clear

513 Crombé *et al.* 2015.

example of this perspective may be found in the occupation history of the river dunes in the Rhine-Meuse basin: while individual sites were occupied in an on-and-off pattern, a continuous occupation can be seen for much of the fifth millennium cal. BC on regional scale. With the restricted spatial extent of any archaeological project as a given, the spatial dimension of discontinuity can easily be taken into account when addressing this research question.

The second aspect of discontinuity is more difficult to deal with: the temporal dimension. In this specific case it deals with the absolute date of the last stage of the LBK in the Dutch loess area in comparison to the oldest absolute date of the post-LBK occupation in the area. While the Dutch LBK is characterised by a detailed ceramic typochronology,[514] the limited understanding of post-LBK occupation (hence the research question) frustrates dating on the basis of established (pottery) chronologies. The need for absolute dates is therefore evident: a series of absolute dates on cultural material would allow for a much needed cultural chronology. While the importance of absolute dating cannot be underestimated to address this research question, we should take into account that all dating methods have a limited resolution: the interpretation of a series of ^{14}C dates into occupation continuity requires auxiliary arguments to be found in the archaeological material itself.

This being said, what can development-led archaeology contribute to the study of this research question? As for the preceding topic, the issue at hand should be considered a regional/national research ambition to be approached with a coherent set of methodologies. The following subquestions are proposed:

- What is the absolute date of (sub-)assemblages for which temporal integrity can reasonably be assumed (e.g. features)? As stated in NOaA 2.0 this subquestion should also be taken into account for presumed Late Mesolithic sites in the region because of the lack of knowledge on post-LBK flint (typology, technology and flint sources). To answer this subquestion absolute dating needs to be seen as essential: dating on the basis of cultural material would lead to a circular argument.
- What are the technological, typological and morphological characteristics of the absolutely-dated material culture? In our opinion it is – at this stage of research – of restricted value to invest time (money) in the description and analysis of cultural material that is not dated. It will not help us answer the research question. As argued above it is of essence that in the analysis and publication of the material culture a standard system is used to allow intersite comparison.
- What subsistence evidence is available? The analysis of archaeobotanical and archaeozoological material should again be based on the available absolutely dated subassemblages. Evidence of agricultural fields is very limited for the Neolithic due to the difficulty to recognise them in area with no or little sedimentation. The best option to find agricultural fields is to include soil micromorphological research as a standard research tool when there is a chance that the Neolithic surface is preserved.
- What evidence is available for human impact beyond the settlement? While development-led archaeology is often focussed on settlements because this site type is more easily found during surveys, an important subquestion pertains to human influence beyond the settlement proper. Already during the desktop phase of development-led projects, locations with the potential for obtaining environmental data (e.g. on vegetation, sedimentation/erosion) should receive extra attention: while these locations would probably not yield large number of boxes with material culture they are the anchor points to understand the development of the environment in the period under study.[515] These locations are defined by sedimentation and therefore also hold great promise for the study of agricultural fields.

514 Van de Velde 2014.
515 Cf. Peeters 2007, 271. For examples see Bouman *et al.* 2013 and Kooistra & Peeters in prep.

7.4 Conclusion

The aim of this study was to evaluate the gains in knowledge that are is achieved through development-led investigations with regard to NOaA 1.0 research questions concerning the early prehistory of the Netherlands. Our synthetic analysis has made clear that basically all NOaA 1.0 research themes and questions remain either unanswered or partially answered. Several questions, particularly those in the 'why' category or which require synthetic work at the regional scale, are well beyond the possibilities of development-led projects. Any future research agenda that is intended to inspire development-led work and is concerned with the quality of the archaeological research needs to be better aligned with the potential and practice of what can reasonably be achieved within such a context. Importantly, our study also leaves us with the impression that there is a lot of potential to be tapped from all the work that has already been done. To tap this potential, all data need to become available, but even once that has been achieved, in many cases researchers will probably need to return to the finds material itself. So paradise is not lost, at least not entirely. Yet, it is necessary to develop further practices which lead to useful and accessible research results from development-led projects, in order to ensure that paradise doesn't crumble much further. This is the responsibility of the archaeological community as a whole.

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Appendices

Appendix I
Overview of the relationship between research questions, overarching themes, analytical dimensions, and NOaA themes

		Analytical themes			Spatio-temporal dimensions				NOaA 1.0 themes					
QID	Question	P&M	P&S	P&E	L	R	S-T	L-T	N1	N2	N3	N4	N5	Method
1	What is the nature and use of flint, and what is the origin of the raw materials?	+			+		+						+	
2	What is the quality of flint production and is there a relationship between quality of flint and length and breadth of the end products?	+			+		+						+	
3	Is any worked stone found? What was the function of such artefacts, what is the origin of the raw material?	+			+		+						+	
4	What is the evolution of form and decoration in ceramics? Is there evidence for gradual regional differences?	+				+		+					+	
5	What is the nature and origin of resoures used in ceramics production?	+				+		+					+	
6	What is the origin, use and archaeological context of jewellry	+			+	+	+						+	
7	Can typological artefacts be seen as culturally specific indicators?	+						+					+	
8	Is there evidence for typological change or developments within a culture? Is the current typochronology adequate for dating purposes, if not, is it possible to refine these typochronological with the new material evidence and dating?	+			+	+		+	+				+	
9	Does the chronological and spatial variation in the use of certain stone resources (e.g. Wommersomquarzite) for certain arrowhead types relate to more than just differences in cultural tradition?	+		+		+		+			+		+	
10	What practical uses of organic material other than food have been recognized and which traces of the associated crafts have been identified? (Evidence for rope, dye, woodworking, tar used for hafting?)	+		+	+		+			+	+		+	
11	What is the function of sites and to what periods/cultures do the phases of habitation date? Is there evidence for continuity or dinscontintuity?	+	+		+		+	+	+	+				
12	What is the function of hearth-pits (any evidence related to food preparation and cooking?) and how can their large numbers and long history of activity at one location be explained (int he mesolithic)?	+	+	+	+	+	+	+		+	+			
13	What can be said on the division between the North and South of the Netherlands in relation to arrowhead styles and stone resource use during the Late Palaeolithic and Mesolithic, how does the dividing line change int time and how does this realte to a changing landscape?	+				+		+	+		+		+	
14	Does the dispersal of deep hearthpits show a similar spatial division as resource and arrowhead use?	+	+	+		+		+			+		+	
15	What can be said on the colonisation and dispersion of cultures and traditions in relation to environmental changes? Are changes in material culture related to these processes?	+		+		+		+	+					
16	Did research on organics yield any signs of natural or cultural disasters or changes, and if this is the case, are there any indications on how people dealt with them?			+	+	+	+	+		+	+		+	
17	What is the importance (shares of the food economy) of hunting, fishing, acquatic resources and plant foods in hunter-gatherer societies versus neolithic societies?	+		+	+	+	+	+			+			
18	Which traces of food preparation, processing and storage have been identified?	+		+	+		+			+	+		+	
19	What can be said about the origin of food sources, the balance between local production and import, including trade, and to what extent did the availability and seasonality of food sources influence human mobility and settlement location choices?													
20	Is there evidence for products that were especially important in the food supply? What was their significance (eg prestigious products)?	+			+		+				+		+	

		Analytical themes			Spatio-temporal dimensions				NOaA 1.0 themes					
QID	Question	P&M	P&S	P&E	L	R	S-T	L-T	N1	N2	N3	N4	N5	Method
21	Are there human remains, what is the character of the remains (i.e. sex, age, health, demographic information) and the deposition (i.e inhumation, cremation, disarticulation, cultic or religious character)?	+		+	+		+					+	+	
22	Have any grave goods been found, what is their character (i.e exotic or local grave goods? Common or elite? Inidividualistic or defined set?)	+		+	+	+	+	+			+	+	+	
23	What role did organic materials (plants and animals) and the landscape play in (religious) rituals and burial customs?	+		+	+	+	+	+			+	+	+	
24	What are the spatial trends of mortuary tradition (relation to settlement, position of the body, consistency of the grave structure)?	+	+		+	+	+	+		+		+	+	
25	Do activity areas or features indicate the presence of structures?	+	+		+		+							+
26	What is the significance of empty and filled spaces	+	+		+		+	+						+
27	Is there evidence for social use of space?		+		+		+		+				+	
28	What activity areas and phases of habitation can be discerned in palimpsest sites? Are there specific zones of artefacts, features and structures?	+	+		+		+	+		+				+
29	What impact does site formation processes and post depositional processes have on the archaeological record and subsequent archaeological interpretation? (incl absence of features in concentrations, erosion, relation between surface finds and underlying features)		+		+			+						+
30	What (spatial) variation exists between sites	+	+		+	+	+			+				
31	Does the zoological or physical anthropological evidence indicate social or economical differences between or within sites?	+		+	+		+				+	+	+	
32	Is there evidence for hierarchic (or some other) relations between or within settlements based on activity within the settlements?	+	+	+	+	+	+			+			+	
33	Is data collected in a suitable manner for spatial research	+	+		+									+
34	Is additional spatial data available online (DANS)?		+											+

P&M	People & Material
P&S	People & Space
P&E	People & Environment
L	Local
R	Regional
S-T	Short-Term
L-T	Long-Term
N1	Colonisation and earliest occupation history of the Netherlands
N2	Landscape use and settlement systems
N3	Food economy, relationship Man and environment
N4	Burial and deposition of human remains
N5	Cultural traditions, social relationships and interaction

Appendix II
List of reports

The following list of publications contains all reports that were selected for analysis. The analysis started with a long list of reports on fieldwork of potential interest for the purpose of this study. These were numbered and added to the research database. In the further assessment a substantial number of reports were discarded (see section 2.3.1). Hence, de sequence of report number (PUBID) is discontinuous.

1: Muller, A., T. Obdam, M.T.I.J. Bouman & J.A.A. Bos 2012: *A2 Viaduct Aalsterhut fase 2 Aalst, viaduct Aalsterhut (Gemeente Waalre)*, Amersfoort (ADC-rapport 3181).

7: Bouma, N. & A. Müller 2014: *Tienduizend jaar landschaps- en bewoningsgeschiedenis in het Maasdal tussen Well en Aijen*, Amersfoort (ADC-rapport 3472).

9: Hielkema, J.B., 2014: *Sporen uit de Prehistorie op de vindplaats Almen-Groot Besselink*, Weesp (RAAP-rapport 2333).

10: Scholte Lubberink, H.B.G., 2014: *Nederzettingssporen uit de Prehistorie en Romeinse tijd op de Whemerenk te Almen*, Weesp (RAAP-rapport 2332).

15: Geer, P. van de, 2013: *Steentijd op de Stichtsekant. Definitieve opgraving van drie vindplaatsen op bedrijventerrein Stichtsekant, gemeente Almere*, Leiden (ARCHOL-rapport 212).

16: Hamburg, T., A. Tol, J. de Moor & Y. Lammers-Keijsers 2014: *Afgedekt Verleden*, Leiden (ARCHOL-rapport 244).

24: Van der Kuijl, E.E.A. 2006: *Archeologische opgraving, Julianastraat 27 te Alphen aan den Rijn*, Zelhem (Synthegra-rapport 174137).

43: Zielman, G., 2013: *Van oale groond. Nieuwe vondsten op de Azeler Esch. Aardgastransportleidingtracé Bornerbroek-Epe (A670), catalogusnummer 1. Gemeente Hof van Twente*, Weesp (RAAP-rapport 2395).

49: Weerden, J.F. van der, 2012: Barneveld Harselaar West-west Archeologisch onderzoek, 's Hertogenbosch/Deventer (BAAC-rapport A-09.0252).

51: Zee, K., 2009: *Archeologische onderzoek aan de Waterstraat in Beek - Gem. Ubbergen*, Nijmegen (Archeologische Berichten Ubbergen 3).

53: Lohof, E. & S. Wyns 2009: *Beek Kerkeveld, de periferie van een Bandkeramische nederzetting Een Definitief Archeologisch Onderzoek*, Amersfoort (ADC-rapport 1292).

61: Roessingh,W., 2008: *Graven op een zandkop. Een archeologische opgraving langs de Geranium te Bergerden, gemeente Lingewaard*, Amersfoort (ADC-rapport 837).

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In the last ten to fifteen years development-led archaeology has boosted the number of prospections and subsequent excavations in the Netherlands. Despite the number of excavations and the availability of much data little is known with regard to the actual gain of knowledge in connection to the wide range of research questions and topics of the National Archaeological Research Agenda. This book reports on a synthetic analysis of reports produced in the context of development-led projects over the past 10-15 years and concerning the early prehistory of the Netherlands. The degree to which development-led work permits to take major steps forward is highly variable. A limited number of topics has profited from the generated data, and in some cases development-led research has shown to be on the forefront of innovative approaches. A larger number of topics and research questions, however, appear to remain unanswerable; data have been generated, but remain of an anecdotal nature.
This volume discusses various issues with regard to the gain of knowledge regarding the early prehistory of the Netherlands, and identifies problems, yet also provides possible solutions.

This scientific report is aimed at archaeologists and other professionals occupied with Archaeology.

With knowledge and advice the Cultural Heritage Agency of the Netherlands gives the future a past.