Moving through a vision: thoughts on contextual GIS

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Abstract: This paper concentrates on the ways in which material culture can inform archaeologists about social practices associated with travel, consumption practices and the perception of space and place within the landscape through the use of geographic information systems (GIS). Focus on social applications to GIS and landscape had previously, and successfully, concentrated on monumental archaeology, addressing their visibility in the landscape and the ways in which their architecture structured movement around them. These studies have been very important to the understanding of elite power structures. However, this paper brings this dialogue to the most ubiquitous artifact on Anglo-Scandinavian sites, pottery, to investigate how its production and consumption structured social practice and understandings of space and place within the landscape.
This paper represents a continuation of the paper I gave at the Dublin conference which was an interim report on my doctoral work. This paper discusses both the material presented at the conference and the developments which occurred subsequently.
Keywords: GIS, landscape archaeology, pottery, Anglo-Scandinavian.

1 Introduction

I have divided the paper into four sections. In the first and second, I explore the theoretical concepts behind developing contextual geographic information systems (GIS) and the difficulties inherent in designing and implementing GIS to reflect cultural and contextual constructs. This is specifically in regard to my thesis topic which investigated landscape and social practice in tenth century Lincolnshire through examining pottery distributions (Symonds 2003) (Fig. 1). The third section reviews the information and developments explored within the Dublin 1999 conference, specifically my investigations using vector analysis to approach travel. The fourth section discusses the subsequent advances from the vector analysis towards mapping time-space geographies.

2 The Project ...

My doctoral thesis focused on developing innovative approaches to landscape archaeology through the study of material culture, specifically pottery. It investigated the tenth century landscape of Anglo-Scandinavian Lincolnshire, integrating social attitudes towards landscape with artifact studies through the use of computer applications, specifically GIS and statistics (Symonds 1999; Symonds and Ling 2002; Symonds 2003). I concentrated on the ways in which material culture informs archaeologists about social practices associated with travel, boundary structures, consumption practices and the perception of space and place within the landscape. Focus on social applications to GIS and landscape had previously, and successfully, concentrated on monumental archaeology, addressing their visibility in the landscape and the ways in which their architecture structured movement around them.

structured movement around them. These studies have been very important to the understanding of elite power structures. However, I was interested in bringing this dialogue to the most ubiquitous artifact on Anglo-Scandinavian sites, pottery, to investigate how its production and consumption structured social practice and understandings of space and place within the landscape.

The project focused on tenth century Lincolnshire, firstly, because the pottery data collection occurring in that county under the auspices of the East Midlands Pottery Project (EMPP) (Vince and Young 1991) was one of the most thorough in the country and had the highest consistent standard of data collection available at the time. While the funding needed to calculate estimated vessel equivalencies (EVE's) for the pottery throughout Lincolnshire was not forthcoming for the EMPP, the pottery data was organised into maximum vessel quantities, a significant improvement over the sherd counts which are prevalent in many post-excavation reports. The EMPP fabric analysis is also superb, enabling detailed investigation into pottery production and distribution practices (Symonds 2003: 118-122).

Secondly, Lincolnshire was an area in which there was heavy Scandinavian immigration during the mid-ninth and tenth centuries. This significantly influenced settlement practices, stimulating urban development (Vince 1994: 115). The re-emergence of urbanism in East Midlands is clearly seen in the sudden shift of pottery production practices and *locales*, with the influx of Continental potters into the nascent towns on the wave of the Scandinavian invasions. At this time, pottery production shifts dramatically from the rural regional hand-made wares to urban-based wheel-thrown hard-fired pottery with permanent kiln structures. This has important archaeological repercussions as it allows detailed pottery analysis which is able to identify specific
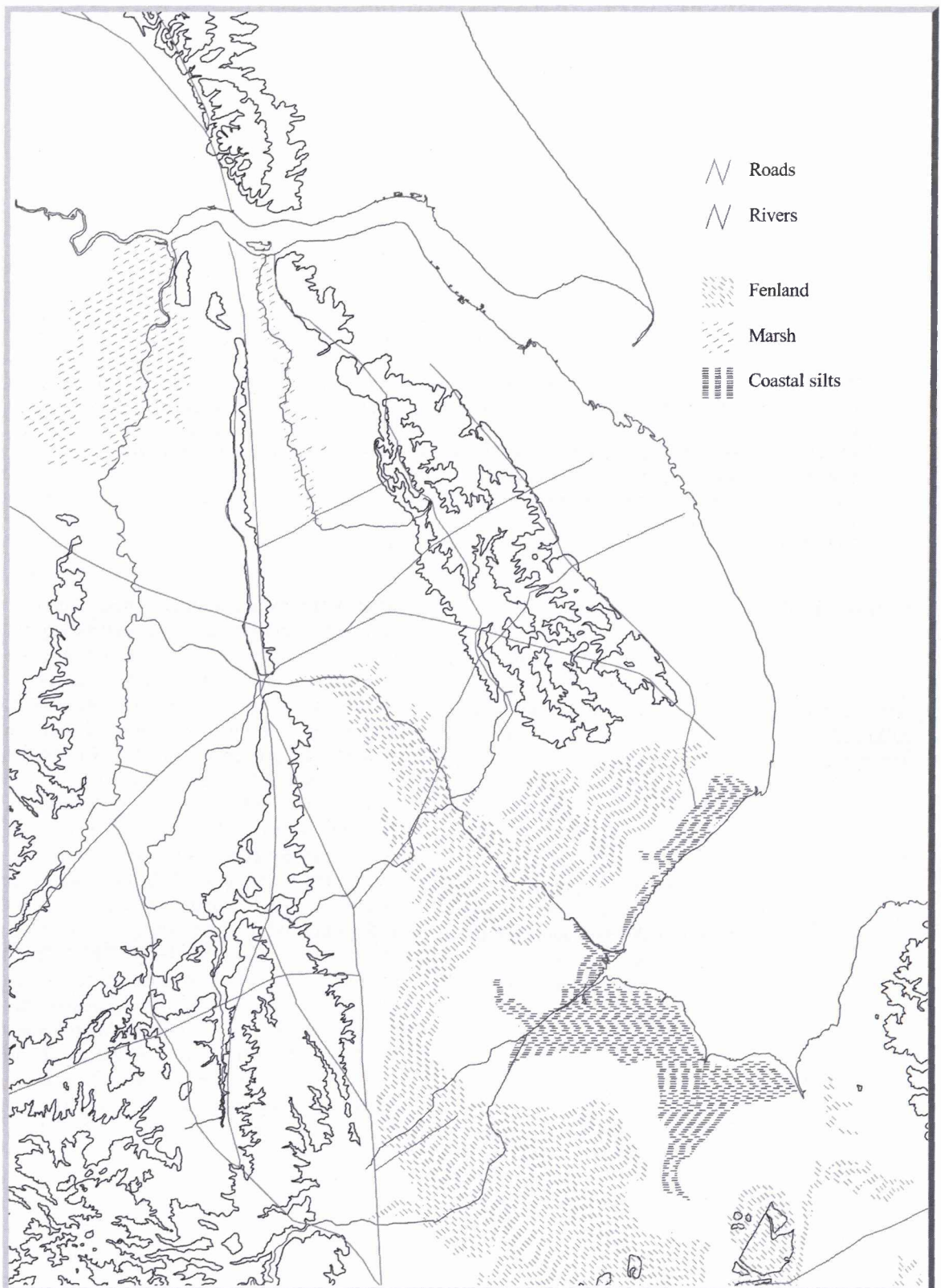
Topography of Lincolnshire

Fenland and Coastal silts derived from Coles and Hall 1998

Marsh rendered from Barley 1971

Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 1999

Legend:
- Roads
- Rivers
- Fenland
- Marsh
- Coastal silts

0 ▬▬▬▬▬ 50 km

Figure 1

kiln products. Indeed, the pottery fabric sequences in Lincolnshire were associated, where possible, with particular kilns, allowing comparison of production practices between towns and regions.

Finally, Lincolnshire has traditionally been thought to have comprised two separate regions, Lindsay to the north and 'Stamfordshire' to the south, which were joined during the eleventh century into the present county (Fig. 2). This argument has been fueled by:

1. the recognition of the territory of Lindsey in earlier documentation
2. the organisation of the shires during the eleventh century around a town or borough listed in tenth century documents, the exception being Lincolnshire which includes two of these boroughs (Lincoln and Stamford) rather than one.

Lincolnshire offered the possibility of exploring the articulation of the territories of Lindsay and 'Stamfordshire' during the Anglo-Scandinavian period through the distribution of pottery (Symonds 2003: 209-220).

3 ... and the Vision

During the 1990s there was a large debate in archaeological GIS circles about whether GIS was inherently environmentally deterministic or whether it could be used to investigate social practices within the landscape (Gaffney and van Leusen 1995). Gary Lock's compilation *Beyond the Map* (Lock 2000) was surely a response to the wide acceptance of the use of GIS and social theory. Adherents of social theory and GIS have successfully used GIS to study monumentalism within the landscape (Llobera 1996; Wheatley 1993, 1995). Indeed, monuments, due to their prominence within the landscape, cry out for intervisibility projects and studies which emphasize movement towards and around the monuments. I was interested in taking this one step further, to explore the combination of GIS, ariefacts and social space. The grass-roots nature of Anglo-Scandinavian pottery (being a low status but ubiquitous item) was ideal for this project, providing a polar balance for the high status monument studies.

The focus of the discussion in this paper deals with investigating mobility in the landscape. It explores the way in which human movement across the landscape participates in the construction of place and territory. Indeed, the places to which people travel and the agencies and actions associated with that travel, contribute to how a place is identified within the landscape. Similarly, the orientation of travel, the directions in which people most often move in the landscape, are often associated with territory. For example, travel within a territory is encouraged through such restrictions as border crossings and tolls which hinder movement across territorial boundaries, which in turn, strengthens the social recognition of territory and the social identities associated with it. Travel, the act of moving through the landscape, participates in the social construction of place and territory.

A primary aim of the thesis project was to explore ways of analysing and representing the social cognition of place and landscape associated with the trade and use of pottery. The most difficult aspect of achieving this aim was using analytical techniques, the traditional arsenal of the 'processual archaeologist', in what was ostensibly a 'post-processual' topic. The use of GIS, associated at the time with environmentally deterministic studies, further compounded the problem. As Llobera asserts "an archaeological study which incorporates environmental information is not condemned to determinism (or *vice versa*). Determinism is the product of our interpretation as reflected through the way we use our information" (1996: 613). Similarly, the use of empirical data within research does not itself denote empiricism, a concept clearly iterated by well-known adherents of social theory (Bourdieu 1990; Bradley 1998, 2000; Ingold 1993).

This resulted in the exploration of ways in which to warp a traditional map of distribution points so that it represented social cognition within the landscape, highlighting issues of territoriality, place and movement. The following sections deal with two approaches used to investigate the cognitive issues associated with travel. The first reiterates the use of network analysis to assess and represent frequency and direction of travel associated with the pottery trade as discussed at the 1998 Barcelona conference (Symonds 1999) and the 1999 Dublin conference. The second section explores a different way of expressing social cognition of place and space in the landscape which is less dependant on topographical cartographic representations.

4 Sticks and Stacks

One of the difficulties with a traditional distribution map is that the places of consumption are highlighted at the expense !!!!! the travel which participated in structuring the identity of those places. In order to explore travel practices (associated with the trade and consumption of pottery), it was imperative to represent movement. Navigable rivers and Roman roads were analysed in association with the Anglo-Scandinavian pottery distributions (Figs. 3 and 4). The exploration of the use of Roman roads and navigable rivers during the Anglo-Scandinavian period did not preclude the use of other less visible paths. Indeed, the only routes available to study were the Roman roads and navigable rivers due to the lack of evidence for local and less permanent routeways. The bane of archaeologists is ever that they must theorize based on admittedly fragmentary evidence. Thus, the project was interested in how closely the pottery trade was associated with the Roman roads and navigable rivers and how movement along these routes structured social practice within the landscape.

It is difficult to assess navigability during the early medieval period due to the lack of written records, especially in areas of Scandinavian settlement such as
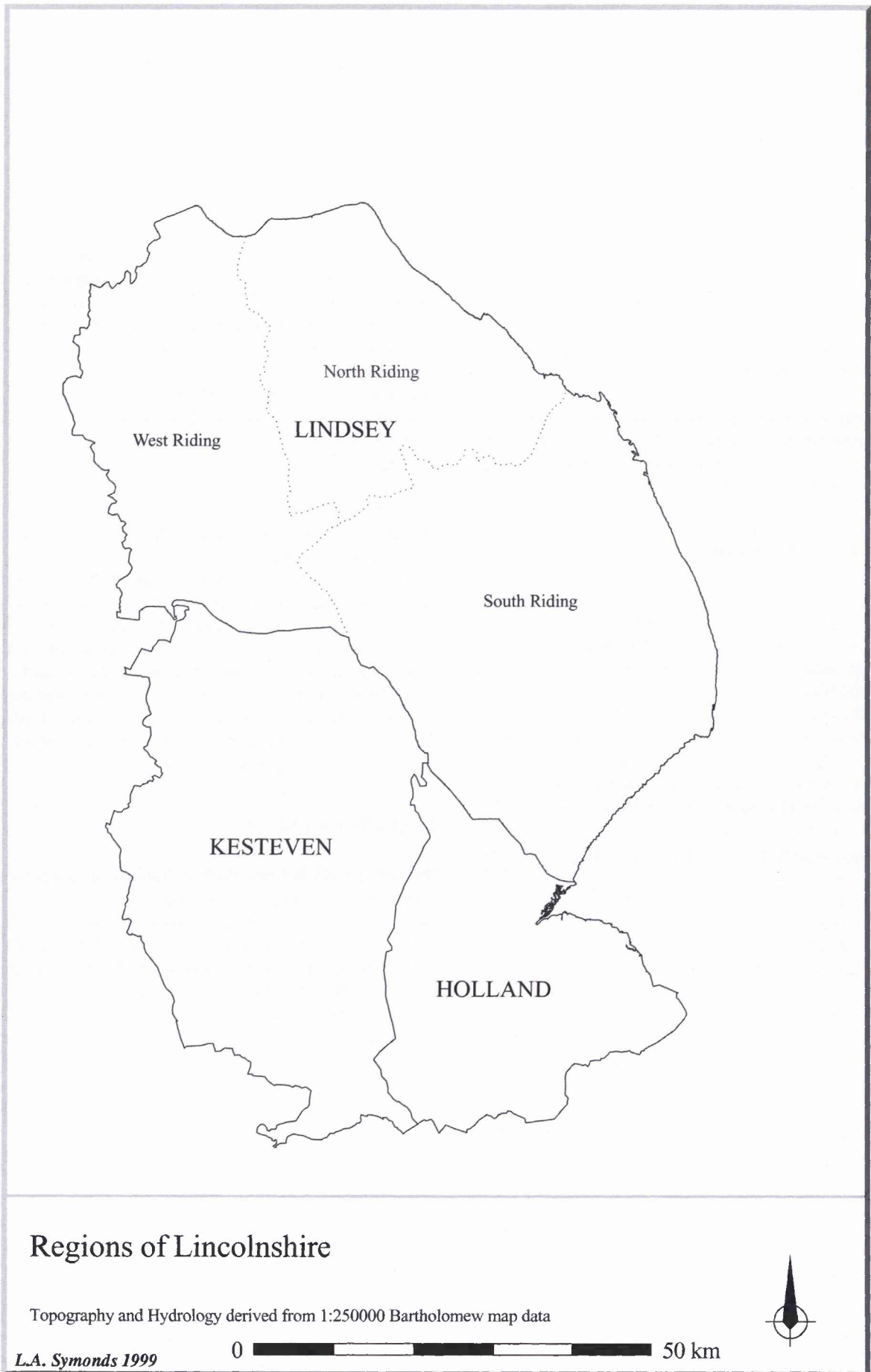
North Riding

West Riding

LINDSEY

South Riding

KESTEVEN

HOLLAND

Regions of Lincolnshire

Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 1999

0 ▬▬▬▬▬▬▬▬▬ 50 km

Figure 2

Roman Roads of Lincolnshire

Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 1999

0 50 km

Figure 3

Lincolnshire Rivers

R. Trent

R. Ancholme

Fosse Dyke

R. Witham

R. Bain

R. Slea

R. Glen

R. Welland

Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 1999

0   50 km

Figure 4

Lincolnshire. Therefore, the extents of navigation during the medieval period presented by Edwards and Hindle (1991) were accepted as the closest approximation of navigability available (Fig. 5). The Roman road network was compiled from Margary (1973) and Vince (in Sawyer 1998: 17).

One of the ways to examine the interaction of route-ways and places in the landscape is to measure the frequency of travel along these routes. This is not designed to illustrate the actual usage of route-ways but, instead, to demonstrate the direction and frequency of travel. Indeed, it would be impossible to directly associate the trade of pottery with specific routes. Nor is this the aim of the analysis. Instead, this technique is used to further address the broader trends of travel in the landscape and to explore how these travel practices structured social perception and understanding of landscape and settlement.

In order to evaluate the interaction of road and river, sites had to be selected on the strength of their relationship to the roads and rivers and then joined onto the road and river systems. It was estimated that sites within five kilometres, or one hour's walk, should be considered proximal to the network of roads and/or rivers. The distances of the Anglo-Scandinavian pottery sites to the rivers and roads were graphed against the entire EMPP post-Roman pottery database to give an idea of how this concept of proximity was reflected in the data. 25% of the Anglo-Scandinavian sites were within five kilometres of a river, whereas 57% of the entire post-Roman EMPP sites were within the same distance (Fig. 6). This contrasts with the road data where 80% of Anglo-Scandinavian sites were within five kilometres of a road, as opposed to 67% of the EMPP sites (Fig. 7). This suggests that overall, roads were more accessible to the Lincolnshire population. However, during the Anglo-Scandinavian period, the accessibility to road travel was greater than to river travel. This implies that, during the Anglo-Scandinavian period in Lincolnshire, sites where pottery was distributed were situated to take greater advantage of the road system than the river system. A more rigorous analysis, such as a Monte Carlo simulation, would be needed to confirm this suggestion.

The amount of pottery moving along the most direct route from the place of production to the settlements where it was consumed was calculated using NETWORK applications within ARC/INFO. Each route – from the place of production to the place of consumption – was traced and recorded the same number of times as the number of vessels in its assemblage. The frequency of movement along each section of the route was then calculated and associated with that section (Symonds 1998: 284-6). This is depicted on the maps illustrating the frequency of movement associated with the Lincoln pottery trade along the rivers and roads (Figs. 8 and 9).

Two aspects of human mobility are represented on these maps. The first is based on the premise that frequent movement between two places condenses the perceive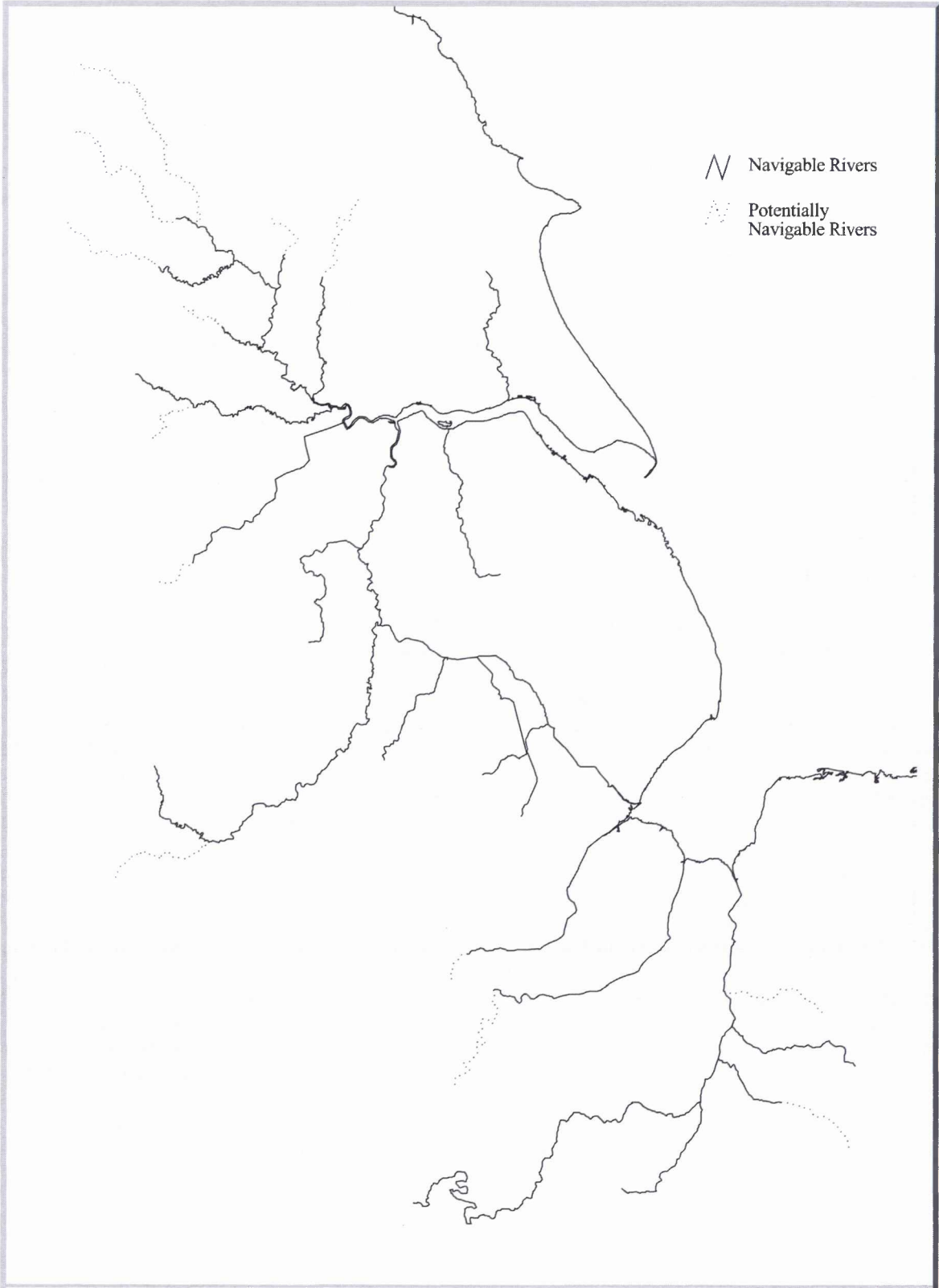d distance between them. This is displayed on the maps by a strong visual link between the place of pottery production and places of significant pottery consumption through representing the high frequency of movement between them in bold vibrant colours. The second aspect addresses communal interaction within the landscape. Due to the association of pottery production with urban development and trade, this was necessarily biased towards the relationships between towns and their connections rather than between rural settlements.

While these maps indicated a number of connections between settlements and regions (Symonds 2003: 123-161), I will highlight only one in this paper: the link between Lincoln and Torksey. It is clear from the maps that a high amount of pottery was travelling either by road or via the Fosse Dyke from Lincoln to Torksey. This is interesting in itself as Torksey was a major producer of pottery at this time and has, to date, by far the largest number of excavated kilns associated with an Anglo-Scandinavian settlement. This suggests that Torksey was an important settlement to Lincoln, most probably due to its position on the River Trent, a major thoroughfare throughout the medieval period (Foster and Longley 1924). The clear association between these settlements is further indicated in the documentary evidence which suggests that although both Lincoln and Torksey were considered important towns in the Lincolnshire Doomsday, Torksey was a satellite settlement of Lincoln rather than an important town in its own right. Torksey's dependence on Lincoln might be the reason it declined during the medieval period when the Fosse Dyke was not navigable and the bridge at Gainsborough funnelled traffic northwards.

Connections between settlements are highlighted in these maps, stressing mobility through the landscape. These maps emphasize the movement of pottery, rather than assemblage composition, enabling discussion to incorporate concepts such as community interaction and social orientation. Indeed, by focusing on the frequency of pottery travelling along the rivers and roads, rather than on location of its consumption, one is able to address the orientation of the pottery trade. These maps illustrate the social connection between sites such as Torksey and Lincoln, including the pottery trade within the wider discussion of social practices enacted in the landscape and linking it with social cognition of settlement interaction (Symonds 2003).

5 Off the Beaten Path

When I first began my doctoral thesis, I naively had a vision of a GIS which reflected a virtual reality experience within a two-dimensional space. I wanted to graphically express what such post-modern writers as Giddens (1984) and Bourdieu (1990) were able to explore in their writings. Continuing through the thesis brought with it the realisation that written and graphic media are two very different things and that while a picture might encompass a thousand words, maps are limited to at most two hundred and fifty!
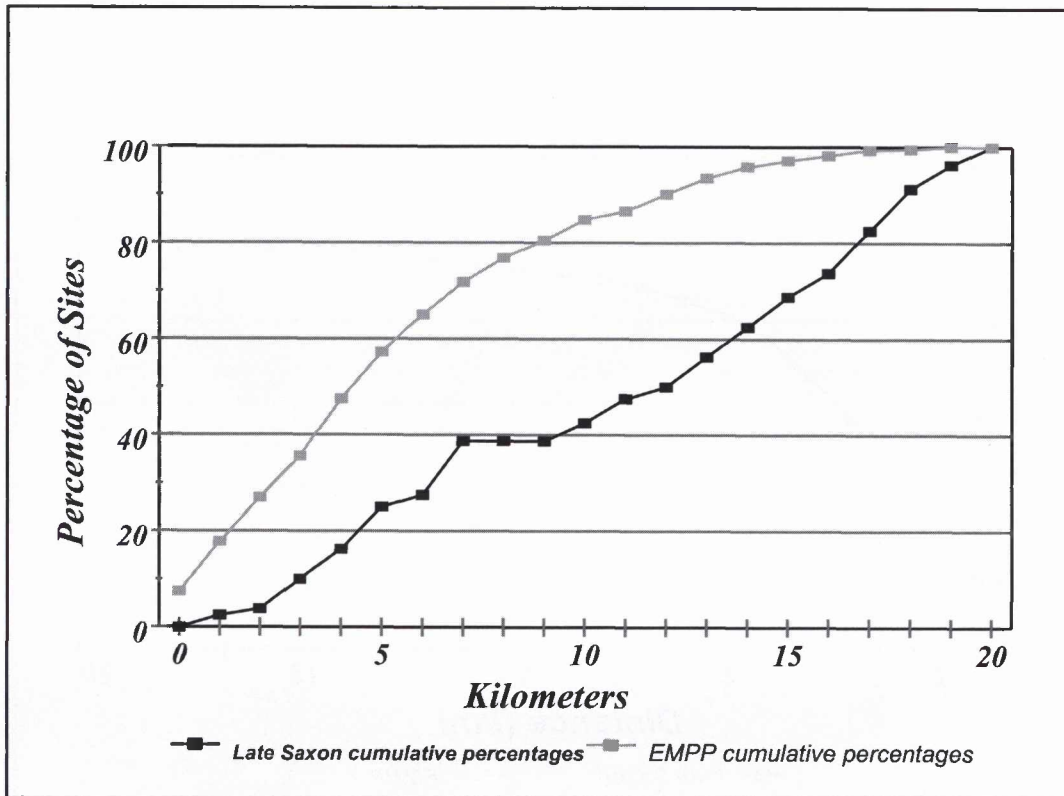
Navigable Rivers

Information derived from Edwards and Hindle 1991

Topography and Hydrology derived from 1:250000 Bartholomew map data
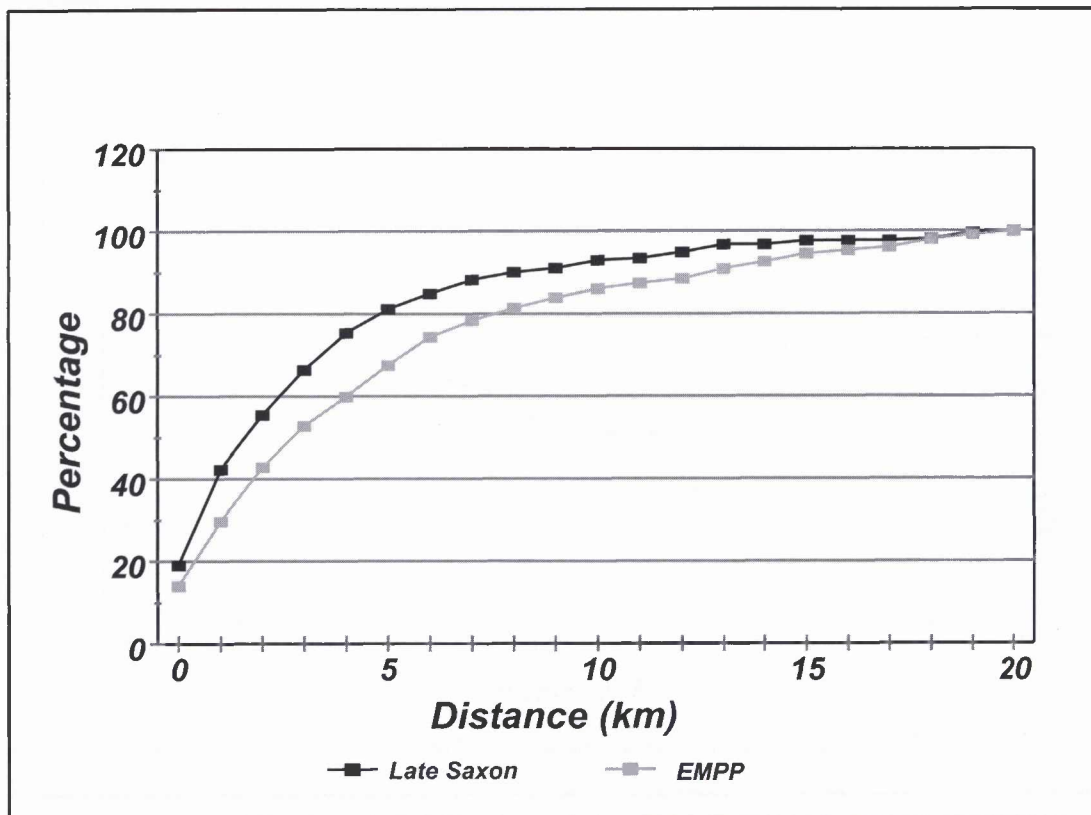
L.A. Symonds 1999

Legend:

- N — Navigable Rivers
- N — Potentially Navigable Rivers

0 ▬▬▬ 50 km

Figure 5

Proximity to Rivers

EMPP vs Late Saxon site (cumulative percentages)

L.A. Symonds 1999
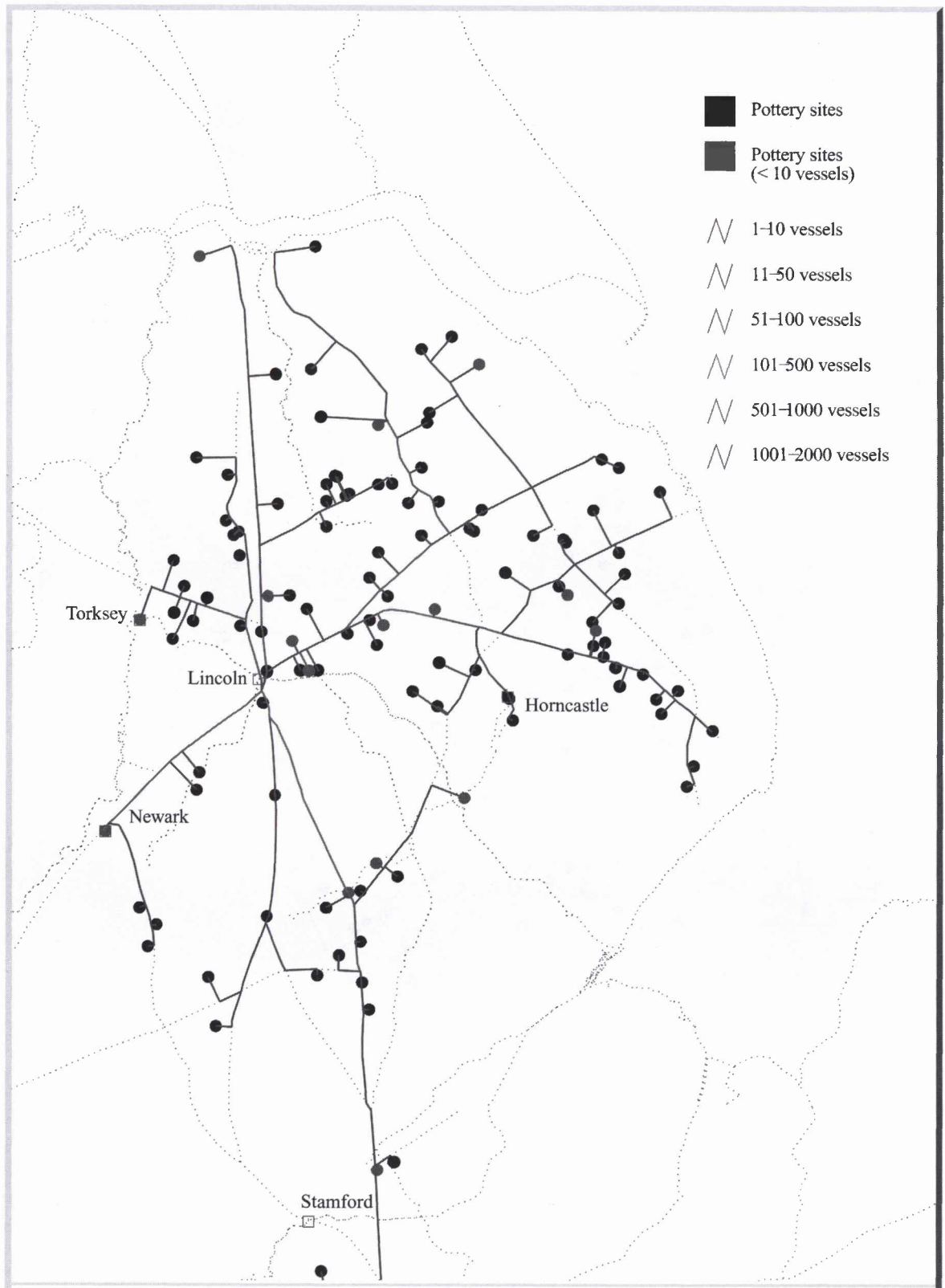
Figure 6

Proximity to Roads

EMPP vs Late Saxon site (cumulative percentages)

L.A. Symonds 1999

Figure 7

Traveling Pots: Lincoln wares

(quantities of pottery along roads)

Sites derived from Vince and Young 1991

Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 1999

0 ▮▮▮▮▮▮▮▮▮▮▮▮ 50 km

Legend:
- ■ Pottery sites
- ■ Pottery sites (< 10 vessels)
- ∧ 1–10 vessels
- ∧ 11–50 vessels
- ∧ 51–100 vessels
- ∧ 101–500 vessels
- ∧ 501–1000 vessels
- ∧ 1001–2000 vessels

Labels: Torksey, Lincoln, Newark, Horncastle, Stamford

Figure 8

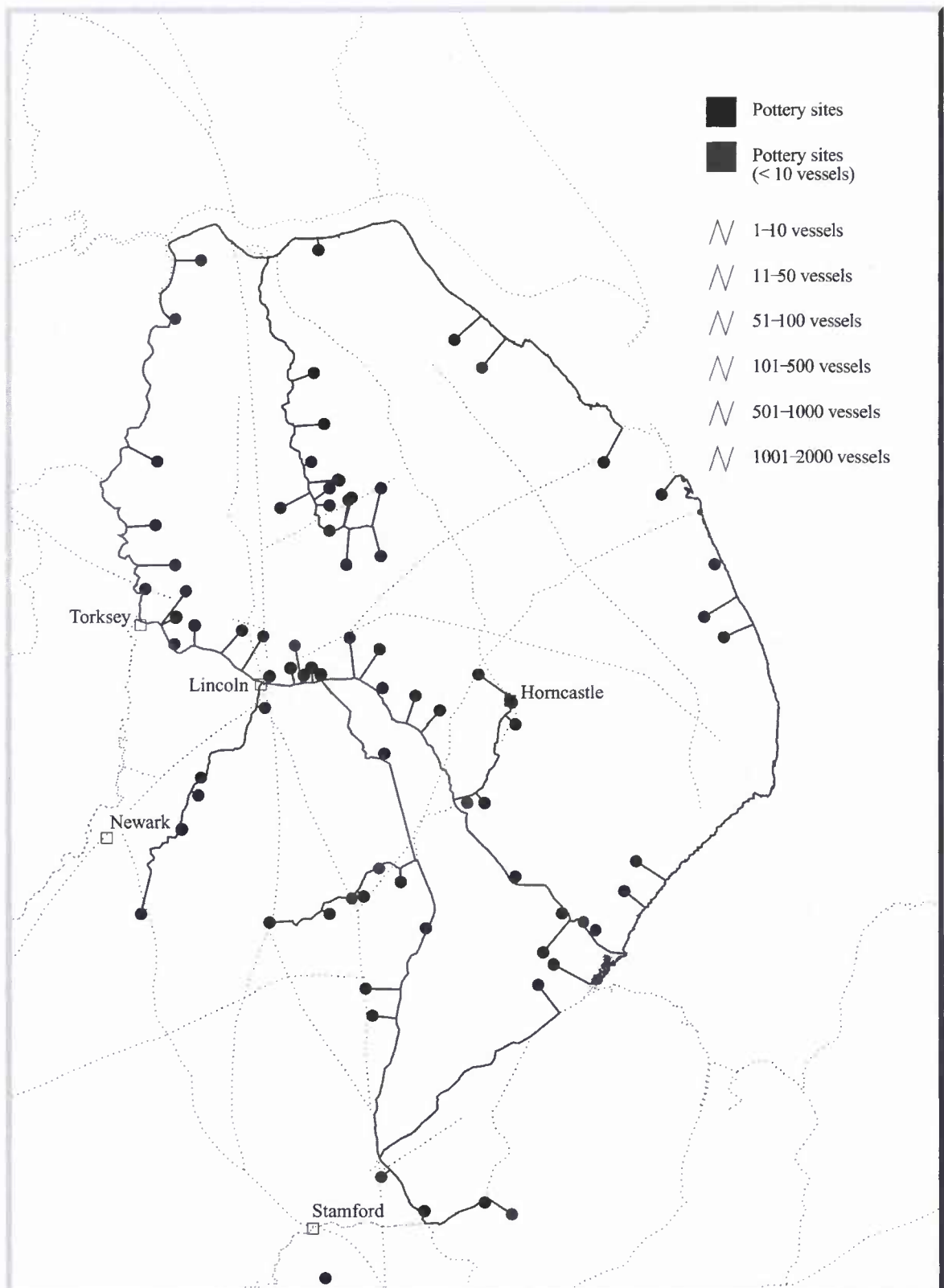# Traveling Pots: Lincoln wares

(quantities of pottery along rivers)

Sites derived from Vince and Young 1991

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L.A. Symonds 1999

Legend:
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- ⋀ 101–500 vessels
- ⋀ 501–1000 vessels
- ⋀ 1001–2000 vessels

Labelled places: Torksey, Lincoln, Newark, Horncastle, Stamford

0 ▬▬▬ 50 km

Figure 9

The use of frequency mapping (above) was valuable in terms of moving the discussion from the settlements into the landscape and to the travel practices which structured cognitive interpretations of inhabitation and identity. But it did not go far enough. It did not present a cognitive map of the landscape.

Instead, it was important to 'jump the groove', to go off the beaten path, and conceive of a map which was not directly linked to topography but rather was designed in terms of a cognitive measurement. The measurement that was chosen was time, phrased broadly in terms of a day's travel by ox-cart and boat (Symonds 2002, 2003). In this way, a cognitive map was designed which graphed the number of days settlements with large pottery assemblages were from the towns which had produced that pottery.

Oxen move at a rate of approximately two miles an hour (Langdon 1986: 162-3, 1987: 56). This is a very slow pace in comparison to horses, but it appears that oxen were preferred in earlier medieval times for their ability to pull immense loads (Langdon 1985: 49, 114). Riverine travel was more difficult to estimate due to the variations in current and tide which undoubtedly were used to the best advantage by boatmen. Furthermore, there is little documentation from which to gather a detailed understanding of

1. how long it took to travel by river as opposed to road
2. whether rivers were travelled downstream but travellers preferred to employ road travel upstream
3. what boats were routinely used, what their carrying capacities were and what their speed was.

River travel was certainly less expensive. Despite these complexities, an hourly rate of four miles an hour was used for river travel, a speed estimated from the few travel accounts available which noted the number of days a river journey took (Leighton 1972: 177; Symonds 2003: 113).

Distances between town (place of pottery production) and hinterland settlement (place of pottery consumption) along the roads and river were measured using NETWORK applications in ARC/INFO. Settlements were then mapped using the same compass angles they normally held in relationship to the towns, but the distance used was not derived from a topographic geography but instead was calculated according to the distance travelled by road and river to reach the settlements. However, measurement on the maps did not use a kilometre notation. Instead, the number of days travel was indicated by a series of concentric circles.

These circles are meant to indicate averages rather than absolutes. Experiments as to how to graph a fuzzy concept of a day's travel resulted in murky-looking maps. Therefore, the binary, but clear, circles to indicate a day's travel were used with the written caveat that the circles indicate only an approximation of the time and distance travelled using an eight hour day. Thus, the map-reader should look for clustering of sites

around various 'time zones' in order to form an understanding of the data.

Returning to the Lincoln data once again, it is clear that there is a tendency for sites with large pottery assemblages to be within a day's travel by road (Fig. 10). This is not so for the river data, which has a less clustered result (Fig. 11). Regression analysis using the same data, supports this visual analysis. Indeed, the road data pertaining to the Lincoln assemblages with more than ten pots, has an r-squared value of 0.1595 (Fig. 12), whereas the river data equals 0.0002 (Fig. 13). This suggests that road travel was more heavily influenced by distance than river travel. Certainly, the importance of a day's travel from a town is demonstrated on the map of road distances.

Furthermore, the orientation of travel towards the Lindsey coast is evident from this map. Indeed, by both rendering the distances in terms of real-world travel and removing the topographical geography from discussion, the distribution of pottery is more clearly understood. The concentration of Lincoln wares in the north suggests a cohesive territorial identity, interpreted in the thesis as the Anglian kingdom of Lindsey. The importance of the Roman road, Ermine Street, to north-south traffic is also demonstrated on the map in a line of settlements running from Lincoln directly south to the bottom of the map. Interestingly, a corresponding northern distribution along Ermine Street is not evident, although a strong distribution along the upper Trent in the map of the riverine distribution of Lincoln wares clearly demonstrates a northern route from Lincolnshire to Yorkshire. This might indicate a preference of travel along rivers northwards from Lincoln. The avoidance of the fenlands along the southeastern coast of Lincolnshire is also evident in these maps, especially in the coastal distribution on the map using river distances. Finally, a comparison of the distribution of coins (Fig. 14), manorial land values of the pottery sites (Fig. 15) and the distribution of pottery indicates 1. the regular use of Roman roads and 2. the importance of trade and transportation to manorial development. The large manorial holdings are clustered around the roads and correspond with the large pottery assemblages which are approximately a day's travel from Lincoln (Symonds 2002, 2003: 230).

The cognitive maps are clearly a significant step towards the vision outlined above. Indeed, concepts of territory, distance and inhabitation are able to be discussed through the cognitive distance maps, allowing fuzzy concepts such as a day's travel to be considered and more a discreet understanding of territorial identities to be inferred. The importance of distribution and statistical analysis has a clear place in the 'post-processual' world, especially regarding such a large region as Lincolnshire. Cognitive approaches might be more apparent in projects with smaller *locales* and those which incorporate architecture and intervisibility analyses. However, the vision of cognitive distribution analysis is clearly within our reach.
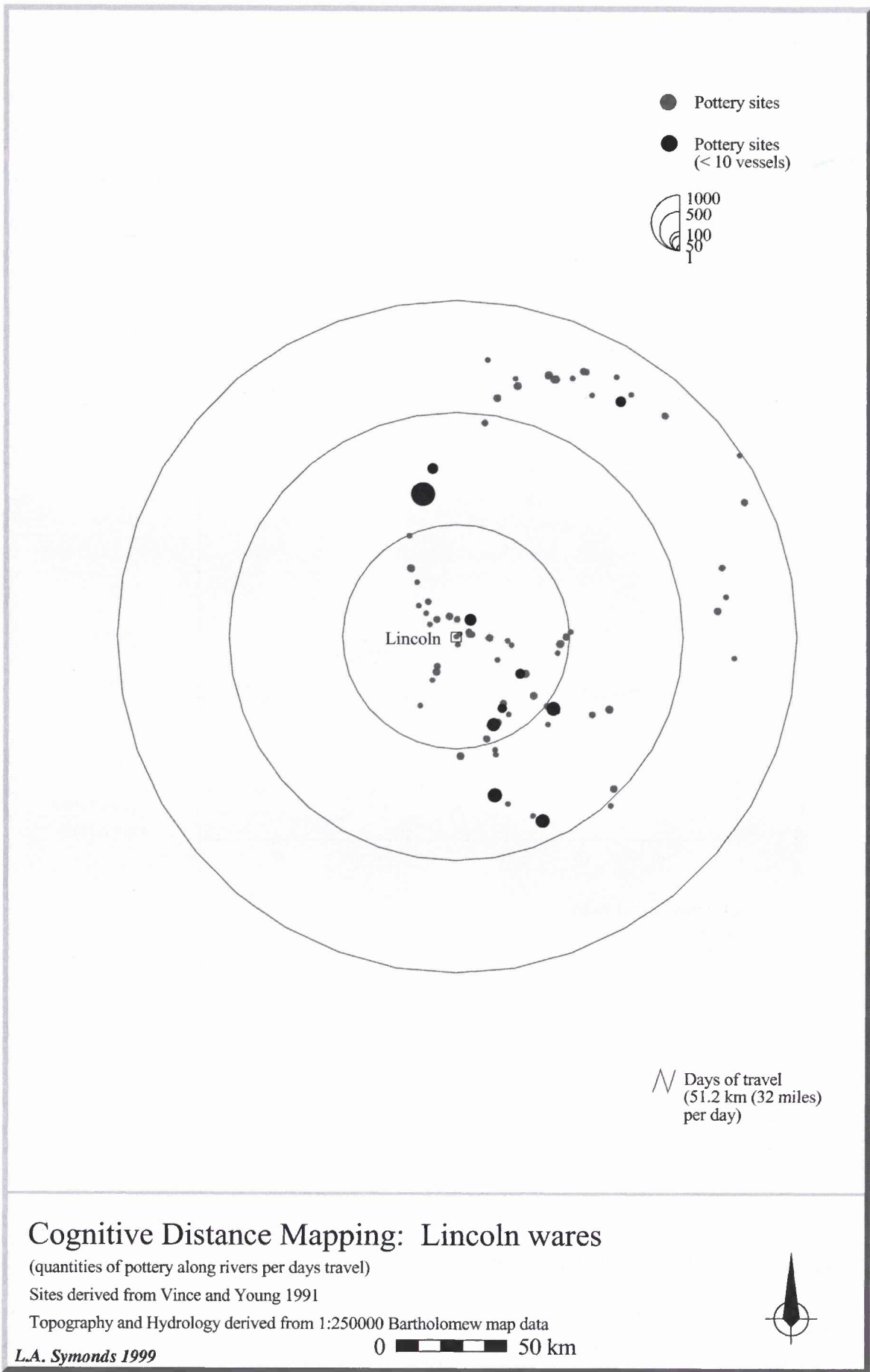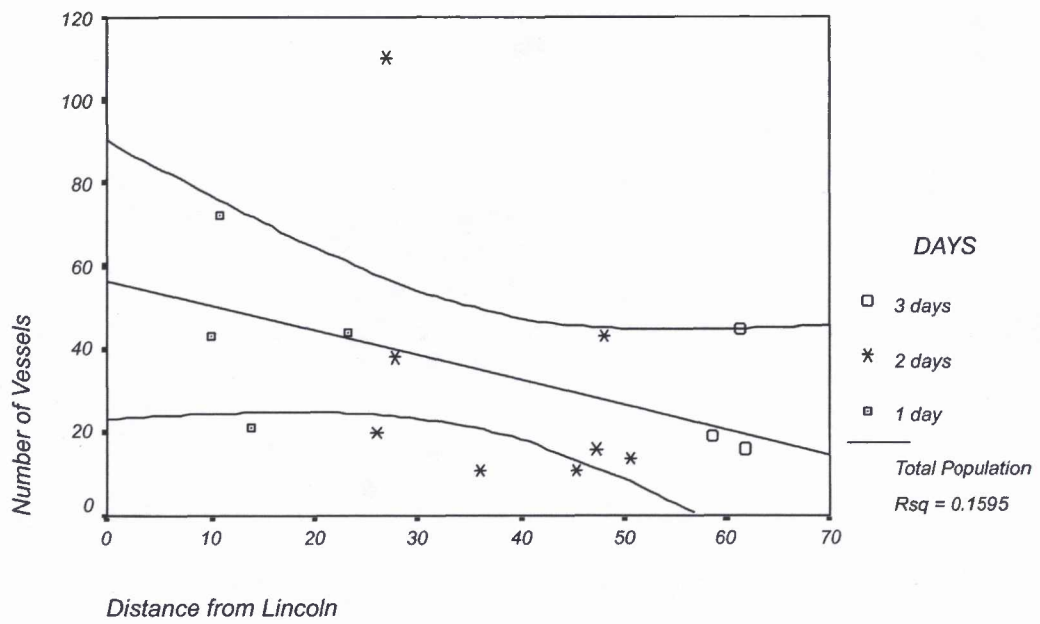
Pottery sites

Pottery sites
(< 10 vessels)

1000
500
100
50
1

Lincoln □

N Days of travel
(25.6 km (16 miles)
per day)

Cognitive Distance Mapping: Lincoln wares

(quantities of pottery along roads per days travel)

Sites derived from Vince and Young 1991

Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 1999

0 ▆▆▆▆▆▆ 50 km

Figure 10

Cognitive Distance Mapping: Lincoln wares

(quantities of pottery along rivers per days travel)

Sites derived from Vince and Young 1991

Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 1999
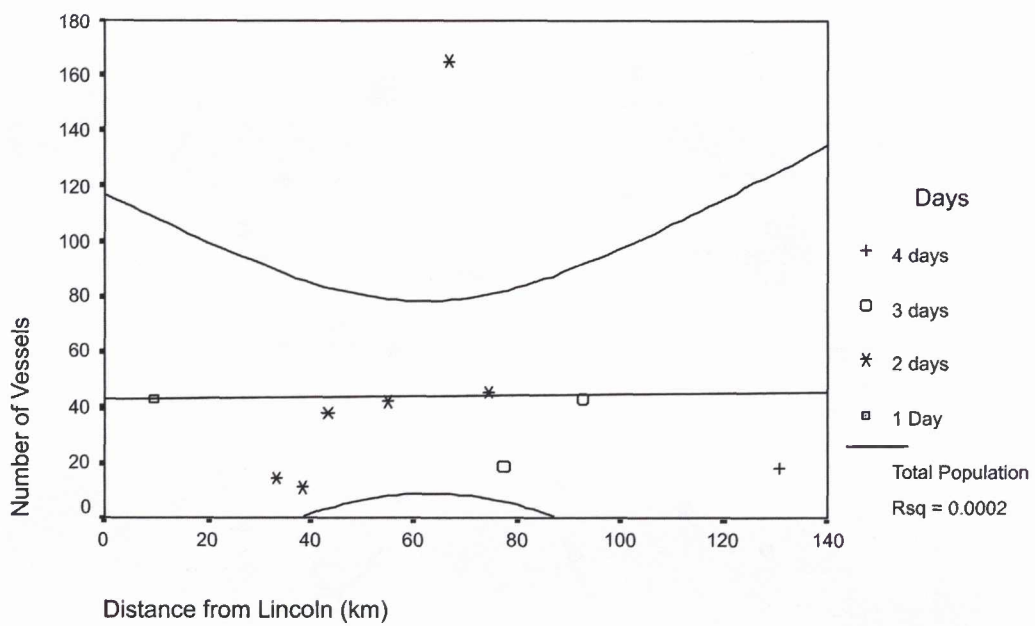
0 ▦▦▦▦▦ 50 km

Figure 11

Regression of Lincoln wares

Road distances
Sites with more than 10 vessels

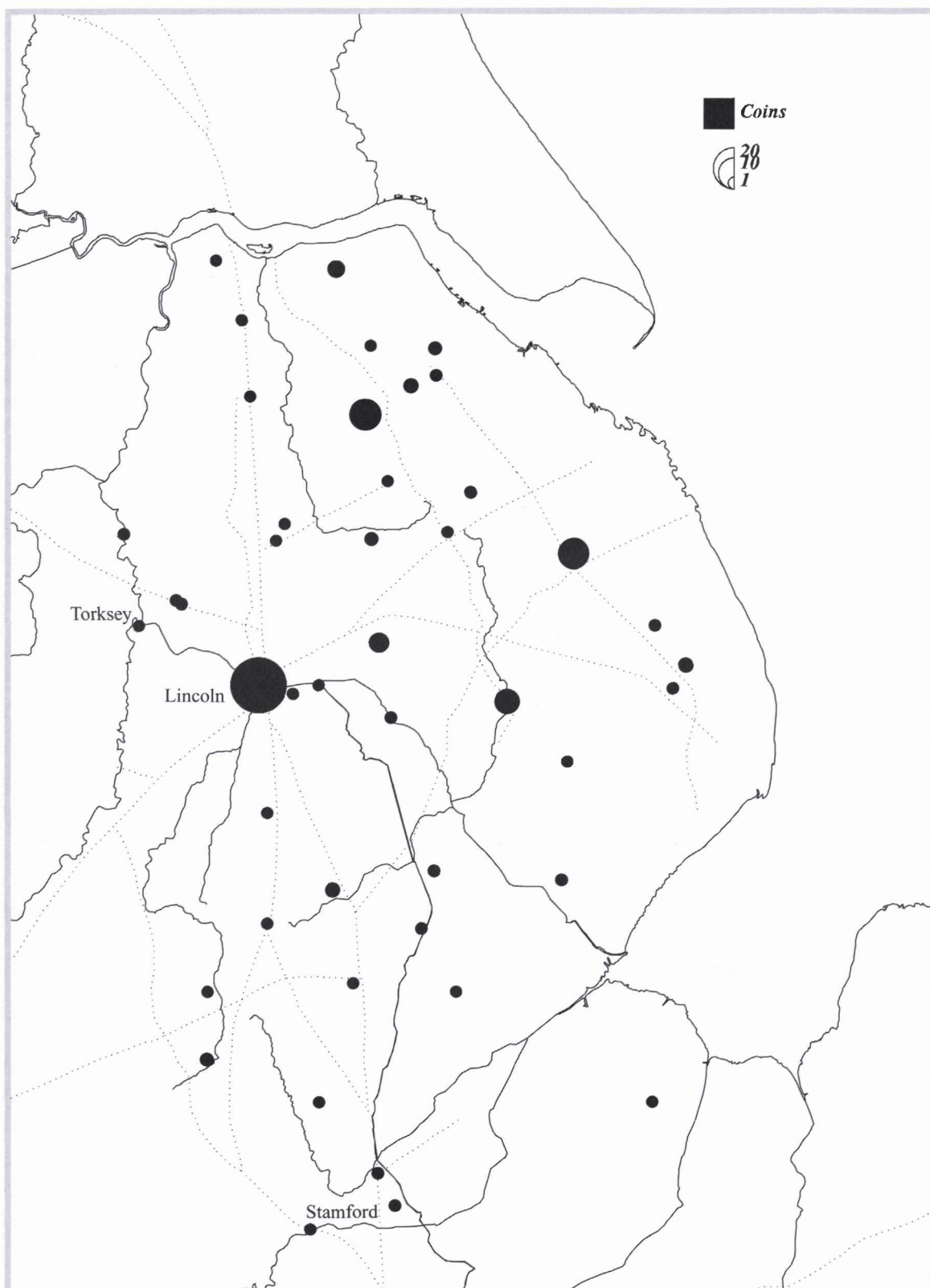**L.A. Symonds 1999**

Figure 12

Regression of Lincoln wares

River distances
Sites with more than 10 vessels

L.A. Symonds 1999

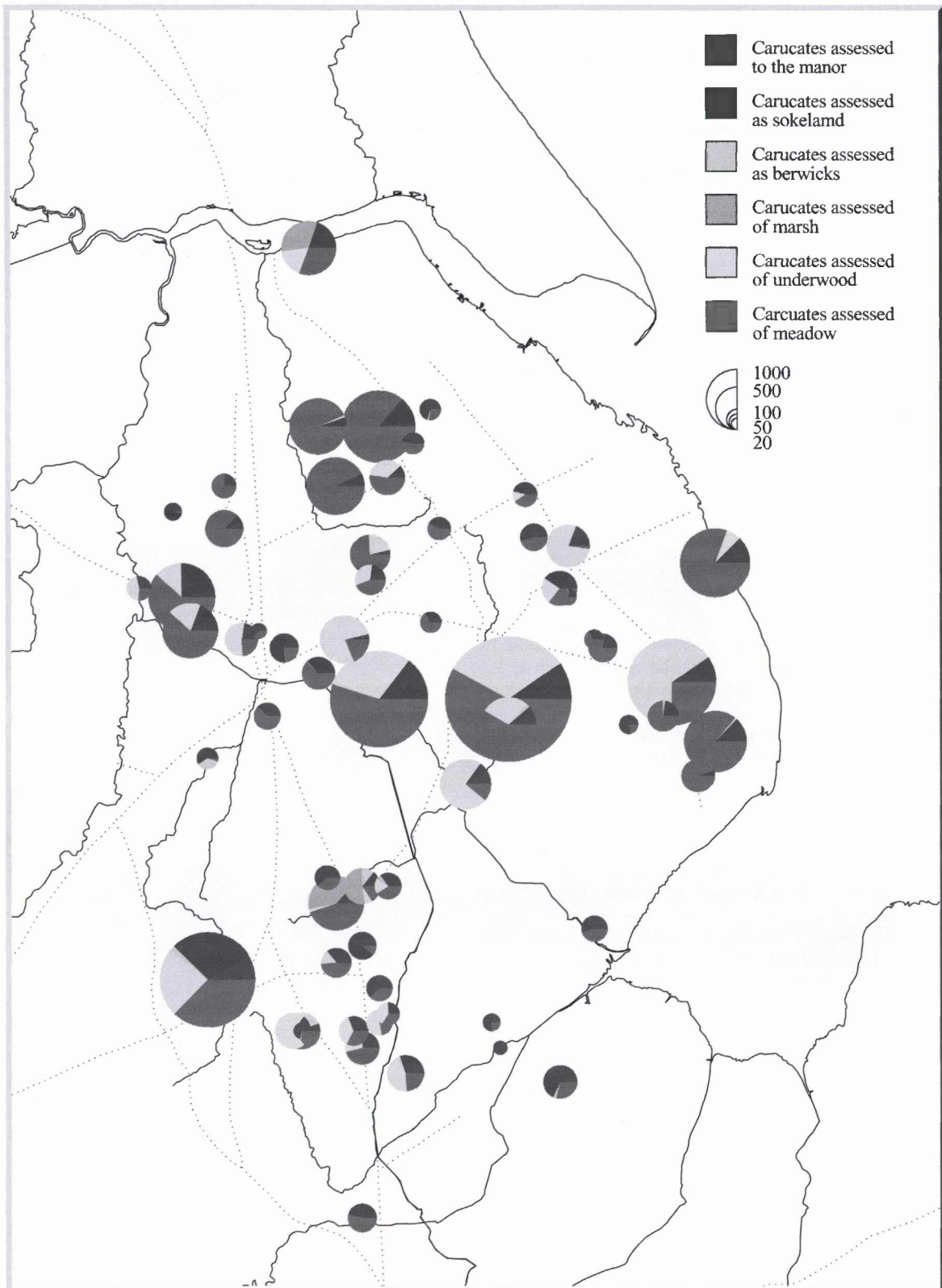*Figure 13*

Coin finds in Lincolnshire
Coin data derived from Blackburn et al 1983 and the Early Medieval Corpus of Coin finds
(http://wwww.-cm.fitzmuseum.cam.ac.uk/emc; last consulted May 2002)
Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 2002

0 ▮▮▮▮▮▮▮▮▮▮ 50 km

Figure 14

Carucates assessed to the manor

Carucates assessed as sokelamd

Carucates assessed as berwicks

Carucates assessed of marsh

Carucates assessed of underwood

Carcuates assessed of meadow

1000
500
100
50
20

Density of manorial land at Domesday

Sites derived from Foster and Longley 1924 and Vince and Young 1991

Roads and Pathways derived from OS 1:675000

Topography and Hydrology derived from 1:250000 Bartholomew map data

L.A. Symonds 1999

0   50 km

Figure 15

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