Mapping Lost Woodland. An Attempt to Use the Spatial Distribution of Woodland-Related Place Names as a Proxy for Localizing Woodland in the Middle Ages

Rural Landscapes

RESEARCH

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ABSTRACT

After many centuries, much of Europe is now largely deforested. Today, plans for reforestation are ongoing. These plans have the potential to significantly impact the landscape. As a contribution to the current debate on large-scale reforestation in the Netherlands, we have tried to conduct a quick and overall scan to determine whether the spatial distribution of woodland-related place names can have an evidential value for locating surviving woodland in the high and late Middle Ages (AD 1000–1500). To do so, we have made extensive use of digital data sets and existing inventories (place names, field names, historical maps, charcoal production sites, ancient woodland, ancient woodland indicator plants). Two different indicative distribution maps (period maps) were produced and tested: period map 1 (AD 750–1350), based on woodland-related place names, and period map 2 (AD 1250–1650), based on historical woodland references. Results suggest that although the spatial reconstructions produced are biased due to multiple factors, pre-1500 place names in combination with historical woodland references and other woodland proxies can indeed be used to quickly and roughly reconstruct the distribution of woodland and even of specific historical woodland types. A precondition is the availability of existing inventories and digital data sets.

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1. INTRODUCTION

Plans for the expansion of the present woodland cover exist all over the world, with climate ambitions (carbon capture, climate adaptation), sustainability, the preservation of biodiversity, and the reduction of recreational pressure among the arguments being cited. The question is where and how to create new woodland. There are many different types of woodland as to appearance, ecology, and functionality. Moreover, with regard to soil conditions, climate adaptability, and social acceptance, and also from a landscape historical perspective, certain locations or woodland types are better suited or more logical than others. However, in our research area, the Netherlands, woodland has been mapped nationwide and in detail only since *c.* 1850, the time when the country's deforestation was almost complete. Woodland cover at that time amounted to about 1% of the country's territory (Van der Meulen, 2003). In addition, due to unfavourable preservation conditions and a lack of research, palynological data post-dating *c.* AD 1000 are scarce. Moreover, the broad scope of (very) large-scale reconstructions that are mainly based on pollen data (e.g. Kaplan et al., 2009; Zanon et al., 2018) lack the required level of detail.

This article describes an attempt to circumvent these difficulties by using new methods and data to determine the presence of woodland in the high and late Middle Ages (AD 1000–1500). An important precondition was to generate information in time to be able to influence the fast-moving decision-making process regarding reforestation. Therefore, speed was crucial. We have in the first place tested the evidential value of the spatial distribution of woodland-related place names. For this purpose, historical woodland references were used in the first stage, followed by (the distribution of) other forest indications: field names, historical maps, charcoal production sites, ancient woodland, and ancient woodland indicator plants. This research in fact was a quest in which the goal was set in advance, but the approach (data and methodology) took shape only during the process. The used data (toponyms, place names, historical references, archaeological information, etc.) often is not structured or published as a consistent database. We simply used the best (most complete and reliable) data sets available. But these are very different in nature. The data and maps resulting from our research are already being used in the designation of search areas for afforestation by both the Dutch national government and private nature conservation organisations. The results and conclusions (Chapter 9) obviously relate to the study area, but application of the approach could be considered elsewhere.

2. A DYNAMIC HISTORY

We will begin by discussing a series of important woodland-historical facts. In densely populated parts of Europe extensive deforestation started as early as the late prehistoric period (e.g. Kaplan et al., 2009; Zanon et al., 2018). Exploitation of what little woodland still remained in the late Middle Ages (AD 1250/1300-1500) tended to be intensive and multifunctional (e.g., Hasel and Schwarz, 2002; Küster, 1998; Oram, Slavin and Newfield, 2019; Peterken, 1993, 1996; Rackham, 1980; 1990; Tack, van den Bremt and Hermy, 1993). This also applies to the Netherlands (Buis, 1985; Dirkx, 1998; Gouw-Bouwman, 2019; Groenewoudt and Spek, 2016), where most woodland remnants were utilitarian and subject to pronounced human intervention. Woodland cover further declined after the late medieval period, causing serious timber shortages in the southern Netherlands already in the 15th century and also in the north in the 16th century (Buis, 1985). Telling may also be the fact that after the 13th century, thick, hollowed-out tree trunks (Fischer, 2008) were no longer used for making water wells.

However, the decline of woodland cover in the Netherlands was not constant. In fact, during the transition from the Roman period (AD 0–450) to the early Middle Ages (AD 450–1000), woodland cover increased, even on a significant scale locally. Moreover, a cycle or repeated cycles of deforestation and spontaneous reforestation have been observed on a local and regional scale (Groenewoudt and Spek, 2016; Gouw-Bouwman et al., 2019). Such cycles occurred mainly on the higher, agriculturally suitable landscape sections. They were far less common in marshy lowland areas, and it was in those low-lying areas that some woodland still survived around AD 1650, when the Netherlands was almost completely devoid of forest (Dirkx, 1998; Groenewoudt, 2012).

In the settled parts of the Netherlands, forests remained spatially dynamic for a long time, at least until the early medieval period (up to *c.* AD 600–800). Forests 'moved' through the landscape (Groenewoudt and Spek, 2016), regrowing on abandoned cultivated land as settlements periodically relocated. This phenomenon explains why today, even so-called ancient forests stand on former plough soil (Spek and Smeenge, 2021; Willemse, De Roode and Neefjes, 2008). It is likely that the fragmentary woodland that still existed on the higher sections of the landscape in the late Middle Ages (AD 1250/1300-1500) was mostly secondary and relatively open. This increasing openness was in part the result of human-induced soil degradation (Faegri et al., 1988; Hermy and Verheyen, 2007; Spek, 1996; Stockmarr, 1975). Due to fluctuating hydrological conditions, marshy, low-lying areas periodically also became suitable

for agriculture, at least locally (Scholte Lubberink and Willemse, 2009). This means that some of the woodland remnants in those locations were also secondary.

3. RESEARCH STAGES

Our study comprised four stages. The first and second stages aimed to produce an overall overview of the nationwide distribution of woodland and specific historical woodland types in the later medieval period, the high and late Middle Ages (AD 1000–1500). No maps exist for that period, but there are other sources of information. In the third stage, we tested whether the results of the first two stages could be verified. The fourth stage consisted of analysis and critical evaluation. Figure 1 shows the total study area, its subregions, and the regions selected to test the results.

4. STAGE ONE: ANALYSIS OF MEDIEVAL PLACE NAMES REFERRING TO WOODLAND

4.1. MATERIAL AND METHOD

Because of the scope of this study (quick scan, large scale, overall patterns), we opted for using existing large data sets (Gattiglia, 2015; McCoy, 2017). The data used in this first stage were place names, particularly the names of larger and smaller settlements (Eijgenraam, 2021). The potential of toponym analysis for landscape historical research is considerable (see Gelling and Cole, 2000; Higham and Ryan, 2011; Paulissen, 2018; Sousa and García-Murillo, 2001; Ter Laak, 2007; Van den Berg, 2015, among others). In the Netherlands, such studies have so far been conducted only on a local or regional scale. Many place names refer to the local landscape or to ways this landscape was exploited (see Ter Laak, 2007,

Figure 1 Research area: The Netherlands. Dark green: low-lying areas (peat, clay); light green: higher, predominantly sandy areas; yellow: coastal dunes. Regions and test areas (numbers mentioned in the text are indicated).

among others). Many Dutch place names refer to the presence of woodland (Blink, 1929). Furthermore, many Dutch settlements and their names originated in the late medieval, large-scale reclamation period (Gyssling et al., 1993; Ter Laak, 2007; Van Berkel and Samplonius, 2006). Etymologically, some of these names may be older; however, because much of the Netherlands saw a considerable population decline between *c.* AD 250 and 500, immediately after the Roman period (Groenewoudt and Van Lanen, 2018; Louwe Kooijmans et al., 2005), an overall persistence of older place names is unlikely.

The data set selected for this stage of our research was Van Lanen's 2016 database of 6,284 late-medieval names of larger and smaller settlements in the Netherlands (Van Lanen et al., 2016). A selection was made of names containing the most common and unambiguous elements referring to woodland. This resulted in 622 names, or roughly 10% of the total database. Our selection was based on an existing list of woodland toponym types (Spek, 2004; Spring in 't Veld, 2010). Names containing the element broek (best translated as carr) were excluded because they do not refer specifically to woodland, and it is moreover uncertain to what extent these areas were still forested during the later medieval period (Spek, 2004).

GIS software was used to model the distribution of both the inventoried woodland toponyms and the individual toponym types. These were visualised by showing the magnitude of distribution density in variations of colour intensity with the goal of suggesting spatial clusters. They do not necessarily have a uniform quantitative basis. We call these visualizations indicative distribution maps.

4.2. RESULTS

4.2.1 General

The resulting overall image reveals significant regional variations in density (Figure 2), as does the distribution map of the different toponym types (Figure 3). Especially in the south (the provinces of Noord-Brabant and Limburg) and to a lesser extent in the north, relatively many (clusters of) woodland-related place names can be identified. Particularly conspicuous is the extremely high density in the east of the province of Noord-Brabant, something noted earlier by the historian Buis (1985).

4.2.2 Historical woodland types

By this, we mean woodland types distinguished by those who lived among them, rather than ecologically defined types. Woodland indicated by the element *holt* was characterized by tall stands of timber suitable for construction. Place names containing *holt* can be found throughout the Netherlands. The element *loo* (English: *leah, ley*) refers to open woodland or to a woodland clearing used for pasture (German: *Hudewald*), and possibly to an even opener type of vegetation called 'wood pasture'. These names are limited almost exclusively to the higher sandy soils in the east. Place names containing the element *el(e)* in many cases probably derived from *loo* names. A dense concentration of such names occurs in the south. The toponym *laar* refers to an open,

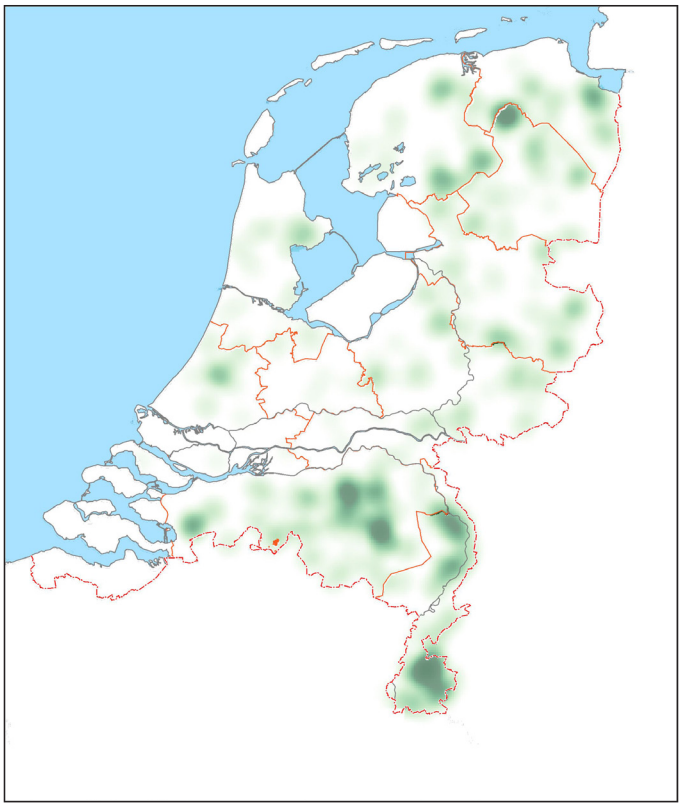

Figure 2 Indicative distribution map of the distribution of larger and smaller settlements with names referring to (the presence of) woodland (period 1: AD 750–1350).

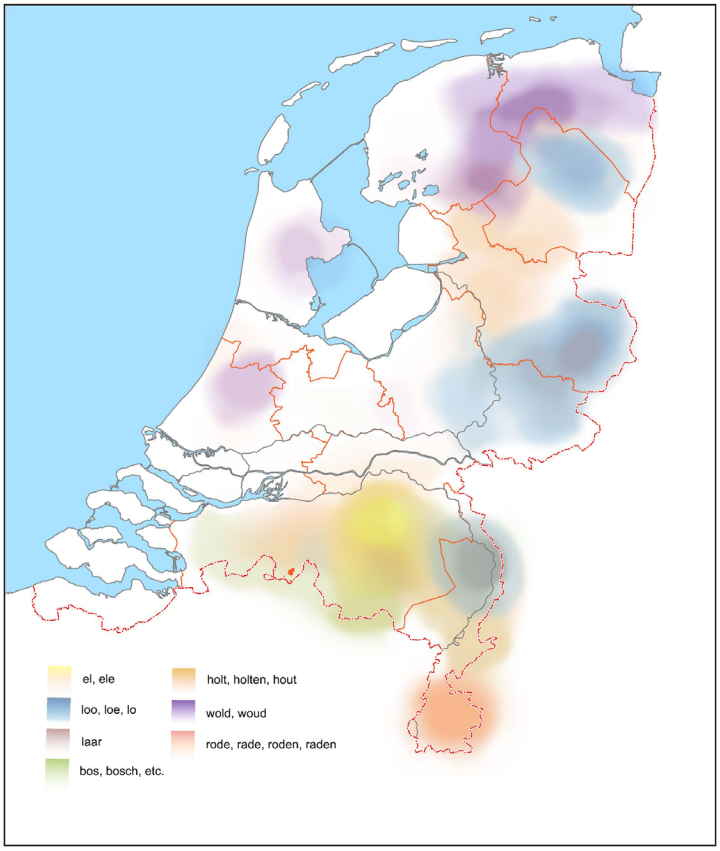

Figure 3 Indicative distribution map of settlements with names referring to specific historical woodland types (period 1: AD 750–1350.

enclosed section of woodland, mostly in low-lying areas. *Laar* names strongly cluster in the province of Noord-Brabant. *Wold* and *woud* allegedly mean 'damp/marshy woodland on peat or clay' (Edelman, 1955; Edelman and Van Liere, 1949; Spek, 2004). Zomer (2016), in contrast, defines *wold* as 'unreclaimed and densely vegetated land'. However, *wold* names are also connected to raised bogs. These will originally have been more or less treeless, but it is likely that by the Middle Ages, they at least partly had become forested due to drainage caused by human intervention (Groenewoudt and Van Doesburg, 2018). *Wold* names cluster in the low-lying periphery of the Drents Plateau (province of Drenthe), whereas *Woud* names are mainly found in the largely wet and peaty marshland in the west of the country. Place names containing the element *rode* (*rade/rath/roth/rothe*) are associated with (planned) forest reclamations (German: *Waldhufen*; Hartmann, 1986); they cluster on the loess soil-plateaus in the far south (province of Limburg). The south also contains most of the names with the element *bos*. Other place-name elements referring to woodland are far less common.

5. STAGE TWO: AN INVENTORY OF MEDIEVAL WOODLAND REFERENCES

The inventory involves place names that refer to woodland, but this woodland almost by definition ceased to exist by the time the settlements associated with the name were established. In fact, the woodland may already have disappeared some time before that, at least partially. In that case, the woodland toponym first referred to existing woodland before continuing as a field name, which then became the name of the settlement established at that location. This leads to the question whether woodland actually still existed. The goal of the second stage was to answer this question.

5.1. MATERIAL AND METHOD

A distribution map of existing woodland in the late medieval period was produced by making use of historical references to woodland and woodland exploitation. The year 1700 was chosen as the final date rather than 1500 because the first historical references to the presence of woodland in some areas are relatively late. Moreover, woodland still extant around 1700 was almost certainly older, and not planted (woodland on country estates was excluded from the study because it is almost exclusively planted after *c.* 1650). Stage two was a quick scan based exclusively on secondary sources in the form of published overviews. The goal was not to be exhaustive but to achieve an even geographical spread of sources to obtain a more or less representative data set. Starting point was a nationwide woodland-historical study by Buis (Buis, 1985) supplemented with references collected from a number of regional studies (Bremer, 2018; Elerie, Smeenge and Van den Berg, 2015; De Rijk,

1990; Leenders, 2002; Renes, 1999; Smeenge, 2020; Vera, 2011; Zeiler, 2013). The resulting list contains generic as well as specific woodland references. A generic reference implies the presence of 'woodland' in a given territory without being explicit as to whether this was one forest or several. A specific reference definitely involves one single forest area. If a generic reference exists for the same area, this could potentially introduce a redundancy in the data set. To prevent that, the only factor recorded for each larger or smaller settlement was the presence or absence of woodland, using the same list of place names as in stage one. The goals of the study made a small error margin acceptable. The results of stage two have been translated into an indicative distribution map.

5.2 RESULTS

The inventory resulted in a list of 305 historical woodland references. After screening for possible redundancies, this was reduced to 259. References are distributed throughout the Netherlands, with a noticeable gap in the low-lying Holocene clays and peats in the west, and higher densities on the higher Pleistocene sandy soils in the east (Figure 4). The latter area also contains several clusters, especially along the northern edge of the Drents Plateau (Drenthe) and on the higher sandy soils (ice-pushed ridges) in the province of Gelderland. In the south (Noord-Brabant), an ill-defined cluster can be distinguished, and the otherwise 'empty' Holocene west contains a small cluster on the tidal barriers and the coastal dunes.

6. PERIOD MAPS

The two indicative distribution maps were not combined. During the inventory of the historical woodland references, it became clear that the map that is based on them on the whole represents a later period than the map that is based on woodland-related place names. The historical woodland references cluster in the period *c.* 1250–1650, whereas the woodland-related place names tend to be older. Archaeological and historical geographical research has demonstrated that most (medieval) Dutch settlements originated before AD 1350 but no earlier than AD 750, the time when settlements ceased to move around and many new settlements were established (Van der Velde, 2004). This results in two distinct but partially overlapping periods:

1. AD 750–1350 (woodland-related place names)
2. AD 1250–1650 (historical woodland references)

Further chronological differentiation is theoretically possible but hardly feasible in practice. *Rode* names tend to be younger (mainly 10th to 13th century; Van Berkel and Samplonius, 2018; Hartmann, 1986) than *loo* names,

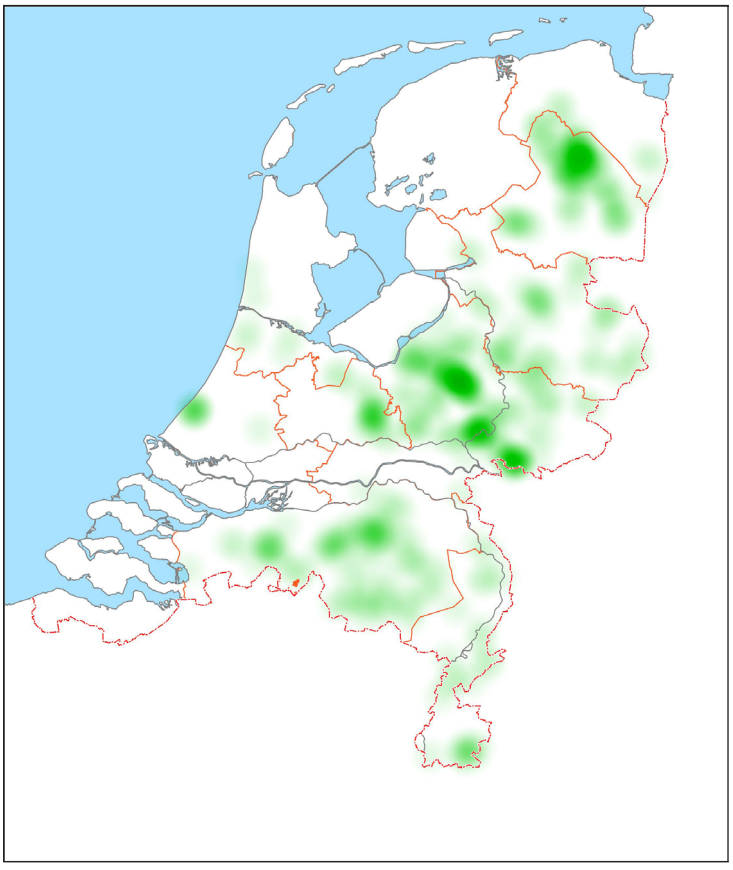

Figure 4 Indicative distribution map of woodland mentioned in historical sources (period 2: AD 1250–1650).

which are largely early medieval and some of which may even have existed before AD 500 (Ter Laak, 2007). Also, *bos* names tend to be younger than the *holt* names they not infrequently replaced (De Rijk, 1990). These various synonyms for woodland remained in use for a long time and show significant chronological overlap, and probably regional variation as well.

7. STAGE THREE: VALIDATION

7.1. INTRODUCTION

The next question is to what extent the generated distribution patterns reflect the historical reality. To validate them, we visually compared them with distribution patterns based on other woodland-related (proxy) data. We briefly considered using the Dutch soil classification system (De Bakker and Schelling, 1966) to map those soil types where the name suggests a connection with the (former) presence of woodland. However, it became clear that a discrepancy exists between the spatial distribution of these soil types and that of the woodland-related place names associated with them (Eijgenraam, 2021). Another potential venue, charting the 'potential natural vegetation' (PNV), is likewise impractical; methodically, the concept itself is open to question (Chiarucci et al., 2010), and using it would not generate more information on the actual presence of woodland at a specific moment in the past. It was therefore decided to validate the two period maps by random sampling, using published inventories of field names (Section 7.2), historical maps (Section 7.3), archaeological information on charcoal production (Section 7.4), the distribution of ancient woodland (Section 7.5), and the distribution of ancient woodland indicator plants (Section 7.6).

7.2. FIELD NAMES

Other sources of information on former woodland besides place names and historical documents are field names (micro-toponyms). To what extent does the distribution of woodland-related field names reflect the visualized clusters and lacunae? Do regions with (compared to other regions) relatively many field names spatially correspond with visualized clusters of woodland-related place names and/or historical woodland references? The majority of the many published field name inventories cover a small area. For our analysis, we selected three regional field name studies that, due to their somewhat wider scope, were probably fairly representative and used a larger data set than the smaller, local studies. The selected studies are (1) Drentse Aa (Drenthe), (2) Westelijke Achterhoek (Gelderland) and (3) Baronie van Breda (Noord-Brabant). For each of these regions, the proportion of woodland-related field names was established. These results were then compared with the densities on a nationwide scale of woodland-related place names and historical woodland references in the same region. Digital data sets were available for two of the three test regions (1 and 2).

1. Region: Drentse Aa (Elerie and Spek, 2009; Spring in 't Veld, 2010).
   Period 1: Low density of woodland-related field names; period 2: high density of the same.
   Data set: 9,097 field names, recorded on the basis of historical cadastral maps. Of this total number, 578 (6.6%) field names refer to woodland.
   Observation: The relatively low density of woodland-related place names (period 1) in this region corresponds to a relatively low density of woodland-related field names. However, the established high density of historical woodland references for this region (period 2) is not matched by an equally high density of woodland-related field names.
2. Region: Westelijke Achterhoek (Ter Laak, 2007).
   Period 1: low to medium density; period 2: low density.
   Data set: 1,317 names of plots, farms, and places, recorded on the basis of old topographical maps as well as existing studies.
   Observation: Discounting place names, 125 (9.5%) of the recorded names are woodland-related. This percentage matches that of woodland-related place names on the nationwide distribution map (*c.* 10%, period 1). The comparatively high percentage of woodland-related field names contrasts with the relatively few historical woodland references in this region (period 2).
3. Region: Baronie van Breda (Buiks, 1997).
   Period 1: medium density; period 2: medium density.
   Data set: 3,058 names, all late medieval field names (mainly 13th to 16th century) referring to the local topography. These names have been recorded on the basis of historical sources.
   Observation: Of the total set, 276 (9.0%) field names refer to woodland. This percentage approaches the nationwide averages for woodland-related place names (period 1) and historical woodland references (region 2) for this region.

7.3. HISTORICAL MAPS

The *Atlas sive Cosmographicae Meditationes de Fabrica Mundi et Fabricati Figura*, or Mercator/Hondius atlas (1607, based on maps made by Mercator in 1596), contains the oldest nationwide maps on which the presence of woodland has been consistently recorded (Figure 5). By determining where areas of forest are indicated on these maps, we have tried to assess to what extent indicated density variations (Figures 2 and 4) match the image that emerges from the maps as regards the presence of woodland.

Overall, the woodland distribution pattern that emerges from the 1607 (1596) maps matches the most recent modelled distribution map (period 2; Figure 6) more closely than the model for the earlier period (period 1). The exception is the north, where the reverse is the case. In the south, 'all' woodland appears to have disappeared by *c.* 1600, whereas forests were still fairly common in that region a few centuries earlier.

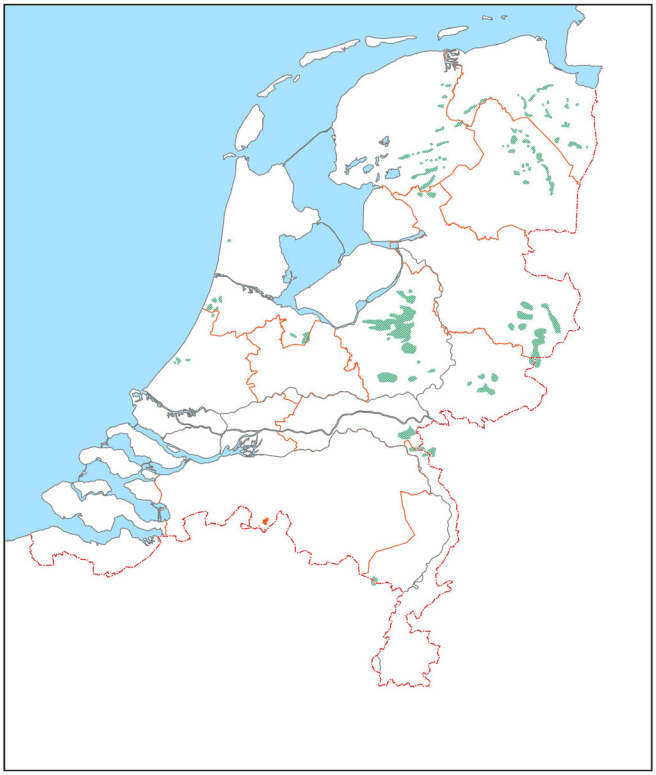

Figure 5 Woodland indicated on the maps of the *Atlas sive Cosmographicae Meditationes de Fabrica Mundi et Fabricati Figura*, or Mercator/Hondius atlas (1607).

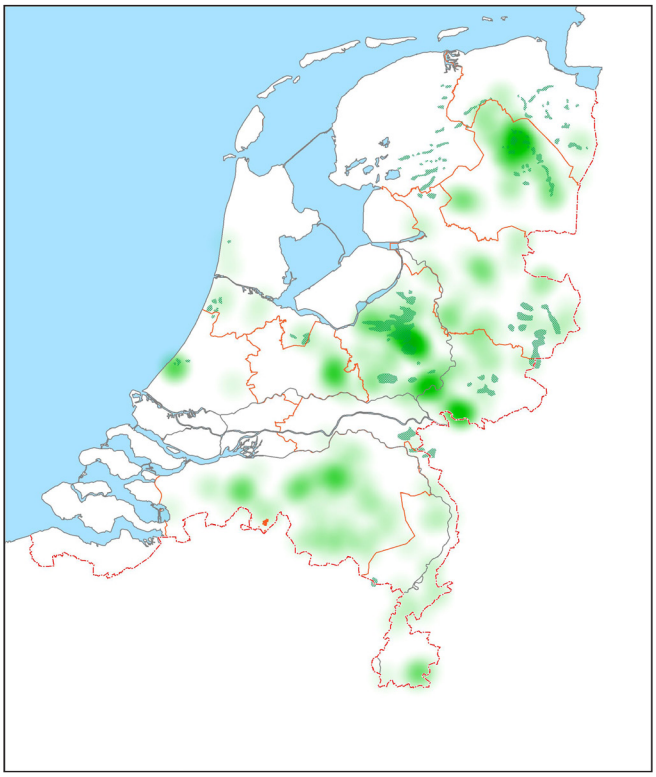

Figure 6 Woodland indicated on the maps of the *Atlas sive Cosmographicae Meditationes de Fabrica Mundi et Fabricati Figura*, or Mercator/Hondius atlas (1607), compared with the indicative distribution map of historical woodland references (period 2, AD 1250–1650).

7.4 ARCHAEOLOGICAL INDICATIONS OF CHARCOAL PRODUCTION

Archaeological charcoal production sites point to the local presence of woodland. A recent inventory of reliably dated charcoal production sites (Deforce, Groenewoudt and Haneca, 2021) was compared with density variations on period maps 1 and 2.

So far, archaeological indications for medieval charcoal production are limited to the higher sandy soils in the east and south. They cluster in two regions, an eastern cluster in the west of the Achterhoek region (early medieval, AD 500–1000) and a southern cluster in the east of Noord-Brabant (late medieval, AD 1000–1500). The southern cluster coincides exactly with the area with the highest density of woodland-related place names (period 1). The situation in the eastern cluster is different; there, charcoal production coincides neither with a cluster of woodland-related place names (period 1) nor with one of historical woodland references (period 2). Nonetheless, written sources clearly indicate that extensive woodland existed in this region until the later Middle Ages (Groenewoudt et al., in press). Apparently, not only the forested landscape itself but also the associated names largely disappeared, and historical sources contain no references to any remaining woodland. However, there are toponymic arguments for assuming that most of the settlements in this region originated before AD 1000 (Ter Laak, 2007), and quite a few of them had woodland-related names. The absence of a cluster on the distribution map for period 1 is probably a product of the relatively low settlement density (see Chapter 8.2.1).

7.5. ANCIENT WOODLAND

Internationally, ancient woodland is defined as forests that are at least several centuries old. In the Netherlands, woodland is classified as ancient if it appears on the earliest topographical maps (*c.* 1850) and has existed since without interruptions (e.g., Maes, 2016). In our analysis, we have made use of a systematic inventory derived from the national landscape-history information system HISTLAND (Dirkx and Nieuwenhuizen, 2013) (Figure 7).

Upon comparison, it became clear that the distribution of ancient woodland on the whole differs greatly from that of the woodland-related place names (period 1), with the two clusters overlapping only in the north. With regard to the distribution of historical woodland references (period 2), the similarities are much more pronounced, and ancient woodland clusters are even more strongly in the central Netherlands (Veluwe area) than appears on the modelled period 2 distribution map. In the south, smaller clusters of ancient woodland tend to occur in the periphery of matching clusters of historical woodland, rather than coinciding with the clusters themselves.

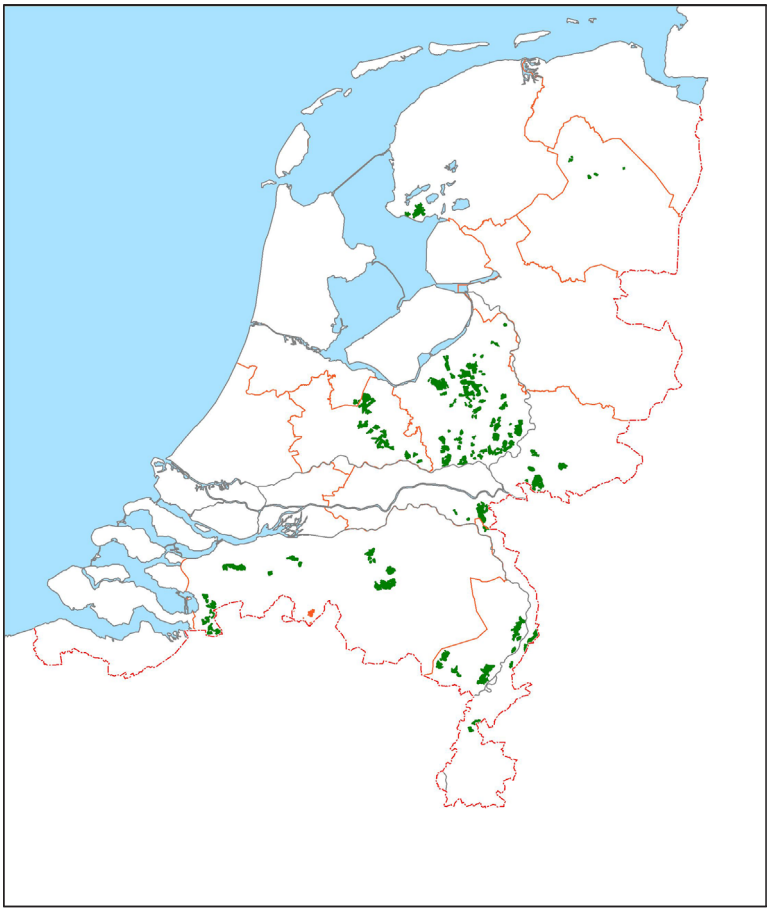

Figure 7 Distribution of 'ancient woodland', based on HISTLAND (Dirkx and Nieuwenhuizen, 2013).

7.6 ANCIENT WOODLAND INDICATOR PLANTS

Ancient woodland indicator plants are plant species that to a greater or lesser extent are associated with ancient forest soils (e.g. Bijlsma, 2002; Schmidt et al., 2014). After a forest has disappeared, these species possibly survive in hedgerows (Smart, Bunce and Stuart, 2001) and as such function as indicators for historical woodland. The modelled distribution maps for periods 1 and 2 have been compared with the distribution per km² of the most indicative plant species (Brinkkemper, Kosian and Maes, 2014) using the national FLORON wild plants database. Clusters can be observed in the far south (Zuid-Limburg), the centre, and the east (Figure 8), whereas lower densities exist in the north and west. The only instance of spatial correspondence with the period maps is that of the Veluwe cluster for period 2. The dense indicator-plant cluster in Zuid-Limburg lies immediately outside a dense cluster of woodland-related place names (period 1) but does not overlap with it.

8. STAGE FOUR: DISCUSSION AND CONCLUSIONS

8.1. SPATIAL PATTERNS

The distribution pattern of woodland-related place names suggests substantial regional differences in the Netherlands during the period AD 750–1350 in the presence of woodland or in the rate woodland disappeared. Particularly noticeable are the low densities in the west, in the provinces of Noord-Holland and Zuid-Holland. The name *Holland* itself derives from *holt land* and suggests that the region was once densely forested. Perhaps those forests were concentrated in the narrow strip of coastal barriers and disappeared early on (Zeiler, 2013), because this is also where the earliest settlements largely cluster. The vast peat marshes behind the coastal barriers and coastal dunes were originally in part covered in carr woodland. This disappeared when the area was reclaimed within a relatively short period from the 10th century AD onwards (Hendrikx, 1989; Van der Linden, 1984).

Also with regard to woodland types, there is regional variation, which to some extent reflects the distribution of specific soil conditions. The elements *loo* and *laar* both seem to be associated with (woodland on) mostly Pleistocene sandy soils, which means these forests are likely to have been predominantly open, secondary woodland. *Wold* names cluster around the Drents Plateau; large-scale reclamation of this marshy peripheral zone is known to have started no earlier than the late medieval period (Spek, 2004) but drainage and small-scale reclamation much earlier (e.g. De Langen, 2011).

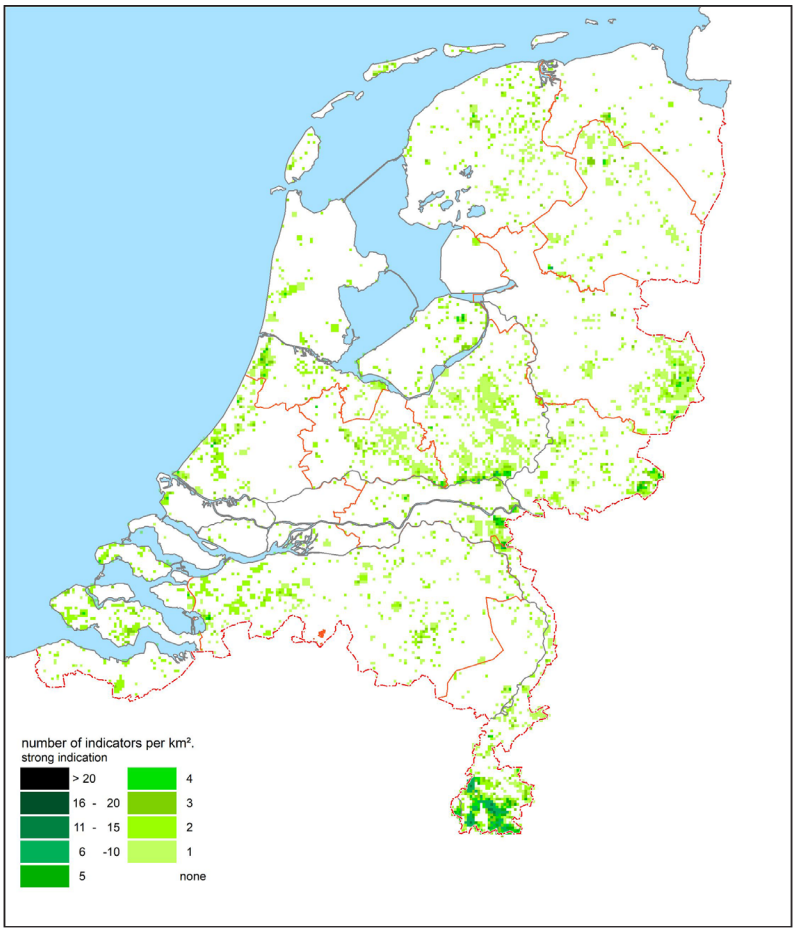

Figure 8 Distribution per km2 of the most indicative ancient woodland indicator plants (with thanks to Dr Otto Brinkkemper, RCE).

Rode names are concentrated in the south, especially on the loess-soil plateaus. In the Roman period, intensive agricultural exploitation caused extensive deforestation in this region (Meures-Balke and Kalis, 2005; Van Haaster, 2018), but reforestation set in following a significant population decrease at the start of the early medieval period (Groenewoudt and Spek, 2016; Theuws, 2011). During the later Middle Ages, this secondary forest—often associated with (comparatively late) *bos* names—was re-reclaimed, probably in the context of the rapid population growth in this formerly 'empty' area (Pierik et al., 2018; Spek 2004).

As was pointed out earlier, woodland-related place names indicate where former woodland has disappeared between *c.* AD 750 and 1350, especially in areas where these place names are clustering. The distribution of woodland-related place names (period 1) is more or less a negative image of that of woodland in the Netherlands today (Compendium Leefomgeving, 2020) (Figure 9). This is easily explained: most of today's forests were planted in the 19th century on thinly populated, severely degraded 'waste land'.

Despite the discrepancies between the data sets, a comparison of the indicative distribution maps for periods 1 and 2 nonetheless gives the impression that they also reflect the process of deforestation. 'Early' woodland is much more common than 'late' woodland, as is particularly obvious in the south (Noord-Brabant), where the distribution map for period 2 is a mere shadow of the situation represented by the period 1 map. Nevertheless, some fragments of woodland still remained in the south, unlike the situation elsewhere in the Netherlands, for instance in the west.

In the central Netherlands, clusters of historical woodland references (period 2) and of ancient woodland both occur, but clusters of woodland-related place names are lacking in this area. Such names in fact do exist, but the area's low settlement density probably explains this noticeable absence of clustering. The same phenomenon was observed in the north (province of Drenthe), which also has a relatively low settlement density.

8.2. METHODOLOGICAL REFLECTION

8.2.1. Periods 1 and 2

The absence of forest indications resulting in voids on the two period maps can mean two things, namely that most of the forest had already disappeared or that it was never there. The former is to be expected in areas with a long history of settlement and agricultural use, the latter in raised bogs. To make this distinction, contextual information is required that provides insight into regional differences in settlement dynamics and reclamation history. Differences in settlement density can cause bias as well. Areas with a relatively low (medieval) settlement

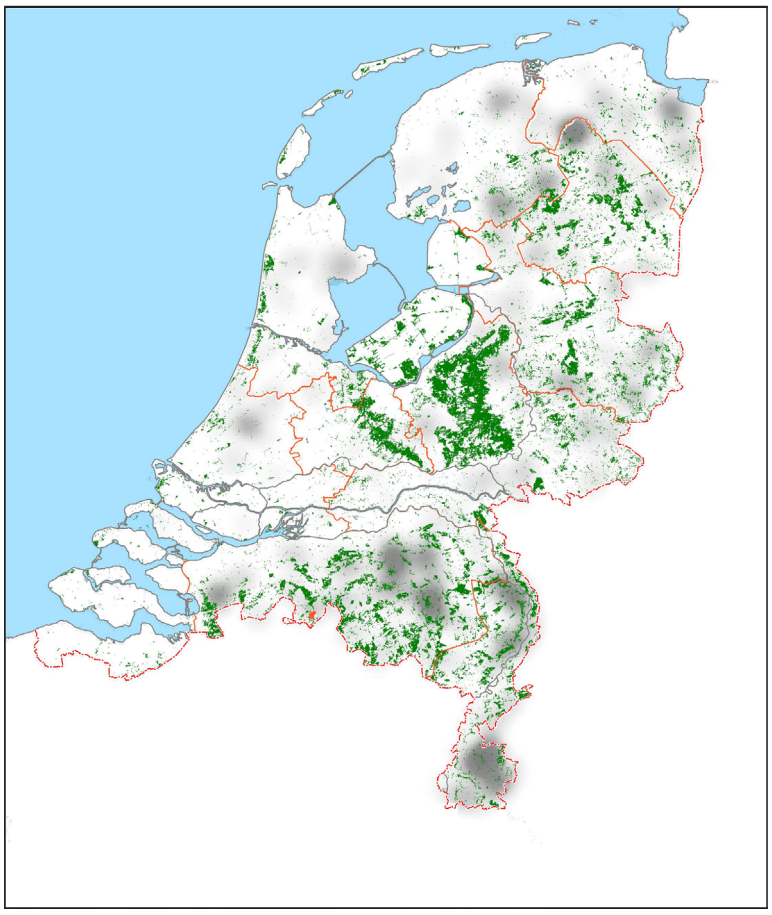

Figure 9 The distribution of woodland-related place names (indicative distribution map period 1: AD 750–1350) differs fundamentally from that of modern woodland (green).

density may well have been forested, without this being apparent from the distribution (clustering) of woodland-related place names. Comparison with other sources of information offers the possibility of verification.

An analysis based on big data sets to reconstruct overall spatiotemporal patterns does not require a level of accuracy down to the smallest detail. As was mentioned earlier, a small error margin does not affect the outcome and is therefore acceptable (Van Lanen, 2017). This applies equally to the core data used in this study. However, that observation does not remove the need to critically examine the methods by which the distribution maps were generated and validated. First, we will discuss the reconstructed distribution maps.

That the list of woodland-related place names on which the period 1 map (AD 750–1350) was based is incomplete is beyond question. Woodland-related names can change to the extent that they are no longer recognizable as such. However, identification of all these 'hidden' woodland names would require a detailed analysis of all Dutch place names from their earliest occurrence, as well as their different spellings. This would be a highly time-consuming undertaking, and one well beyond the scope of the present study. Moreover, it is highly likely that on occasion, modern place names do not reflect former woodland that once existed there (see Section 7.4), or that woodland-related names are spaced too far apart for our methods to be able to identify the underlying connection. Furthermore, the distribution of woodland-related place names is likely to be biased to some extent as a result of socio-cultural and chronological variation in the emergence and survival of both woodland-related place names and historical woodland references.

This complex theme was also left out of the study, all the more because translating it spatially did not seem possible.

As was mentioned earlier, in our analysis of historical woodland references (period 2: AD 1250–1650), we aimed for an even spatial distribution of the selected sources. However, those primary sources themselves were almost certainly not representative. To what extent the presence of woodland was actually recorded undoubtedly varied on a regional scale, as did the preservation of the documents containing those. Other relevant factors in the establishment of new settlements (and woodland-related place names) in recently deforested areas were the landscape, population density, and (during the feudal late medieval period) the willingness of local landlords to stimulate new settlements. Whether or not the name of a new settlement referred to the former woodland, it stood on maybe yet another variable. With regard to landscape conditions, the modelled map for period 1 is probably more reliable for the higher settlement grounds than for marshy low-lying areas (which in part first became suitable for settlement after *c.* AD 1350). One observation that seems to confirm this is the fact that a cluster in the south on the modelled map for period 2 (AD 1250–1650: historical woodland references) is far less distinct on the map for period 1 (AD: 750–1350: woodland-related place names). The possibility that the period 2 cluster largely consists of 'new' woodland can safely be ruled out.

Not all woodland areas referred to by place names and historical sources were of equal size. During the early Middle Ages, cultivated areas alternated with vast stretches of wilderness. A 'woodland' name may therefore refer to a comparatively small forest but also to an extensive woodland area. This complicates the reconstruction of the variation in woodland cover. However, clusters of historical woodland indicators likely point to forestation on a relatively large scale.

A final critical note concerns the selection of place-name elements referring to woodland. Names containing the element *broek* (roughly carr) were excluded (Section 4.1). Yet during our research, it became clear that quit a few areas with *broek* names were still wooded in the late Middle Ages, so mapping these names might have had added value. In this study, *wold* is considered indicative of medieval woodland, but it turned out to be uncertain to what extent this is correct (Section 4.2.2). Temporal and regional variability is to be expected.

8.2.2. Validation methods

A spatial discrepancy between the reconstructed period maps and the data used to validate them can mean two different things:

a) The period map is incorrect, or was interpreted incorrectly
b) The validation method was unsuitable

Field names

The results of the field name-based validation of the reconstructed density variation in the occurrence of woodland-related place names and historically known forests are ambiguous in that both (weak) correspondences and contradictions were observed. There are several possible explanations. The selected inventories (as well as others) of (sub)recent field names mostly comprise names of individual plots (Ter Laak, 2007) and occasionally also of farms. Many of those names are probably post-medieval, because much common land was first enclosed after the Middle Ages, albeit with significant local variations. Moreover, it turns out that field names may change rapidly, but this was not everywhere the case. In field-name region 3, 37% of all field names recorded before AD 1363 had disappeared again before *c.* 1500 (Buiks, 1997). In field name region 1, only 40% of the field names that were in use in AD 1640

survive to the present day (Spring in 't Veld, 2010). Finally, especially younger plot names can refer to recently planted forest, and these should therefore be excluded from the inventory.

In test region 3, the lack of methodical uniformity in field name studies adds yet another dimension to the puzzle. With hindsight, this data set of late medieval names does not lend itself to a comparison with the on average younger data sets of test regions 1 and 2. In addition, only landscape names were registered in test region 3, which may have led to an over-representation of woodland-related names.

All this raises considerable doubt whether field name inventories, or at least those available at present, are a proper instrument for obtaining a reliable overall impression of the distribution of woodland in the Middle Ages. In theory, medieval field names (which many of those listed in the inventories are not) are more suitable.

Historical maps

Historical maps may show too much woodland (i.e. former woodland that actually no longer existed) or too little (i.e. the map is incomplete). Both issues probably apply to the set of maps used for this study and produced around AD 1600. It is certain that most woodland had already disappeared by the time the first maps were made. This explains the generally weak spatial correspondence with period Map 1. The single exception, in the north, may perhaps be explained by the fact that here, the reclamation of extensive *wold* areas coincided with the establishment of many new settlements, leaving hardly any woodland worth mentioning. In our opinion, the fairly close match between the woodland distribution pattern on the maps and period Map 2 supports the accuracy of the latter.

Archaeological indications for charcoal production

The partial overlap of the distribution of medieval charcoal production sites and the modelled pattern of woodland clusters seems to confirm the accuracy of the two reconstructed period maps, although it is important to keep in mind that the number of reliably dated charcoal production sites is still limited. Although the overall distribution pattern of these sites is probably accurate, it is likely that regional differentiation is still obscured.

Ancient woodland

Although the fact that ancient woodland demonstrably existed around AD 1850 does not automatically imply its existence since at least the late medieval period, it is likely that this is the case. Very little woodland was planted or spontaneously regenerated in the Netherlands between *c.* 1500 and 1850. A fairly strong spatial correlation between the distribution of ancient woodland and historical woodland references before AD 1700 point in the same direction. It should be noted that the overview of ancient woodlands used (Figure 7) has proved incomplete, especially as far as eastern Overijssel and Drenthe are concerned.

Ancient woodland indicator plants

Whether or not ancient woodland indicator plants were actually indicative of the centuries-long survival of woodland is debatable (see Rolstad et al., 2002, among others). Our analysis of this particular data set resulted in a limited degree of spatial correspondence with the modelled distribution maps for periods 1 and 2, and also with that of ancient woodland. Ancient woodland indicator plants are also fairly numerous in places where woodland is known to have disappeared early on (e.g. the coastal dunes and areas in the north). This suggests that this source of information is of limited value to a reconstruction of the presence of woodland during the late medieval period, unless the plant species in question somehow managed to survive there for a very long time (but apparently not elsewhere) in refuges such as hedgerows.

9. CONCLUSIONS

1. Pre-1500 place names in combination with historical woodland references can be used to roughly reconstruct the distribution of woodland and of historical woodland types in the late medieval period. However, due to socio-cultural and chronological variation in the emergence and survival of both woodland-related place names and historical woodland references, such reconstructions are likely biased to some extent. Testing by using other (proxy) data, for instance on charcoal production, can make reconstructions more reliable.
2. To be able to conduct a study as described in this article within a short period of time, the availability of existing inventories and digital data sets is required.
3. Despite the cautionary remark under conclusion (1), it seems that considerable regional differences existed with regard to the distribution of woodland in general and in particular specific historical woodland types.
4. The best match between the resulting spatial reconstructions and the various sources used to validate them was observed for the most recent reconstruction (AD 1250–1650), which was based on historical woodland references.
5. The earlier of the two indicative distribution maps is mostly a reflection of places where woodland disappeared between AD 750 and 1350, whereas the later map (AD 1250–1650) shows where woodland still existed.

6. Marshy, low-lying areas are probably under-represented on the reconstructed map based on woodland-related place names (period 1).
7. Validation on the basis of other sources (historical maps from *c.* 1600, historical charcoal production sites, the distribution of ancient woodland [woodland present by AD 1850]) partially confirms the reconstructed regional variation in the degree of forest cover. More generally, validation with as many different kinds of data as possible is crucial for the reliability of woodland cover reconstructions. The more recent the period, the easier it is to find alternative sources to verify.
8. In general, in our research area, field names (micro-toponyms) proved to be too recent to be useful, at least on the level of individual plots, and the indicative value of ancient woodland indicator plants in this respect seems equally doubtful.
9. The location of most woodland existing in the Netherlands today seems to be different than that of (late) medieval woodland. This observation, especially when considering the long-term spatial dynamism of earlier woodland, leaves more room for creativity with regard to the localization and creation of new woodland. After all, woodland has appeared and disappeared almost everywhere at some point in time.
10. Even general reconstructions of the historical distribution of woodland (and of specific historical woodland types) can be used as input for decision-making regarding reforestation.

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COMPETING INTERESTS

The authors have no competing interests to declare.

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