eTopoi Journal for Ancient Studies

Special Volume 4 (2015): Bridging the Gap – Integrated Approaches in Landscape Archaeology, ed. by Daniel Knitter – Wiebke Bebermeier – Oliver Nakoinz, pp. 1–24.

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Received December 14, 2014
Revised March 4, 2015
Accepted April 24, 2015
Published August 18, 2015

Edited by Gerd Graßhoff and Michael Meyer,
Excellence Cluster Topoi, Berlin

eTopoi ISSN 2192-2608
http://journal.topoi.org

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The Whole Story. Bridging the Gap between Landscape-archaeological Data from Drylands and Wetlands

Detailed historical reconstructions require high-quality data. In the traditionally densely settled higher and drier Pleistocene sandy areas ('drylands') of the North European Plain (the European aeolian sand belt) and comparable regions elsewhere evidence-based reconstructions are hampered by poor preservation of archaeological remains and archaeologically relevant deposits. This problem can be partially solved by combining, on a microregional level, dryland data with data from nearby wetland pockets ('wetlands'), in particular stream valleys. This asks for an integrated and systematic inventory of all available data. For this purpose an instrument was developed: the Landscape-Land use Diagram (LLAND). Because data from dry and wet contexts are to some degree supplementary, integrated analysis is essential for obtaining information on the full range of economic and ritual practices. This is demonstrated by research carried out in the valley of the small river Regge (the Netherlands), the results of which are being treated as a stratified landscape-archaeological sample. This paper does not focus on cultural interpretation but on methodology, specifically the potential of data and the benefits of an integrated approach.

Site preservation; landscape archaeology; alluvial archaeology; off-site archaeology; sampling strategy; LLAND diagram.

1 Introduction

So far excavations in the dry Pleistocene sandy areas of the North European Plain ('drylands') have provided a globally incomplete picture of the region's settlement, landscape and land use history. How may we improve this situation? Conducting yet more excavations tends to contribute little. This is in part a result of the prevalent archaeological research traditions, which for decades have concentrated on settlement studies whilst largely neglecting other archaeological phenomena, such as those related to off-site activity. To some extent this also applies to archaeological research in alluvial wetland contexts, which often has a strong emphasis on techniques and methods rather than analysing data. However, the current stagnation in our studies of the past is largely due to poor preservation. Uncharred organic remains are rarely preserved in the deep Pleistocene sandy soils, which are characterised by a low water table and acid, well-oxygenated soils.[1] In the past an overall lack of suitable natural stone has led to the use of wood and other perishable materials for construction of shelters/houses, with the result that all that remains of foundation

I would like to express my thanks to Roy van Beek (University of Leiden), Bjørn Smit (Cultural Heritage Agency of the Netherlands) and Andy Howard (formerly of the University of Birmingham) for their critical comments on an earlier draft of his paper, and Andrzej Pelisiak (University of Rzeszów) for kindly supplying relevant publications. The Dutch text was translated by Gerre van der Kleij (GrondtaalVerTaalbureau).

1 Renfrew and Bahn 2000; Cronyn 2001; Kars and Van Heeringen 2008; Huisman and Deeben 2009.

beams, posts, pits, ditches etcetera are discolorations in the soil, i. e. soil features. Due to a combination of biotic and a-biotic processes even these soil features fade over time and may finally become completely invisible.[2]

Archaeological studies of the scarce wetland contexts ('wetlands') in the same areas create a very different picture. There, archaeological remains and organic deposits including palaeobotanical material are often exceptionally well preserved. This makes these locations potentially highly important from a landscape archaeological perspective. At the same time the data these wetland contexts produce appear to be fundamentally different from that from adjoining drylands[3] to the extent that the two landscape zones seem worlds apart. They certainly are in terms of archaeological fieldwork; dryland and wetland locations are rarely investigated in conjunction.

This paper presents the outcome of a test case exploring the feasibility of the integration of both types of data within a micro-regional context, and the potential of such an approach to enhance our insight in the cultural and landscape history of areas where poor preservation conditions prevail. For this purpose a landscape-land use (LLAND) diagram was developed (see Material and Method section).

Our research questions were twofold:

1) What is the nature of the relation between wetland and dryland data from the same area?

2) Is an integrative approach feasible, and what are the potential benefits and limitations?

From a methodological perspective these questions are highly relevant to all areas where detailed cultural-historical and landscape-historical reconstructions are being hampered by poor preservation. Our pilot-study area was the valley of the river Regge, in the east of the Netherlands.

2 Wetland pockets in dry landscapes

Wetland archaeology undoubtedly ranks among the best preserved and most informative archaeology of North- and North-west Europe.[4] Waterlogged conditions are especially widespread in lowland coastal areas around the North Sea, resulting in extremely well preserved archaeological sites, structures and deposits from various periods.[5] However waterlogged conditions also occur in dry inland areas such as in the European aeolian sand belt (Fig. 1).[6] In this area wetland conditions survive predominantly in isolated depressions such as Pleistocene pingos and kettle holes, and in the valleys of rivers and major brooks; of the once vast mires, well known for their prehistoric wooden trackways and votive depositions very little now remains. Especially in places where river valleys border on high and dry river dunes or coversand ridges, which were usually densely settled during prehistory and in more recent periods, such 'wetland pockets' may contain rich and generally well-preserved archaeology.[7]

In the Netherlands these recent insights mainly proceed from research carried out during the past two decades in the wake of a large number of nature (biodiversity and ecology)

2 Huisman and Deeben 2009.

3 B. Coles and J. Coles 1989; De Rooij (Unpublished); Becker et al. 2001; Gerritsen and Rensink 2004; Jong 2012; Menotti 2012.

4 J. Coles and Lawson 1987; B. Coles and J. Coles 1989; B. Coles 1992; Van de Noort and O'Sullivan 2006; Menotti and O'Sullivan 2013.

5 Louwe Kooijmans 1974; Louwe Kooijmans 1987; Louwe Kooijmans 1993; Brandt, Waateringe, and Van der Leeuw 1987; Pryor 2005.

6 E. A. Koster 1982; E. Koster 2009; Hilgers 2007; Tolksdorf and Kaiser 2012.

7 Brown 1997; Howard, Macklin, and Passmore 2003; Groenewoudt 2004.

Fig. 1 | The European aeolian sand belt (after Hilgers 2007). Arrow indicates research area.

development schemes in stream valleys.[8] A systematic investigation, and protection, of this inland wetland archaeology has proved to be challenging because of its unpredictable nature and generally adverse research conditions. Nonetheless substantial progress has been made, resulting in predictive models of the distribution of archaeological phenomena based on archaeological as well as historical-geographical patterns in areas contiguous to watercourses.[9] Guidelines have been developed to allow targeted research and improve effectiveness and cost-efficiency.[10] These guidelines differ from those defined by Howard and Macklin[11] and Howard *et al.*[12] for the Holocene river valleys of Britain in that they are more 'contextualized': they proceed from a wider geographical and cultural-historical perspective (as suggested by Coles[13]) and largely exclude formation processes. In Flanders, Deforce and Bastiaens[14] took on an inventory of palaeoecologically valuable deposits in wet contexts, 'value' in this case being defined in terms of archaeological relevancy and potential to contribute to historical frames of reference on behalf of nature development. Because of their potentially high information value the presence of such deposits in the Netherlands is one of the factors evaluated in site assessments in archaeological heritage management.[15]

Wetland archaeology in the valleys of water courses in the European aeolian sand belt may seem very different from the archaeology of surrounding upland areas, but it should not be studied in isolation.[16] The importance of integrating dryland and wetland data both within (micro) regional and interregional contexts[17] can hardly be overestimated. Rensink *et al.*[18] specifically emphasised the importance of studying stream valleys not only from a long-term perspective but also as part of the wider cultural landscape. In this regard it is important to keep in mind that zones along small inland rivers were never settled by

8 Gerritsen 2004; Rensink, Gerritsen, and J. Roymans 2006.
9 Drenth and J. Roymans 2004; J. Roymans (Unpublished).
10 Rensink 2008a.
11 Howard and Macklin 1999.
12 Howard, Macklin, and Passmore 2003.
13 J. Coles 1991.
14 Deforce and Bastiaens 2006.
15 Deeben et al. 1999.
16 Haselgrove et al. 2001; Van de Noort and O'Sullivan 2006.
17 J. Coles 1991; Louwe Kooijmans 1993; Menotti 2012.
18 Rensink, Gerritsen, and J. Roymans 2006.

'people of the wetlands'[19], i. e. people living in and socio-economically interdependent with, wetland landscapes. In terms of land use the evidence from the waterlogged environments discussed here mostly reflects specialized off-site activities that were limited to these stream valleys[20]; there are no indications of settlement.[21] The problematic distinction between 'wet sites' and 'wetland sites'[22] is in the context of our research neither useful nor relevant.

3 Material and method

The potential of an integrative approach to dryland and wetland data was assessed by using the detailed information generated by recent research carried out along the river Regge in the east of the Netherlands. The focus of the fieldwork was landscape archaeological, as recommended by Gerritsen,[23] i. e. broad in scope, interdisciplinary, and concentrating on the interaction between people and landscape from a long-term perspective.[24] This approach renders the generated dataset particularly suitable to provide answers to our research questions. Our analysis will focus on the presence and potential of the data, not on cultural interpretation. The dryland data derive from some of the large river dunes along the Regge valley, the wetland data from adjoining locations or from elsewhere in the valley. The dataset will be treated as a stratified sample of the entire Regge valley (Fig. 2). Level 1 of this stratigraphy consists of a 5 km-long section of the river valley near the village of Nijverdal (5 km-Nijverdal section; Fig. 3). Level 2 consists of all studied locations within this section, while subsamples from the locations that were studied in detail for various reasons form Level 3 (Fig. 4). In specific sub-zones artefacts were collected stratigraphically by screening the soil.

After briefly introducing our research area and presenting an inventory of the available data (Table 1) we will reflect on the potential benefits (and limitations) of combining datasets. In order to facilitate this analysis the instrument of a Landscape-Land use Diagram (LLAND) was developed, which for each context separately (wetland and dryland) presents a diachronic overview of all available landscape and land use data (Fig. 5). Landscape data encompass both natural and anthropogenic phenomena and processes. The diagram only includes presence/absence for each data category; numbers between brackets refer to individual datasets listed in table I. We will not discuss them in detail here.[25] All scientific dates have been summarised in Table 2. The results of the combination of both datasets were qualitatively tested for general applicability by comparing them to data from similar regions. The term 'river' in this paper refers to any medium to small natural watercourse, including those that might more properly be called a brook.

Most of the data derive from recent excavations at Nijverdal-Eversberg, further referred to as 'Eversberg'[26] and Nijverdal-Zuna's Hooilanden, further referred to as 'Zuna'.[27] Although both were rescue excavations, they were guided by specific, multidisciplinary questions regarding the reconstruction of long-term interaction patterns between land use and landscape, with a focus on phenomena of an as yet uncertain nature and age. Consequently field strategies needed to be flexible. Specialist input included archaeobotany, archaeozoology, geomorphology, physical geography and micromorphology, and was sup-

19 B. Coles and J. Coles 1989.
20 Fontijn 2004.
21 De Rooij (Unpublished).
22 Purdy 1990; Menotti 2012
23 Gerritsen and Rensink 2004.
24 Thomas and David 2008; Kluiving, Lehmkuhl, and Schütt 2012; Kluiving and Guttman-Bond 2012.
25 Groenewoudt 2014.
26 Pronk 2008; Gerrets, Opbroek, and Wiliams 2012.
27 Groenewoudt 2002b; Groenewoudt 2004; Krekelbergh 2008; Dyselinck, Moser, and Witte 2012.

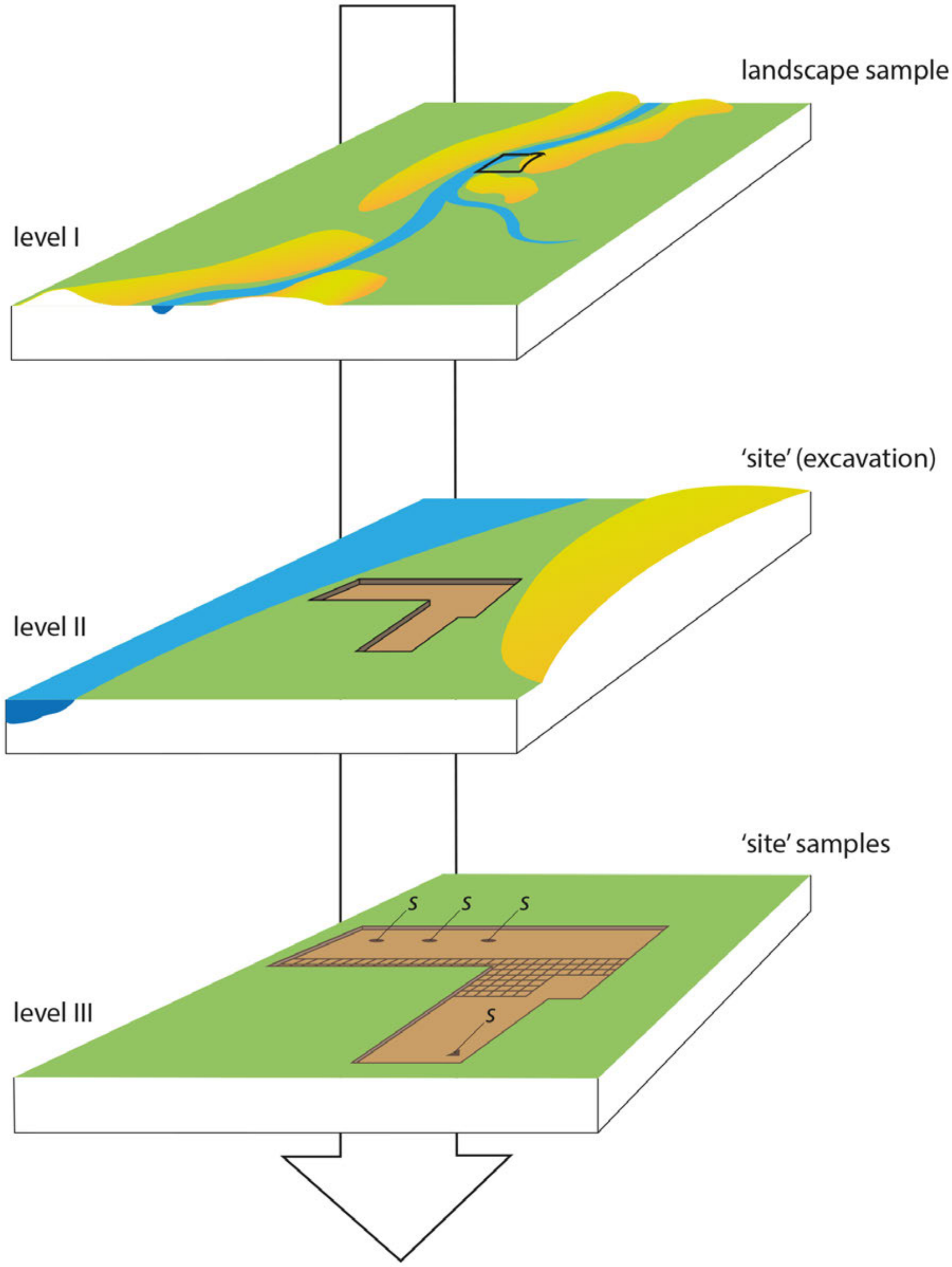

Fig. 2 | Stratified landscape archaeological sampling.

plemented by radiocarbon and dendrochronological dating. Small-scale research was carried out at Nijverdal-Groene Mal,[28] Nijverdal-Velderberg[29] and Nijverdal-Veldkamp.[30]

28 Willemse 2005a; Willemse 2005b.
29 Willemse 2008.
30 Gerrets, Opbroek, and Wiliams 2012.

	DRY	WET	data
1	x		*physical geography, geomorphology*
2	x		*arable farming: 'Plaggen' Soil (Late-Post Medieval)*
3	x		*pedology: wind erosion (Middle-Late Bronze Age)*
4	x		*palaeobotany: vegetation (Middle Mesolithic)*
5	x		*archaeobotany: vegetation (Middle Ages)*
6	x		*hunter-gatherer activity (Middle-Late Mesolithic)*
7	x		*hunter-gatherer activity (Middle-Late Mesolithic)*
8	x		*settlement (Middle Neolithic)*
9	x		*settlement (Late Neolithic)*
10	x		*settlement?(Middle Bronze Age)*
11	x		*settlement (Late Bronze Age)*
12	x		*arable farming: plough marks (Middle-Late Bronze Age and/or Iron Age)*
13	x		*settlement (Late Iron Age)*
14	x		*settlement? (Early-Middle Roman period)*
15	x		*hunter-gatherer activity (Late Palaeolithic-Early Mesolithic)*
16	x		*charcoal burning: charcoal kilns (Middle Ages)*
17		x	*palaeobotany: vegetation (Late Neolithic)*
18		x	*fluvial activity (Early Neolithic)*
19		x	*fluvial activity (Late Neolithic>)*
20		x	*fluvial activity (Middle Bronze Age)*
21		x	*physical geography, fluvial activity (Late Mesolithic- Early Neolithic, Iron Age)*
22	+	x	*palaeobotany: (human impact on) vegetation (Early-Middle Neolithic)*
23	+	x	*palaeobotany: (human impact on) vegetation (Late Bronze Age-Roman period)*
24	+	x	*pedology: wind erosion (Middle Bronze Age)*
25	+	x	*pedology: wind erosion (Middle-Late Iron Age)*
26		x	*palaeobotany: woodland management (Early Medieval)*
27		x	*hunter-gatherer activity (Late Mesolithic-Early Mesolithic)*
28		x	*ritual activity: ritual deposition (Late Neolithic)*
29		x	*ritual activity: ritual deposition (Middle-Late Iron Age)*
30	+	x	*archaeozoology: animal husbandry (Middle-Late Iron Age)*
31	+	x	*settlement (Late Neolithic)*
32		x	*Infrastructure: wooden trackway (Middle Neolithic)*
33		x	*Infrastructure: wooden trackway (Late Neolithic)*
34	+	x	*settlement (?Neolithic-Middle Bronze Age)*
35	+	x	*settlement Middle Bronze Age*
36		x	*fishing: fish weirs (Late Neolithic)*
37		x	*fishing: fish weirs (Early Bronze Age)*
38		x	*fishing: fish weirs (Early Iron Age)*
39		x	*infrastructure: wooden trackway (Early Middle Ages)*
40	+?	x	*hunter-gatherer activity (Late Mesolithic)*
41	+	x	*settlement (Middle-Late Iron Age)*

Tab. 1 | Origin (x) and character of the available datasets from the 5km-Nijverdal section of the river Regge. Datasets from wetland contexts marked + provide important land use information concerning nearby dry land.

4 Context: the Regge valley

The test area is part of the valley of the river Regge, a small stream which cuts into the Pleistocene sandy soils of the eastern Netherlands, shaped largely by the combined action of wind, water and ice during the last two ice ages, the Saalian and Weichselian.[31] During the coldest phase of the Weichselian (Younger Dryas) the Regge was a braided river in a relatively wide floodplain, with many shoals and several channels. During dry periods quantities of sand in the floodplain would be deflated to form elongated dunes

31 Van den Akker, Knibbe, and Maarleveld 1964; Ebbers and Visschers 1983; Schwann 1988.

Fig. 3 | The location of the 5km-Nijverdal section of the river Regge (red square): Sample level 1.

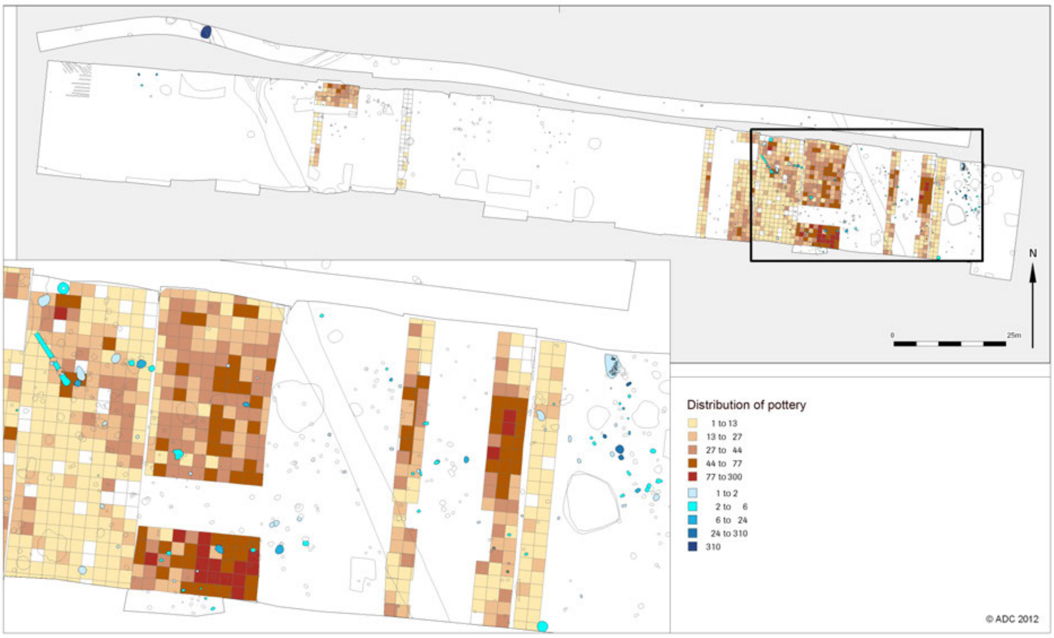

Fig. 4 | Eversberg. Excavated area (Sample level 2) and distribution of pottery within sieve-sample area (Sample level 3); after Gerrets, Opbroek, and Wiliams 2012).

alongside the valley. These sandy ridges can be up to several hundred metres wide and several kilometres long, and today they are still raised ca. 5m above the valley bottom. The dunes are asymmetrical: steep towards the river, gently sloping on the other side.

Large-scale (aeolian) sand drifting slowed down by the early Holocene (ca. 9700BC) as postglacial climatic amelioration gained pace; vegetation colonised and stabilised the uneven dune landscape, and the Regge became a meandering stream with only one main channel. As a result of erosion of the outer bends and sedimentation in the inner bends the course of the river gradually migrated downstream, while meandering caused further erosion of the valley bottom and edges. Sediments within the river channel are mainly composed of sandy channel deposits and peaty and loamy gully infills.

Location	Lab. code	Information LS: landscape LU: land use	14C BC/AD probability 95.4%	Dendro-chronology BC	OSL BC
EV	SUERC-35691	LS/LU	6070–5985		
EV	KIA44265	LS/LU	6211–6026		
EV	KIA44266	LS/LU	6379–6239		
EV	SUERC-35690	LU	7330–7080		
EV	KIA44264	LU	1489–1321		
EV	KIA44268	LU	509–388		
EV	KIA44267	LU	1029–981		
EV	SUERC–35692	LU	AD1160–1010		
EV	SUERC–35693	LU	AD1260–1040		
EV-GM	KIA37873	LS/LU	404–212		
EV-GM	KIA37874	LS/LU	2135–1946		
EV-GM	KIA37966	LS/LU	366–185		
EV-GM	KIA44260	LS	351–55		
EV-GM	KIA44261	LS	161–19		
EV-GM	KIA44262	LS	399–232		
EV-GM	KIA44263	LS	399–208		
GM	UtC–13179	LS	6215–6021		
GM	UtC–13246	LS	3941–3665		
EV	X5058	LS/LU			1400–740
EV	X5059	LS/LU			1750–1010
EV	NCL–7611087	LS/LU			*310–270*
EV	NCL–7611088	LS/LU			1560–1.000
ZU	1EN0031	LS		ca. 5156	
ZU	GrA 52640	LS/LU	AD692–887		
ZU	GrA 52784	LU/LS	768–431		
ZU	GrA 52616	LU/LS	788–537		
ZU	GrA 52783	LU/LS	774–434		
ZU	GrA 52617	LU/LS	2110–1889		
ZU	GrA 52119	LU/LS	2463–2211		
ZU	GrA 52 621	LS/LU	AD771–947		
ZU	GrA 52622	LU/LS	771–431		
ZU	GrA 52 623	LS/LU	AD771–947		
ZU	GrA 52635	LU/LS	3991–3800		
ZU	GrN–20182	LU	4310–3826		
ZU	GrN–20183	LU	3942–3532		
ZU	zul 01.0	LU/LS		ca. 3898	
ZU	zul 02.2	LU/LS		ca. 3898	
ZU	zul 03.1	LU/LS		ca. 3901	
ZU	zul 06.1	LU/LS		ca. 3889	
ZU	zul 09.1	LU/LS		ca. 3887	
ZU	zul 07A	LU/LS		ca. 2246	
ZU	zul 08.0	LU/LS		ca. 3561	
ZU	UtC–3102	LU	1613–1450		
ZU	UtC–3103	LU	1671–1442		

Tab. 2 | Scientific dates from the 5km-Nijverdal section of the river Regge: radiocarbon, dendrochronology, OSL. Italic: unreliable date. Locations: EV: Eversberg (Gerrets, Opbroek, and Wiliams 2012); EV-GM: Eversberg-Groene Mal: Willemse 2005a; ZU: Zuna (Groenewoudt 2002b; Dyselinck, Moser, and Witte 2012).

The Regge has always been a habitable corridor through otherwise mostly marshy lands which until well into the Middle Ages were virtually uninhabited.[32] In prehistory the higher grounds along the river were already densely settled. Both in landscape and in archaeology the upper course of the Regge differs fundamentally from the river's mid-

32 Van Beek and Groenewoudt 2011.

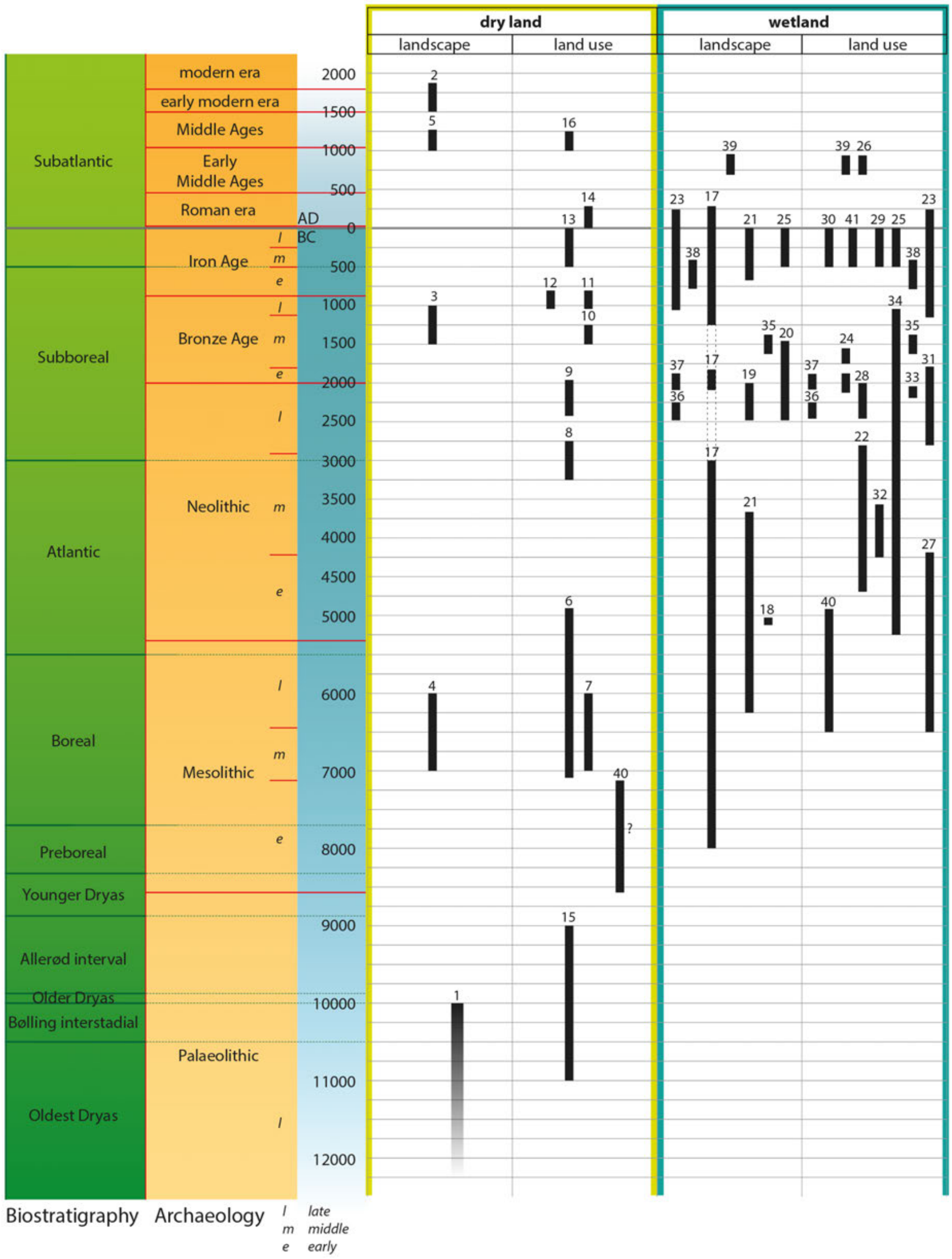

Fig. 5 | Landscape-land use (LLAND) diagram of the river Regge (5km-Nijverdal section) showing the general information potential of all available data. Landscape: geomorphology, soil, vegetation. Land use: human activity. For archaeological dates the maximum range is listed, for radiocarbon dates the 2-sigma range (95.4% probability). Numbers in the diagram refer to datasets in Table I.

dle section, the location of the 5km-Nijverdal section. Upstream the still narrow river meandered through a wide floodplain in which many coversand ridges were the only permanently dry locations. Here, virtually the only archaeological remains are traces of Late Palaeolithic and Mesolithic hunter-gatherer activity and of dispersed (post)medieval settlement. In its middle and lower sections, on the other hand, the Regge flows through a valley hemmed in by elongated river dunes. The archaeology in this section is much more varied and suggestive of a much longer settlement history.

5 Different data

Our data show that dryland and wetland data from the Regge valley are indeed very different, and functionally to some extent even complementary. This may be a product of a situation in which one of these landscape zones was not exploited in certain periods, or at least not in an archaeologically visible manner. However, the specific nature of the archaeological phenomena found in wetland contexts strongly suggests that the wetland-dryland discrepancy reflects historical reality. It has also been established that alluvial wetland contexts may contain evidence for human activity from periods of which immediately adjoining higher grounds contain absolutely no trace. As we know only too well, however, absence of evidence (artefacts, structures) does not equal evidence of absence (of human activity).

Reversely, in other cases the higher areas along a water course turn out to have been the scene of intensive human activity which is also detectable in depressions as debris and blown-out fields but which has left no palynological markers. This situation is almost certainly the result of the – at that time – overall dense woodland vegetation in the valley, which blocked the distribution of pollen in this direction.[33] With regard to the large-scale, Late Bronze Age sand drifts at the Eversberg, an example of anthropogenic landscape dynamics, the situation is comparable. As a result of the dominant winds this sand was almost exclusively blown east; very little was deposited west, in the valley. Both examples emphasise the importance of – literally – multiple research angles, both spatially and methodologically.

Also the range of variation displayed by wetland and dryland archaeology in the study area is different. The research conducted at the Eversberg creates the impression of a much greater archaeological variation in the dryland zone than in the wetland area, and also of apparent differences in the continuity of activities in the two landscape contexts. Land use on the Eversberg was both highly varied and changeable. Activities in the adjoining river valley, on the other hand, seem to have been limited to grazing, ritual activity and dumping settlement debris. Information on dryland activities at Zuna is limited but here, too, exploitation of the river valley seems to have been dominated by long-term, extensive and essentially unchanging activities (fishing, wood cutting, grazing, infrastructural constructions?). However, these activities were intermittent, as the greatly divergent dates show (see below).

Obviously every archaeological dataset has its own limitations. While stratified landscape archaeological sampling (Fig. 2) may certainly contribute to a more balanced dataset we will never have an entirely representative sample. When combining wetland and dryland datasets a constant awareness of the fundamentally different and highly variable nature of the formation processes involved is essential. The fact that a phenomenon appears to be limited to wet contexts may simply be a result of different preservation conditions.

6 Representativity

Is the 5km-Nijverdal section of the Regge valley a representative sample in terms of archaeological phenomena and landscape history? Many case studies published after the inventories conducted by Gerritsen and Rensink[34] and Rensink[35] have created the impression that the archaeology of waterlogged environments in river valleys is structurally distinct in other regions as well, but that a relation with adjoining higher grounds is universal. With regard to archaeological features the record is dominated by revetments,

33 Sugita, Gaillard, and Broström 1999.
34 Gerritsen and Rensink 2004.
35 Rensink 2008a.

wet infrastructural phenomena, fords, bridges, watermills, watering places, waste dumps, 'kill sites' connected to hunting, fisheries, ritual(?) deposits and traces of the extraction of raw materials.[36] A spectacular example from north-eastern Germany is a Bronze Age battlefield in the valley of the river Tollense.[37]

The conclusion that the 5km-Nijverdal section of the Regge valley constitutes a representative sample is confirmed when we look at the observed landscape and archaeological phenomena from a wider perspective. Evidence of intensive sand drifting documented at Zuna <3> is not an isolated case. In recent years archaeological excavations have produced a growing body of evidence for the existence of prehistoric sand drifts along terraced Dutch river valleys that were caused by the reclamation of naturally already impoverished soils and by an over-exposure of the Late Glacial sandy landscape underneath, sparking off intense drifting.[38] Rising groundwater tables and periodic peak discharges in rivers from late prehistory onwards have also been documented at many locations. The main cause of these phenomena was large-scale deforestation.[39] Paradoxically, it is the lower parts of the landscape that were exploited more intensively and in the Late Iron Age sometimes even briefly settled.[40] In many regions ritual depositions cluster in wetland contexts such as river valleys, which is why such landscape zones are being labelled 'sacrificial landscapes'.[41] A clustering of depositions near fords (Eversberg) has often been observed.[42] Pottery depositions <28,29> are a common phenomenon in alluvial wetland contexts.[43] Also trackway-like wooden structures <32,29> near fords and along river banks are known from a number of stream valleys,[44] as are fishweirs <36,37,38>.[45]

7 Data integration

The overall conclusion is that limiting our studies to the high and dry parts of the landscape will indeed result in a biased image of both the archaeological reality and the micro-regional settlement history. The same conclusion seems warranted for the nearby wetland contexts. Combining wetland and dryland data certainly fills in gaps (see Fig. 5). The building of linear infrastructure (roads, railroads, gas pipes, underground power lines) is ideally suited to collect data from both contexts. However, merely lumping the two datasets together will not in itself generate interesting new information and fresh insights. This requires not only an integral (micro-) regional approach but also a theoretically explicit, question-oriented one, which should translate into serious interdisciplinary research and an awareness of phenomena that break the mould.[46] A study by Mazurkevich et al.[47] on the 'neolithisation' process along the Western Dvina river, North-west Russia, is a textbook example.

Most important perhaps is a holistic perspective, and it is essential that cultural archaeologists and geo and environmental archaeologists cooperate in projects from the start, and not just in the post-excavation phase. Such research may benefit greatly from the

36 J. Roymans 2007; J. Roymans and Sprengers 2011; A. Roymans and Sprengers 2012; J. Roymans 2013; Jong 2012; Vermeulen, Mittendorf, and Van der Wal 2012.
37 Jantzen et al. 2010.
38 Willemse and Groenewoudt 2012.
39 Groenewoudt et al. 2007; Groenewoudt 2012.
40 Lubberink and Willemse 2009; Van Beek 2009.
41 Fontijn 2002; Fontijn 2004.
42 Drenth and J. Roymans 2004; J. Roymans (Unpublished).
43 Bulten, Van der Heijden, and Hamburg 2002.
44 Drenth and J. Roymans 2004.
45 Hamburg, Hogestein, and Peeters 1997; Bulten, Van der Heijden, and Hamburg 2002.
46 Gerritsen and Rensink 2004; Huijbers 2004; Van de Noort and O'Sullivan 2006; Van de Noort 2008.
47 Mazurkevich et al. 2009.

concept of landscape biography.[48] Rensink *et al.*[49] proposed the following research topics: 1) Material culture studies; 2) Vegetation and landscape development; 3) Stream valleys as a source of food and raw materials; 4) Structure and long-term landscape development; 5) The socio-cultural division of landscape. A systematic, transparent inventory of all available data in the form of a LLAND diagram turns out to be a suitable tool to assess the options for carrying out such research. And it facilitates systematic source criticism. It also allows other researchers to verify to what degree claims and conclusions are underpinned by solid evidence. Depending on the research questions a LLAND diagram can be made more specific, for example thematically.

The LLAND diagram for our study area clearly shows that the wetland data encompass a briefer period but that they are also much more varied. This in itself suggests that they would allow more reliable and detailed reconstructions than those we possess today, and that also in this context wetland data are 'high-resolution' data.[50] In micro-regions where there are dryland settlement and wetland 'pockets' in close proximity, such as in our study area, the wetland dataset can greatly increase our knowledge of human exploitation of the nearby drylands and of the cultural history of the micro-region as a whole, both for land use and for landscape. Wetland datasets contain information on economic and ritual activities specific to wetland contexts; but what is equally important is that they can also supply valuable information on the exploitation of nearby dryland zones, specifically settlement indicators and evidence for anthropogenic erosion caused by deforestation and agriculture < 22,24,24,30,31,34,35,40?>. With regard to the reconstruction of vegetation history and the impact of human action on vegetation in these and similar areas we largely depend on botanical data from wetland contexts.[51]

The availability of a large number of scientific dates proved to be crucial for building a solid chronological framework, which is itself indispensable for identifying connections between wetland and dryland evidence, and for placing traces of off-site activity – often poorly dated archaeologically – in a specific chronological context. Even a few charcoal-based radiocarbon dates may suffice to elucidate human activity in situations where other indicators are lacking <10,13>.[52] In the case of the Eversberg 'site' a sampling strategy geared to the systematic collection of artefacts – a strategy which normally only applied to hunter-gatherer artefact scatters[53] – proved to be crucial. Without this strategy several occupation phases, specifically those which had left no archaeological features <8,9,15>, would certainly have been overlooked. Both in alluvial dryland and in wetland contexts the material manifestation of off-site economic activities and those of a potentially non-economic (i.e. ritual?) nature deserve much more attention, as do phenomena related to landscape dynamics, anthropogenic or otherwise (fluvial erosion, sand drifting and soil degradation). In terms of data acquisition there is evidently much to be gained by linking wetland and dryland evidence on a micro-regional level. What has also become clear is that the information yield of dryland excavations may be significantly increased by investigating land use in its broadest sense, instead of merely excavating the immediately obvious and familiar archaeology.

48 Kolen 1993.
49 Rensink, Gerritsen, and J. Roymans 2006.
50 Menotti 2012.
51 Pelisiak, Rybicka, and Ralska-Jasiewiczowa 2006; Forysiak et al. 2010.
52 Raab et al. 2011.
53 Groenewoudt 2002a; Smit 2010.

8 Continuity

Our studies revealed that it is difficult to define exact site boundaries on the larger river dunes along the Regge. Often the 'site' is rather a palimpsest zone, an accumulation of archaeological material covering an extended chronological range and with at best internal fluctuations in artefact density and composition; Bailey (2007) uses the term 'cumulative palimpsests'. This conclusion confirms that our decision to treat our research locations not as 'sites' but as landscape samples was methodically correct. Palimpsests such as the Eversberg 'site' are sometimes called 'persistent places', i. e. places that were never completely abandoned.[54] Such places are important because they give us an opportunity to study the interaction between people and their environment from a long-term perspective. The fact that the archaeology of one particular period may not be intact – damaged by subsequent occupation of the location, for example – is from a landscape-archaeological perspective irrelevant; rather, what matters most is identifying, dating and contextualising forms of land use, instead of documenting well-preserved archaeological structures. In this context 'negative' observations (the absence of specific phenomena) may be equally valuable.

As said before the wetland archaeology of the Pleistocene inland regions of North-west Europe is largely an off-site archaeology, i. e. reflecting specialised activities carried out by the inhabitants of nearby settlements. The general assumption is that the character and distribution of this kind of archaeology in river valleys are largely determined by settlement and land use patterns on nearby high grounds, and that it clusters where such valleys border locations with long-term or frequent occupation. This may be true in many cases, but a reverse situation is also thinkable. The valleys of minor and major water courses in inland lowland areas of North-western Europe probably had their own 'persistent places', focal points of activity during longer periods of time, which influenced spatial behaviour and spatial patterns in the wider landscape. Such sites may be expected at river crossings (Du. voordes) and confluences,[55] but no doubt also at other types of location. Where evidence of ritual activity clusters such places may be classified as 'natural places' in the sense of Bradley.[56] How 'persistent' were such places? Caution is called for when using terms like 'continuity' and 'persistence', as Van de Noort and O'Sullivan demonstrated by presenting a number of cases in which scientific dates could be systematically obtained.[57] Often the presumed continuity turned out to be in fact non-continuity. Moreover, in dynamic alluvial wetland contexts continuity of certain forms of land use may well be linked to a specific landscape zone or an area with specific landscape characteristics, rather than to a specific fixed location within that zone or area. Incidentally, in the case of certain activities there may be period-specific differences in the extent to which they were localised.[58]

9 Predictability

Earlier we pointed out the 'palimpsest' character and the great time depth of 'sites'. Both phenomena are largely the product of a situation marked by continuity, of the landscape itself and of the way it was exploited. The landscape in the study area is much more stable than for example Holocene fluvial zones, which prior to the construction of dikes were highly dynamic. On favourable locations in this zone, such as levees, palimpsests do

54 Schlanger 1992.
55 Fontijn 2002; Fontijn 2004; J. Roymans (Unpublished).
56 Bradley 2000.
57 Van de Noort and O'Sullivan 2006.
58 Hubert 1997; Fontijn 2002; Ashton et al. 2006.

occur but they lack the time depth of those on the Pleistocene sands. There, the regional rivers often were transformed into mere brooks in the course of the Holocene, after which meandering and erosion were confined to the existing valley. This meant that river dunes along those valleys were henceforth only exposed to local erosion. The degree of soil erosion of valley bottoms was highly variable and largely dependent on the meandering of each individual water course – which in our research area after ca. 250BC was being increasingly affected by human activities upstream.[59]

The great time depth of settlement locations along rivers in the Pleistocene inland areas of North-west Europe is also the result of the stable position these areas occupy in regional settlement patterns, at least in the eastern Netherlands. Until the Middle Ages regional settlement patterns were characterised by, on the one hand, endemic mobility and, on the other, alternating phases of expansion and contraction. Favourable locations along water courses were marked by a high degree of settlement continuity.[60] Raised bogs were the scene of ritual practices for millennia.[61] For these reasons the presence of archaeological remains in the river valleys greatly depends on the landscape context and associated settlement patterns and infrastructure. Their preservation and availability to investigation is determined by depositional factors and conditions and by post-depositional processes.[62] These, in turn, are the product not only of anthropogenic factors but also, and to a large extent, of subsequent fluvial dynamics, ground water dynamics and ground water chemistry. Along the middle and lower reaches of watercourses, where river valleys are wide, sedimentation processes prevail and waterlogged conditions are wide-spread,[63] conditions for preservation tend to be much better than they are along the upper reaches. Also preservation conditions tend to be most favourable along rivers that constitute the oldest (Late Pleistocene) core of drainage systems. Such rivers have carved relatively deep valleys an have much accommodation space for the deposition of sediments (and hence archaeology). As a result not only the location but also the degree of preservation and the age of archaeological remains in alluvial wetland contexts are to a degree predictable.[64] Chronological predictability depends on the availability of adequate geoarchaeological and geohydrological data as well as data on floodplain evolution in general.[65] Access to and an understanding of the presence, character, distribution and internal relations of all information sources in contiguous dryland and wetland contexts allows further predictions regarding the presence of additional sources of information. The construction of a LLAND-diagram therefore may not only be helpful in selecting promising research options, but also to conduct targeted field work aimed at filling-in major gaps in the available dataset.

59 Willemse 2008; Bork et al. 1998; Dotterweich 2008; Brown 2009; Brown et al. 2013; Dreibrodt et al. 2010.
60 Groenewoudt et al. 2007.
61 Van der Sanden 1995, 1997, 1998; Gerritsen 2003; Wentink 2006.
62 Schiffer 1972; Schiffer 1987; Mol 2003; Stern 2008.
63 Wassink 1999.
64 Groenewoudt 2004.
65 Howard and Macklin 1999; Howard, Macklin, and Passmore 2003.

References

Ashton et al. 2006
N. Ashton, S.G. Lewis, S. Parfitt, and M. White. "Riparian Landscapes and Human Habitat Preferences during the Hoxnian (MIS 11) Interglacial". *Journal of Quaternary Science* 21 (2006), 497–505.

Becker et al. 2001
W.-D. Becker, H. Berke, C. Fritz, B. Halman, M. Heinen, H. Hesse, H. Jacobs, A. Mende, J. Meurers-Balke, R. Nehren, A. Pastoors, U. Stodiek, and M. Volland. *Archäologische Talauenforschungen. Ergebnisse eines Prospektionsprojekts des Instituts für Ur- und Frühgeschichte der Universität zu Köln*. Rheinische Ausgrabungen 52. Mainz: Verlag Philipp von Zabern, 2001.

Bork et al. 1998
H.-R. Bork, H. Bork, C. Dalchow, B. Faust, H.-P. Piorr, and T. Schatz. *Landschaftsentwicklung in Mitteleuropa*. Gotha: Perthes, 1998.

Bradley 2000
R. Bradley. *An Archaeology of Natural Places*. London: Routledge, 2000.

Brandt, Waateringe, and Van der Leeuw 1987
R.W. Brandt, W. Groenman-Van Waateringe, and S.E. Van der Leeuw, eds. *Assendelver Polder Papers 1*. Amsterdam, 1987.

Brown 1997
A.G. Brown. *Alluvial Environments: Geoarchaeology and Environmental Change*. Cambridge: Cambridge University Press, 1997.

Brown 2009
A.G. Brown. "Colluvial and Alluvial Response to Land Use Change in Midland England: an Integrated Geoarchaeological Approach". *Geomorphology* 108.(1–2) (2009), 92–106.

Brown et al. 2013
A.G. Brown, Ph. Toms, C. Carey, and E. Rhodes. "Geomorphology of the Anthropocene: Time-transgressive Discontinuities of Human-induced Alluviation". *Anthropocene* 1 (2013), 3–15.

Bulten, Van der Heijden, and Hamburg 2002
E.E.B. Bulten, F.J.G. Van der Heijden, and T. Hamburg. "Emmeloord, Prehistorische visweren en fuiken". In. Vol. 140. ADC-rapport. Bunschoten, 2002.

B. Coles 1992
B. Coles. *The Wetland Revolution in Prehistory*. Exeter: WARP/University of Exeter, 1992.

B. Coles and J. Coles 1989
B.J. Coles and J.M. Coles. *People of the Wetlands: Bogs, Bodies and Lake Dwellers*. London: Tames & Hudson, 1989.

J. Coles 1991
J.M. Coles. "From the Waters of Oblivion". In. Vol. 2. C.J.C. Reuvenslezing. Assen: Stichting voor de Nederlandse Archeologie, 1991.

J. Coles and Lawson 1987
J.M. Coles and A.J. Lawson. *European Wetlands in Prehistory*. Oxford: Clarendon Press, 1987.

Cronyn 2001
J.M. Cronyn. "The Deterioration of Organic Materials". In *Handbook of Archaeological Sciences*. Ed. by D.R. Brothwell and A.M. Pollard. Wiley Interscience. Chichester, 2001, 627–636.

De Rooij (Unpublished)
M. De Rooij. *Archeologie in beekdalen. De betekenis van beekdalen voor de archeologie. Een onderzoek naar aanleiding van natuurontwikkelingsplannen, toegespitst op de Loobeek in Noord-Limburg*. PhD thesis. University of Amsterdam, 1995. Unpublished.

Deeben et al. 1999
J.H.C. Deeben, B.J. Groenewoudt, D.P. Hallewas, and W.J.H. Willems. "Proposals for a Practical System of Significance Evaluation in Archaeological Heritage Management". *European Journal of Archaeology* 2 (1999), 177–199.

Deforce and Bastiaens 2006
K. Deforce and J. Bastiaens. *Inventarisatie van het paleo-ecologisch bodemarchief voor archeologisch onderzoek en bescherming, CAI–II: Thematisch inventarisatie en evaluatieonderzoek*. VIOE rapporten 2. Brussel, 2006.

Dotterweich 2008
M. Dotterweich. "The History of Soil Erosion and Fluvial Deposits in Small Catchments of Central Europe: Deciphering the Long-term Interaction between Humans and the Environment". *Geomorphology* 101 (2008), 192–208.

Dreibrodt et al. 2010
S. Dreibrodt, C. Lubos, B. Terhorst, B. Damm, and H.-R. Bork. "Historical Soil Erosion by Water in Germany: Scales and Archives, Chronology, Research Perspectives". *Quaternary International* 222 (2010), 80–95.

Drenth and J. Roymans 2004
E. Drenth and J. Roymans. "Eén of twee beekovergangen uit de Late Prehistorie in het dal van de Lei nabij Riel en Goirle (provincie Noord-Brabant)". In *Beekdallandschappen in archeologisch perspectief. Een kwestie van onderzoek en monumentenzorg*. Ed. by F. Gerritsen and E. Rensink. Vol. 28. Nederlandse Archeologische Rapporten. Amersfoort: RCE, 2004, 85–94.

Dyselinck, Moser, and Witte 2012
T. Dyselinck, M. Moser, and N. Witte. *Rijssen, Elsenerbeek tracé C. Locatie Zuna's Hooilanden. Inventariserend veldonderzoek door middel van proefsleuven en aansluitend definitief onderzoek*. BAAC rapport, No. A-10.0104. 's-Hertogenbosch, 2012.

Ebbers and Visschers 1983
G. Ebbers and R. Visschers. *Bodemkaart van Nederland 1:50.000. Toelichting op het kaartblad 28 West Almelo*. Wageningen: Stiboka, 1983.

Fontijn 2002
D.R. Fontijn. *Sacrificial Landscapes. Cultural Biographies of Persons, Objects and 'Natural'*

Places in the Bronze Age of the Southern Netherlands, c. 2300–600 BC. Analecta Praehistorica Leidensia 33/34. Leiden: University of Leiden, 2002.

Fontijn 2004
D.R. Fontijn. "Schatvondsten' uit beekdalen. De interpretatie van metaaldeposities uit de Bronstijd". In *Beekdallandschappen in archeologisch perspectief. Een kwestie van onderzoek en monumentenzorg*. Ed. by F. Gerritsen and E. Rensink. Vol. 28. Nederlandse Archeologische Rapporten. Amersfoort: RCE, 2004, 69–83.

Forysiak et al. 2010
J. Forysiak, M. Obremska, D. Pawłowski, and P. Kittel. "Late Vistulian and Holocene changes in the Ner river valley in light of geological and palaeoecological data from the Ner-Zawada peatland". *Geologija* 52 (2010), 25–33.

Gerrets, Opbroek, and Wiliams 2012
D. A. Gerrets, M. Opbroek, and G. L. Wiliams, eds. *Onvoltooid verleden. Sporen van meer dan 10.000 jaar menselijke activiteiten langs de Regge bij Nijverdal*. ADC monografie, No. 13. Amersfoort, 2012.

Gerritsen 2003
F. Gerritsen. *Local Identities: Landscape and Community in the Late Prehistoric Meuse-Demer-Scheldt Region*. Amsterdam Archaeological Studies 9. Amsterdam, 2003.

Gerritsen 2004
F. Gerritsen. "Het belang van beekdalen voor de archeologie van de zandlandschappen". In *Beekdallandschappen in archeologisch perspectief. Een kwestie van onderzoek en monumentenzorg*. Ed. by F. Gerritsen and E. Rensink. Vol. 28. Nederlandse Archeologische Rapporten. Amersfoort: RCE, 2004, 13–24.

Gerritsen and Rensink 2004
F. Gerritsen and E. Rensink, eds. *Beekdallandschappen in archeologisch perspectief. Een kwestie van onderzoek en monumentenzorg*. Nederlandse Archeologische Rapporten 28. Amersfoort: RCE, 2004.

Groenewoudt 2014
B. Groenewoudt. "Flesh on the Bones. The Landscape-Archaeological Benefits of Integrating Data from Poorly Preserves Dryland Sites and Alluvial Wetland Contexts Using a LLAND Diagram". *ACADEMiA* (2014). https://www.academia.edu/6211243/Groenewoudt_B.J._2014_Flesh_on_the_Bones._The_landscape_archaeological_benefits_of_integrating_data_from_poorly_preserved_dryland_sites_and_alluvial_wetland_contexts_using_a_LLAND_diagram (visited on 06/05/2015).

Groenewoudt 2002a
B.J. Groenewoudt. "Sieving Plaggen Soils: Extracting Historical Information from a Man-made Soil". *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek* 45 (2002), 125–154.

Groenewoudt 2002b
B.J. Groenewoudt. "Wierden-Zuna's Hooilanden. Een veenweg uit het Neolithicum?" *Archeologische Kroniek van Overijssel over 2001 – Overijsselse Historische Bijdragen* 117 (2002), 227–229.

Groenewoudt 2004
B.J. Groenewoudt. “Afdalen in Oost Nederland”. In *Beekdallandschappen in archeologisch perspectief. Een kwestie van onderzoek en monumentenzorg*. Ed. by F. Gerritsen and E. Rensink. Vol. 28. Nederlandse Archeologische Rapporten. Amersfoort: RCE, 2004, 57–67.

Groenewoudt 2012
B.J. Groenewoudt. “History Continues. Drowning and Desertification. Linking Past and Future in the Dutch Landscape”. *Quarternary International* 251 (2012), 124–135.

Groenewoudt et al. 2007
B.J. Groenewoudt, H. van Haaster, R. van Beek, and O. Brinkkemper. “Towards a Reverse Image. Botanical Research into the Landscape History of the Eastern Netherlands (BC 1100–AD 1500)”. *Landscape History* 29 (2007), 17–33.

Hamburg, Hogestein, and Peeters 1997
T. Hamburg, W.-J. Hogestein, and H. Peeters. “Drie visvangstsystemen uit het Neolithicum van de vindplaats “Hoge Vaart” (Prov. Fl., Gem. Almere)”. *Archeologie* 8 (1997), 69–92.

Haselgrove et al. 2001
C. Haselgrove, I. Armitt, C. Champion, J. Creighton, A. Gwilt, J.D. Hill, F. Hunter, and A. Woodward. *Understanding the British Iron Age: an Agenda for Action*. Salisbury: Wessex Archaeology, 2001.

Hilgers 2007
A. Hilgers. *The Chronology of Late Glacial and Holocene Dune Development in the Northern Central European Lowland Reconstructed by Optically Stimulated Luminescence (OSL) Dating*. Cologne: University of Köln, 2007.

Howard and Macklin 1999
A.J. Howard and M.G. Macklin. “A Generic Geomorphological Approach to Archaeological Interpretation and Prospection in British River Vales: a Guide for Archaeologists Investigating Holocene Landscapes”. *Antiquity* 73 (1999), 527–541.

Howard, Macklin, and Passmore 2003
A.J. Howard, M.G. Macklin, and D.G. Passmore, eds. *Alluvial Archaeology in Europe. Proceedings of the Alluvial Archaeology of North-West Europe and Mediterranean, Leeds UK, 18–19 December 2000*. Lisse etc: Swets & Zeitlinger, 2003.

Hubert 1997
J. Hubert. “Sacred Beliefs and Beliefs of Sacredness”. In. Ed. by D.L. Carmichael, J. Hubert, R. Reeves, and A. Schanche. Vol. 23. One World Archaeology. London etc, 1997, 9–19.

Huijbers 2004
T. Huijbers. “De vele dimensies van natte gebieden in de Middeleeuwen. ‘Zand-Brabant’ met de microregio Laarbeek-Helmond centraal”. In *Beekdallandschappen in archeologisch perspectief. Een kwestie van onderzoek en monumentenzorg*. Ed. by F. Gerritsen and E. Rensink. Vol. 28. Nederlandse Archeologische Rapporten. Amersfoort: RCE, 2004, 103–119.

Huisman and Deeben 2009
D.J. Huisman and J. Deeben. "Soil Features". In *Degradation of Archaeological Remains*. Ed. by D. J. Huisman. Den Haag: Sdu uitgevers, 2009, 147–176.

Jantzen et al. 2010
D. Jantzen, U. Brinker, J. Orschiedt, J. Heinemeier, J. Piek, K. Hauenstein, J. Krüger, G. Lidke, H. Lübke, R. Lampe, S. Lorenz, M. Schult, and Th Terberger. "A Bronze Age Battlefield? Weapons and Trauma in the Tollense Valley, North-Eastern Germany". *Antiquity* 85 (2010), 417–433.

Jong 2012
Th P.J. de Jong. "Holocene Fauna from Brook Valleys in the Southern Netherlands". In *A Bouquet of Archaeological Studies. Essays in Honour of Wietske Prummel*. Ed. by D.C.M. Raemaekers, E. Esser, R.C.G.M. Lauwerier, and J.T. Zeiler. Groningen: Barkhuis, 2012, 47–59.

Kars and Van Heeringen 2008
H. Kars and R.M. Van Heeringen, eds. *Preserving Archaeological Remains in Situ. Proceedings of the 3rd Conference 7–9 December 2006*. Geoarchaeological and Bioarchaeological Studies 10. Amsterdam: VU University, 2008.

Kluiving and Guttman-Bond 2012
S.J. Kluiving and E. Guttman-Bond. *Landscape Archaeology between Art and Science: From a Multi- to an Interdisciplinary Approach*. Amsterdam: Amsterdam University Press, 2012.

Kluiving, Lehmkuhl, and Schütt 2012
S.J. Kluiving, F. Lehmkuhl, and B. Schütt. "Landscape Archaeology at the LAC 2010 Conference". *Quarternary International* 251 (2012), 1–6.

Kolen 1993
J. Kolen. *The Cultural Biography of the landscape, A Re-appraisal of History (Paper Presented to TAG, Durham 1993)*. Leiden, 1993.

E. A. Koster 1982
E A. Koster. "Terminology and Lithostratigraphic Subdivision of (Surficial) Sandy Eolian Deposits in The Netherlands: an Evaluation". *Geologie en Mijnbouw* 61 (1982), 121–129.

E. Koster 2009
E.A. Koster. "The European Aeolian Sand Belt: Geoconservation of Drift Sand Landscapes". *Geoheritage* 1 (2009), 93–110.

Krekelbergh 2008
N.J. Krekelbergh. *Gemeente Wierden. Landinrichtingsplan Rijssen, inrichting Elsenerbeek. Bureauonderzoek en archaeologisch inventariserend veldonderzoek*. BAAC-rapport, V-07.0281. 's-Hertogenbosch, 2008.

Louwe Kooijmans 1974
L.P. Louwe Kooijmans. *The Rhine/Meuse Delta; Four Studies on its Prehistoric Occupation and Holocene Geology*. Analecta Praehistorica Leidensia 7. Leiden: Leiden University, 1974.

Louwe Kooijmans 1987
L.P. Louwe Kooijmans. "Neolithic Settlement and Subsistence in the Wetlands of the Rhine/Meuse Delta of the Netherlands". In *European Wetlands in Prehistory*. Ed. by J.M. Coles and A.J. Lawson. Oxford: Clarendon Press, 1987, 227–251.

Louwe Kooijmans 1993
L.P. Louwe Kooijmans. "Wetland Exploitation and Upland Relations of Prehistoric Communities in the Netherlands". In *Flatlands and Wetlands: Current themes in East Anglian Archaeology*. Ed. by J. Gardiner. Vol. 50. East Anglian Archaeology Report. Norwich, 1993, 71–116.

Lubberink and Willemse 2009
H.B.G. Scholte Lubberink and N. Willemse. *Bornsche Maten-Grutterskamp. Gemeente Borne. Een nederzetting uit de IJzertijd en vroeg-Romeinse tijd*. RAAP-rapport 1937. Weesp, 2009.

Mazurkevich et al. 2009
A.N. Mazurkevich, B.N. Korotkevich, P.M. Dolukhanov, A.M. Shukurov, Kh.A. Arslanov, L.A. Savel'eva, E.N. Dzinoridze, M.A. Kulkova, and G.I. Zaitseva. "Climate, Subsistence and Human movements in the Western Dvina – Lovat River Basins". *Quaternary International* 203 (2009), 52–66.

Menotti 2012
F. Menotti. *Wetland Archaeology and Beyond: Theory and Practice*. Oxford and New York: Oxford University Press, 2012.

Menotti and O'Sullivan 2013
F. Menotti and A. O'Sullivan, eds. *The Oxford Handbook of Wetland Archaeology*. Oxford: Oxford University Press, 2013.

Mol 2003
J. Mol. "Landscape Evolution and Site Formation of Two Mesolithic Sites in the Lower Rhine-Meuse Delta (Hardinxveld, the Netherlands)". In *Alluvial Archaeology in Europe*. Ed. by A.J. Howard, M.G. Macklin, and D.G. Passmore. Rotterdam: Lisse etc: Swets & Zeitlinger, 2003, 147–161.

Pelisiak, Rybicka, and Ralska-Jasiewiczowa 2006
A. Pelisiak, M. Rybicka, and M. Ralska-Jasiewiczowa. *From the Mesolithic to Modern Times: Settlement Organization and Economy Recorded in Annually Laminated Sediments of the Lake Gościąż (Central Poland)*. Rzeszów: Fundacja Rzeszowskiego Ośrodka Archeologicznego. Instytut Archeologii Uniwersytetu Rzeszowskiego, 2006.

Pronk 2008
E.C. Pronk. *Onderzoeksgebied locatie 1, combiplan Nijverdal, gemeente Hellendoorn. Archeologisch vooronderzoek: een waarderend veldonderzoek (proefsleuven)*. RAAP-rapport 1698. Amsterdam, 2008.

Pryor 2005
F. Pryor. *Flag Fen. Life and Death of a Prehistoric Landscape*. Stroud: Tempus Publishing, 2005.

Purdy 1990
B.A. Purdy. *Wet Site Archaeology*. Cald-Well: Telford Press, 1990.

Raab et al. 2011
A. Raab, W. Brützke, D. Christophel, J. Völkel, and T. Raab. "Reconstructing the Fire History in the Siedlungskammer Burgweinting (Bavaria, Germany) in Relation to Settlement and Environmental History". In. Vol. 352. Geological Society London Special Publications. 2011, 137–161.

Renfrew and Bahn 2000
C. Renfrew and P. Bahn. *Archaeology: Teories, Methods and Practice*. London: Thames & Hudson, 2000.

Rensink 2008a
E. Rensink. "KNA Leidraad beekdalen in Pleistoceen Nederland". *SIKB* (2008a).

Rensink, Gerritsen, and J. Roymans 2006
E. Rensink, F.A. Gerritsen, and J.A.M. Roymans. "Archaeological Heritage Management, Nature Development and Water Management in the Brook Valleys of the Southern Netherlands". In. Vol. 46. Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek. Amersfoort, 2006, 383–399.

A. Roymans and Sprengers 2012
A.M. Roymans and N. Sprengers. *Tien bronzen bijlen bij een Romeinse dam. Herinrichting beekdal Kleine Beerze, deeltraject Hoogeloon-Vessem. Resultaten archeologische begeleiding en opgraving*. RAAP-rapport 2537. Weesp, 2012.

J. Roymans (Unpublished)
J.A.M. Roymans. *Een cultuurhistorisch verwachtingsmodel voor Brabantse Beekdallandschappen. Een mogelijke toekomst voor het verleden van beekdalen*. MA thesis. 2005. Unpublished.

J. Roymans 2007
J.A.M. Roymans. *Herinrichting en sanering Tungelroyse Beek fase 2; archeologische begeleiding van de grondwerkzaamheden*. RAAP-rapport 1401. Amsterdam, 2007.

J. Roymans 2013
J.A.M. Roymans. *Hert in de pot, herinrichting Tungelroyse Beek deeltrajecten C, D en E, gemeenten Nederweert en Leudal; archeologisch onderzoek: een archeologische begeleiding van de graafwerkzaamheden*. RAAP-rapport 2680. Weesp, 2013.

J. Roymans and Sprengers 2011
J.A.M. Roymans and N. Sprengers. *Een Romeinse muntschat in het dal van de Vlootbeek, gemeente Roerdalen: resultaten van de archeologische begeleiding van de graafwerkzaamheden ten behoeve van de herinrichting Vlootbeek en Putbeek*. RAAP-rapport 2298. Weesp, 2011.

Schiffer 1972
M.B. Schiffer. "Archaeological Context and Systemic Context". *American Antiquity* 37 (1972), 165–172.

Schiffer 1987
M.B. Schiffer. *Formation Processes of the Archaeological Record. Albuquerque (NM)*. University of New Mexico Press, 1987.

Schlanger 1992
S.H. Schlanger. "Recognizing Persistent Places in Anasazi Settlement Systems". In

Space, Time, and Archaeological Landscapes. Ed. by J. Rossignol and L. Wandsnider. New York: Plenum Press, 1992, 91–112.

Schwann 1988
J.C.G. Schwann. *Sedimentology of Coversands in Northwestern Europe. A Study on Weichselian to Early Holocene Aeolian Sand Sheets in England, the Netherlands and the Federal Republic of Germany*. PhD thesis. 1988.

Smit 2010
B.I. Smit. *Valuable Flints. Research Strategies for the Study of Early Prehistoric Remains from the Pleistocene Soils of the Northern Netherlands*. PhD thesis. Groningen, 2010.

Stern 2008
N. Stern. "Stratigraphy, Depositional Environments, and Palaeolandscape Reconsruction in Landscape Archaeology". In *Handbook of Landscape Archaeology*. Ed. by J. Thomas and B. David. Walnut Creek: Left Coast Press, 2008, 365–378.

Sugita, Gaillard, and Broström 1999
S. Sugita, M.-J. Gaillard, and A. Broström. "Landscape Openness and Pollen Records: a Simulation Approach". *The Holocene* 9 (1999), 409–421.

Thomas and David 2008
J. Thomas and B. David. *Handbook of Landscape Archaeology*. Walnut Creek: Left Coast Press, 2008.

Tolksdorf and Kaiser 2012
J. Tolksdorf and K. Kaiser. *Holocene Aeolian Dynamics in the European Sand-Belt as Indicated by Geochronological Data*. Boreas, 2012.

Van Beek 2009
R. Van Beek. *Reliëf in Tijd en Ruimte. Interdisciplinair onderzoek naar bewoning en landschap van Oost- Nederland tussen vroege prehistorie en middeleeuwen*. PhD thesis. Wageningen: Wageningen University, 2009.

Van Beek and Groenewoudt 2011
R. Van Beek and B.J. Groenewoudt. "An Odyssey along the River Vecht in the Dutch-German Border Area. A Regional Analysis of Roman-period Sites in Germania Magna". *Germania* 89 (2011), 157–190.

Van de Noort 2008
R. Van de Noort. "The Archaeology of Wetland Landscapes: Method and Theory at the Beginning of the 21st Century". In *Handbook of Landscape Archaeology*. Ed. by J. Thomas and B. David. Walnut Creek: Left Coast Press, 2008, 482–489.

Van de Noort and O'Sullivan 2006
R. Van de Noort and A. O'Sullivan. *Rethinking Wetland Archaeology*. London: Duckworth, 2006.

Van den Akker, Knibbe, and Maarleveld 1964
A.M. Van den Akker, M. Knibbe, and G.C. Maarleveld. "Het Sallandse dekzandlandschap". *Tijdschrift Koninklijk Nederlandsch Aardrijkskundig Genootschap* Tweede Reeks LXXXI (1964), 287–296.

Van der Sanden 1995, 1997, 1998
W.A.B. Van der Sanden. “Veenvondsten in Drenthe (1, 2, 3)”. *Nieuwe Drentse Volksalmanak* 112, 194/ 114, 117–201/ 115 (1995, 1997, 1998), 103–197.

Vermeulen, Mittendorf, and Van der Wal 2012
B. Vermeulen, E. Mittendorf, and M. Van der Wal. *Locatie ongeschikt! Archeologisch en historisch onderzoek naar het klooster Maria ter Horst, de Sint Anthoniskapel en de Molendijk in het dal van de Dortherbeek in Epse-Noord*. Rapportage Archeologie Deventer 40. Deventer, 2012.

Wassink 1999
W.Th. Wassink. *Beekdallandschapen. Een morfologisch onderzoek in de zandgebieden van Nederland*. PhD thesis. Wageningen: University of Wageningen, 1999.

Wentink 2006
K. Wentink. *Ceci n'est pas une hache. Neolithic Depositions in the Northern Netherlands*. MA thesis. 2006. http://www.academia.edu/231952/Ceci_Nest_Pas_Une_Hache_Neolithic_Depositions_in_the_Northern_Netherlands (visited on 06/05/2015).

Willemse 2005a
N.W. Willemse. *Rijksweg 35, combiplan Nijverdal. Stratigrafie en inventariserend palynologisch onderzoek van een restgeul in het Reggedal*. RAAP-rapport 1115. Amsterdam, 2005a.

Willemse 2005b
N.W. Willemse. *Groene Mal Reggedal te Nijverdal, gemeente Hellendoorn; archeologisch vooronderzoek: een bureauonderzoek en geo-archeologisch veldonderzoek (kartering)*. RAAP-rapport 1189. Amsterdam, 2005b.

Willemse 2008
N.W. Willemse. “Land in lagen. De geschiedenis van het Oost-Nederlandse beekdallandschap”. In *Archeologie en beekdalen. Schatkamers van het verleden*. Ed. by E. Rensink. Amersfoort, 2008, 88–105.

Willemse and Groenewoudt 2012
N.W. Willemse and B.J. Groenewoudt. “Resilience of Meta-Stable Landscapes? The Non-linear Response of Late Glacial Aeolian Landforms to Prehistoric Reclamation Along Dutch River Valleys”. *e-Topoi – Special Volume* 3 (2012), 1007–1017.

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