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Reconstructing the Roman London flavourscape: new insights into the exotic food plant trade using network and spatial analyses

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ABSTRACT

Using archaeobotanical data and examining them with a novel combination of density interpolation surfaces and social and spatial network analyses, this study has brought together exotic food plants in Roman London to outline the changing 'face' of its flavourscape, and contextualise it within the broader exotics commerce in Britannia. Consumption of a variety of exotics appeared to be widespread since the very first stages of London's establishment and their presence was maintained throughout although later on, as life in the town developed and its character changed, the focus of their distribution also changed. The emphasis shifted from the core of the city in its early days towards its outer zones, such as the upper Walbrook valley and Southwark in the Middle Roman, and the western and eastern sectors in the Late Roman phase. These changes appeared to largely reflect the changes in the overall commerce network of exotics in *Britannia*. In this network London starts as a mainly consumption place in the Early Roman phase to become the main redistribution centre in the Middle Roman and the necessary intermediate node in the transport system that had been established by the Late Roman phase, connecting the south to the north.

1. Introduction

A substantial body of work on exotic food plant introductions in the northern provinces during the Roman period, adopting more contextual approaches, has been underway during the past decade (e.g. Bakels and Jacomet, 2003; Jacomet et al., 2002; Livarda, 2008a, 2008b, 2011; Livarda and van der Veen, 2008). As a result, significant advances have been made, indicating a diverse socio-cultural pattern in accessing these food plants. This research has demonstrated that, alongside the movement of people, urban centres and military sites were key in the introduction and dispersal of exotic food plants, whilst rural sites seem to have somewhat lagged behind in time in accessing them.

In Britain, this contextual approach has indicated the presence of several consumer groups (military, major towns, rural), regional variations (e.g. rural southeast, rural southwest and north) and temporal changes in the incorporation of new food plants into the cuisine of its population (Van der Veen et al., 2008), highlighting the diversity of Roman foodways. Of the major town consumer group identified, London stands out as one of the richest sites in terms of types of new food plants, including some of the rarest ones (Van der Veen et al., 2007, 2008). London is also among the best-studied places in regards to archaeobotany. This is due to the systematic work carried out since the 1970s largely by the Museum of London Archaeology (MOLA) but also other units that were responsible for the study of material from numerous excavations conducted prior to urban development projects. This unique past and present privileged position of London offers a great potential to move one step further and investigate in detail, at a site level, how and why a new 'flavourscape' emerged during the Roman period. Most importantly, it offers a means to study how this impacted on and became intertwined with the new ways of life in Britain after the Roman invasion.

The term 'flavourscape' has been coined here in order to convey the methodological and theoretical approach adopted in this study. It refers to the urban and socio-cultural landscape that consists of several nodes, that is sites, linked together by their shared acquisition/possession of exotic food plants, following a network analysis approach (*sensu* Knappett, 2013). Exotics are defined here as those food plants that were either imported or started to be cultivated more widely in Britain during the Roman period (see Livarda,

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2008a; Livarda and van der Veen, 2008). Willcox (1977) first reported on exotics from London, providing an early stimulating glimpse of their presence and trade. Now, almost 40 years after this publication, the dataset has increased significantly allowing better insights into the exotics' access and circulation in the city.

Within the suggested framework of network analysis, London can be characterised as an 'impact' site because it fulfils two criteria (*sensu* Knappett, 2013, 10): first, it is large in size and the largest city in *Britannia*; and second, it is a 'busy' site with high inflow and outflow of exotics (Orengo and Livarda, forthcoming). London is thought to have started as a commercial centre at a boundary area that fell outside the control of native groups and it is speculated that it had some military presence, potentially used as a supply base, by around 50–55 AD (e.g. Mattingly, 2006, 273–274; Perring, 2011, 252). Wallace (2013) recently revaluated the character of early London and refuted the argument for its planning by a central administration to provide supplies to the army. Instead she favoured the idea that London started as a port town where the traders had stronger ties to the trade networks and craftsmen of Gaul and Germany than to the British ones, and only in the post-Boudican period (i.e. post AD 60/1) the military and administration became actively involved in the town (see also e.g. Jones and Mattingly, 1993; Millett, 1994; Carreras Monfort and Funan, 1998). London's key role in the early post-conquest overland communications has been attributed to its geographical position (Mattingly, 2006, 511), and to the commercial nature and varied socio-cultural make up of the early settlement (Wacher, 1975, 80–82). Its pivotal role and commercial success were also reflected by the size of its port and variety of imports and services found there (Hall, 2008, 36).

Given this prominent role of *Londinium*, our aim is thus to investigate the trade and distribution of exotics within London to shed light on the factors related to the weight of the 'node' of London within the exotics trade network of Roman Britain as a whole. This micro-scale, site-specific approach can provide one of the most significant basic building blocks upon which solid new interpretations of aspects of Roman society and economy in this province can be achieved.

2. Methods

2.1. The archaeobotanical data

The collection of the data on food plants from Roman Britain was completed in 2013. It involved extensive bibliographical research, including use of an updated version of the ArchaeoBotanical Computer Database (ABCD) (Tomlinson and Hall, 1996) kindly provided by Dr Allan Hall, the Ancient Monuments Laboratory reports from English Heritage, and the Museum of London Archaeology (MOLA) archive. Any information retrieved through the ABCD database was double checked with the original publication report. All available published texts reporting on archaeobotanical finds from London were accessed as well as a great body of grey literature from MOLA.

The presence of all plants, including exotics, in each London excavation site was recorded on a sample-by-sample basis in order to record both presence and absence of material and to take into account contextual evidence. Samples taken from possibly mixed stratigraphic layers, as stated in the archaeological reports, were excluded. For the rest of Britain, only the exotics presence was noted at this stage of the project. The preservation mode/s of each species, the security of its identification, and the part of the plant recovered were noted. All taxa were classified as native or exotics to differentiate between those that were already fully established or not in Britain prior to the Roman conquest. A full list of species that are classified as exotics is provided in Van der Veen et al. (2008, 13). The same list is used here with the exclusion of those referred to as 'other' as they are not food plants, vegetables and mint (*Mentha* sp.). Vegetables pose particular preservation issues and thus their distribution is harder to trace, and asparagus in particular, according to contextual evidence is likely to represent intrusive material from much later, post-Roman layers (Pelling et al., 2015). The *Mentha* genus contains several species that are difficult to distinguish morphologically and thus usage of the herb for culinary or other purposes is difficult to infer with a high degree of certainty.

2.2. Archaeological information

To obtain a more detailed level of information on the usage of various plants, a series of other parameters were recorded. Thus, the exact location of every excavation site was noted and geolocated in a GIS environment. Sites were divided into 'records' according to their chronology, following Livarda, 2008a; Van der Veen et al., 2008 and Livarda, 2013, and classified as early (ER: 1st century AD up including up to early 2nd century AD), middle (MR: 2nd and 3rd centuries AD) or late (LR: 4th century AD including those starting in the 3rd century AD) Roman. Where detailed dating was lacking the closest match was taken or an intermediate, broader category was attributed. If samples were attributed a specific date range then this was also noted. For every record, contextual information (per sample in the case of London) was recorded alongside more detailed descriptions where available. Finally, the recovery method and the minimum mesh size used to retrieve the archaeobotanical material were noted as a control means for the potential absence of certain items, such as small sized ones.

2.3. Social and spatial network analysis

Social Network Analysis (SNA) studies relationships and in archaeology it has been mostly used to study the links between sites according to their shared material culture (e.g. Sindbæk, 2013). Here, SNA is employed to investigate the relationships between records that include exotics. Our approach follows Dobres and Robb (2005) who maintain that material culture in reality 'constitutes social relations and meaning making', and extends this argument to include food culture and its remains. We hypothesise that the shared use of exotic foods (as defined in this study) were sought after for a variety of largely socio-cultural reasons. New fruits, condiments and other such foods were not essential ingredients for the physical, but for the social individual, newly arrived from elsewhere in Britain or beyond in the developing commercial centre of *Londinium*.

Two types of SNA metrics are employed: degree centrality and betweenness centrality. Both measurements display the relative importance and centrality of nodes (here referring to records) according to their shared use of species. However, there are some differences. Degree centrality values (colour coded nodes in Figs. 1–3) highlight those records with a higher number of exotics shared with other records. Therefore, those records with higher degree centrality have access to a higher number of exotics. Betweenness centrality (size coded nodes in Figs. 1–3) measures the relative potential of records to act as (re)distribution centres according to the presence of certain species serving as links between records. A second category of measures has also been introduced in the analysis: the number of shared species between records ('number of connections' in Figs. 1–3, thickness coded lines) and the betweenness values of the links (colour coded lines in Figs. 1–3). The former provides an indication of the strength of the connection, with a thicker line representing a higher number of shared species between the connected nodes, while the latter highlights those records with access to few but particularly rare

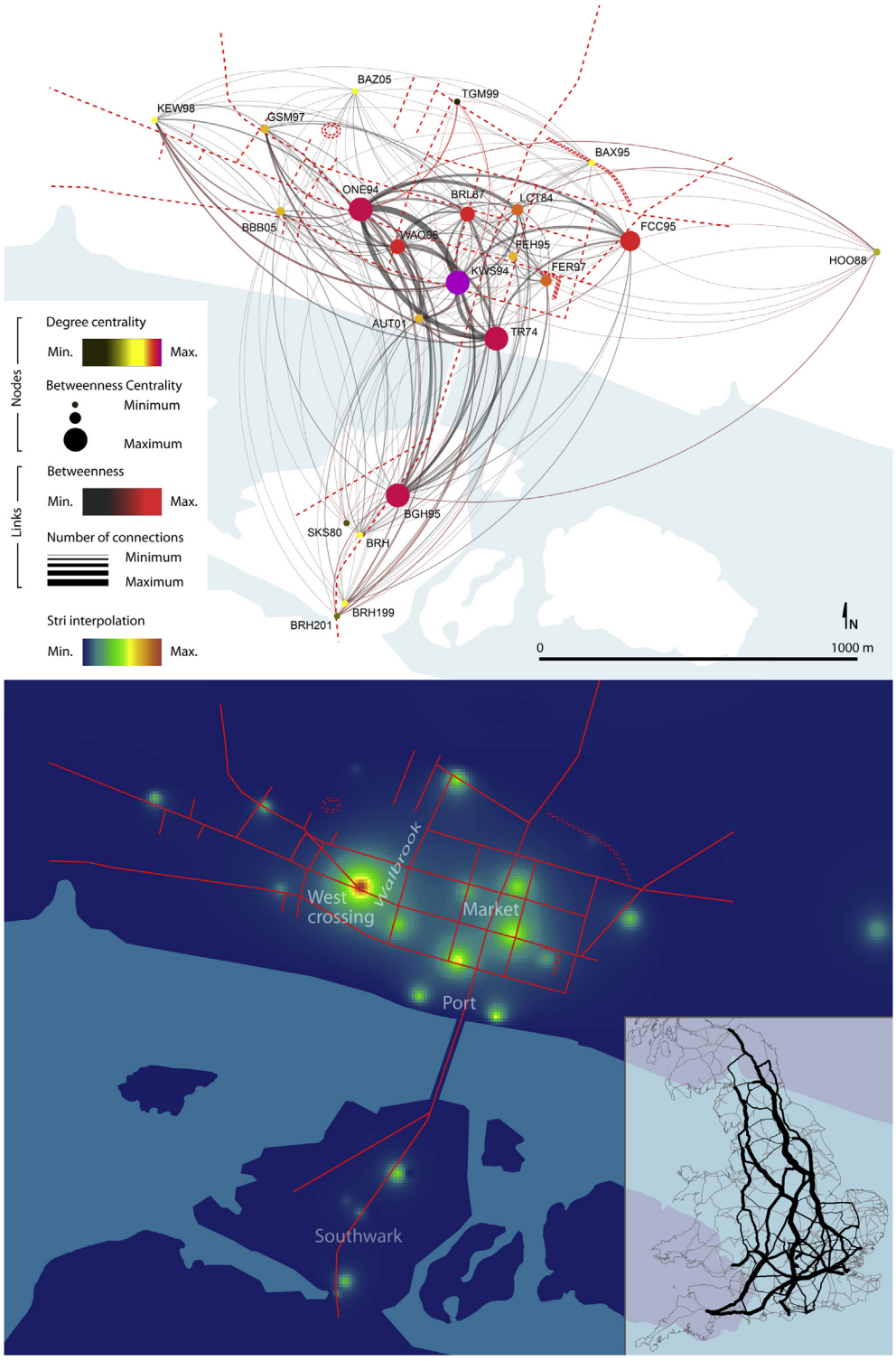

Fig. 1. Combined analysis of social network analysis (top) and Stri interpolation (below) for *Londinium*, and spatial network analysis for *Britannia* (lower left window) during the Early Roman phase.

exotics, that is, the redder the line, the more important it is in connecting records with rarer exotics. The link values, thus, act as a balance to the measures displayed by the nodes, offering contextual information about the nature of the relations between records and not only the records' centrality values. The link values combined with the centrality metrics of the nodes provide an indication of the potential of a site to act as a (re)distribution centre, occupying a more or less central position in the exotics' network. Consumption sites can have variable centrality values in accordance to the type of site and its potential for the acquisition of rare exotics, and therefore all sites are potential consumption sites. A (re)distribution centre is considered here, as a general rule, any node combining

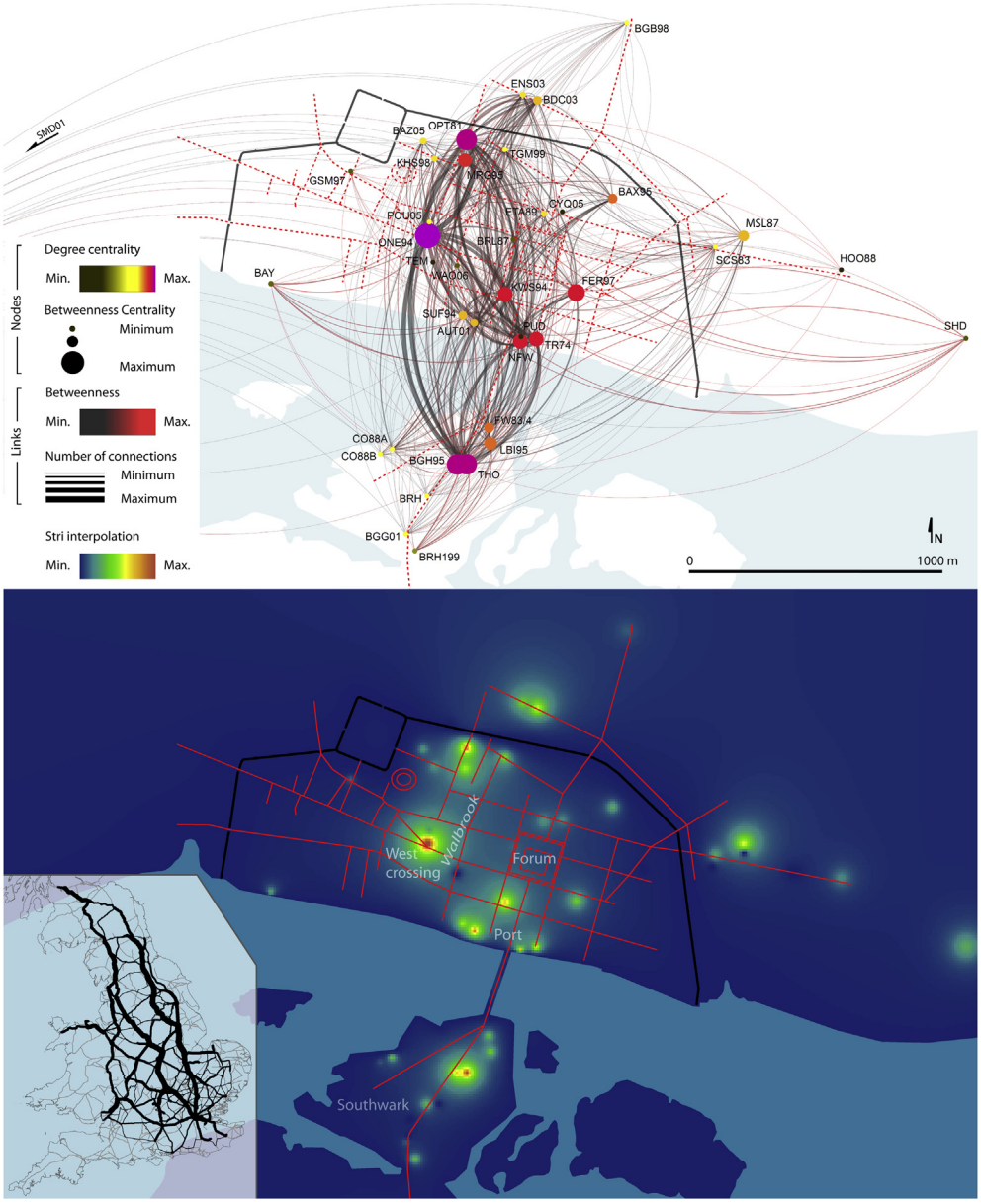

Fig. 2. Combined analysis of social network analysis (top) and Stri interpolation (below) for *Londinium*, and spatial network analysis for *Britannia* (lower right window) during the Middle Roman phase.

high centrality values, a high number of connections and multiple links to sites with low centrality but with which it shares rare species. The combination of these measures has the potential to provide new perspectives in the commerce of exotics within London, investigating the relative importance of records in terms of access to and distribution of exotics. To calculate these metrics and illustrate the exotics' use network, two SNA packages were employed, Pajek (De Nooy et al., 2005) and Cytoscape (Shannon et al., 2003).

To contextualise the *Londinium* analysis, data on the distribution of exotics in the whole of *Britannia* were included. In particular, Spatial Network Analysis (SpNA) was employed to analyse both the distribution of (food plant) true imports and the occurrence of all selected exotics in *Britannia*. The land and river routes displaying higher values of betweenness according to the least cost routes for their distribution were accordingly mapped (line thickness reflecting betweenness values), combining the results of the abovementioned analyses (see maps of Britain in Figs. 1–3). A full description of the methodology followed and the results obtained can be found in Orengo and Livarda, forthcoming.

2.4. Rarity index

A 'rarity index' was developed and spatially interpolated in order to examine the relative importance of taxon assemblages over space according to how un/common and varied they were in *Britannia*. The presence of the selected exotics reflects, to some extent, their relative importance and status, and therefore, rare taxa would have been possibly more expensive and/or luxurious. However, factors, such as taphonomic processes, the physical characteristics of the remains, recovery techniques, and consumption patterns, play an important role in the preservation/presence of plant remains, and are considered alongside careful contextual analysis of the data.

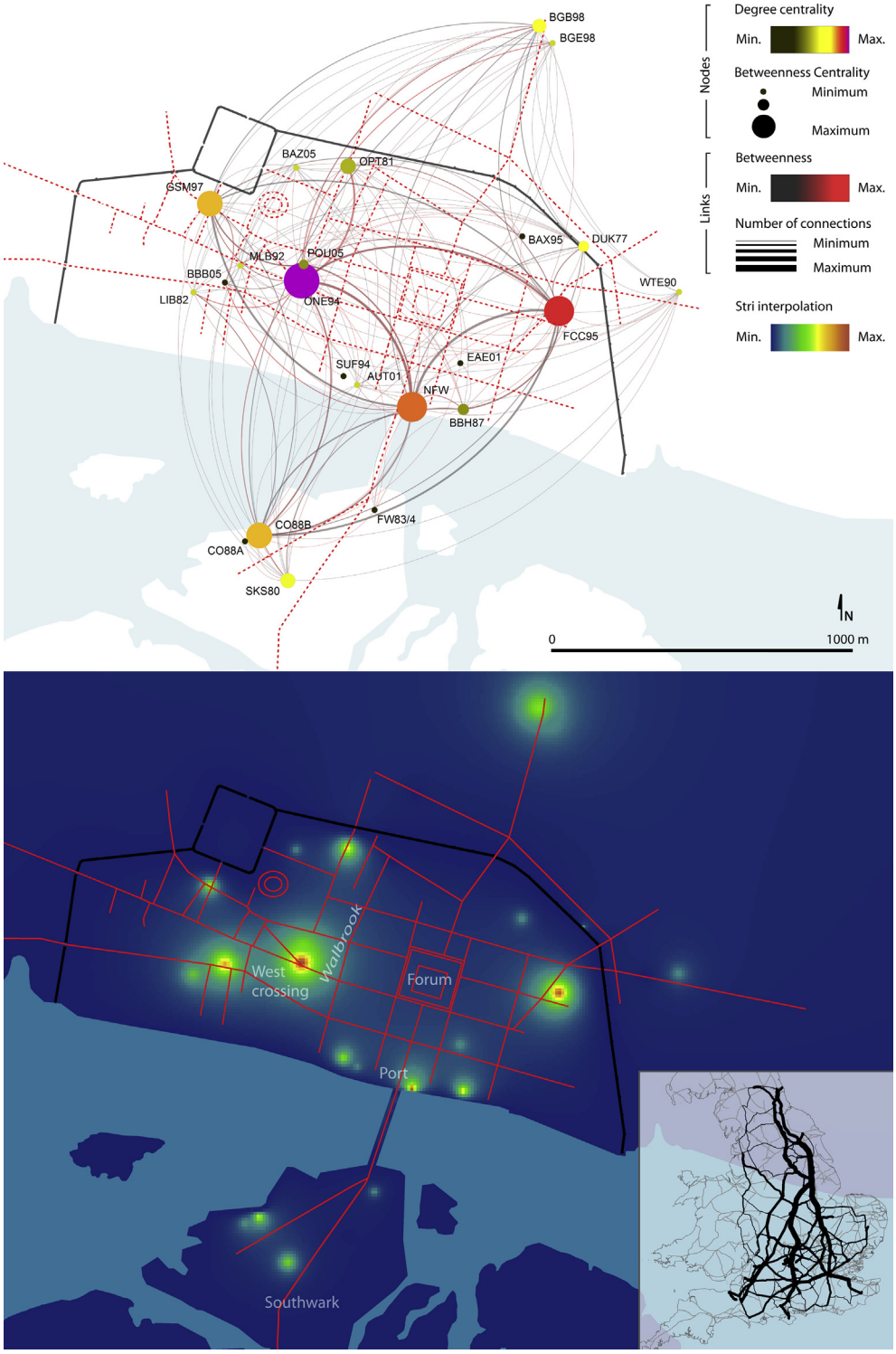

Fig. 3. Combined analysis of social network analysis (top) and Stri interpolation (below) for *Londinium*, and spatial network analysis for *Britannia* (lower left window) during the Late Roman phase.

To calculate the rarity index of a site (Stri) the following formula was developed:

$$Stri = \sum^{n} \left(\frac{tSp}{tSt}\right)^{-x}$$

Where 'tSt' is the total number of sites (= records according to our terminology, see Section 2.2) with available archaeobotanical data and 'tSp' is the number of records with presence of a given exotic food plant type. 'x' is a scaling factor for the relative weighting of rare species. In this case, a value of 0.5 was considered adequate to reduce the strength of the weighting on the rarest species, whose extreme

rarity could be conditioned by preservation, identification or processing issues. A given species' rarity index (Spri) value is inversely proportional to the number of records in which it has been found. The Site Rarity Index (Stri) is the summation of the rarity index of each exotic food plant (Spri) found at a record.

Stri was interpolated using an Inverse Distance Weighted (IDW) method (with a power value of two in accordance to the proximity between clusters of records) to produce a continuous surface of the distribution of rare exotics, using a colour scale from blue (low values) to red (high values). Using Stri has two advantages: firstly, rare species include all true imports but also other species that although they could potentially be locally grown they were not widely established and thus the potential list of imports may be extended, taking into account taphonomic/preservation issues; secondly, our working hypothesis is that long-distance imports of especially non-staple food plants had higher value and were acquired in smaller quantities. Their value would possibly impose a greater care in their usage and thus it is likely that their archaeological presence would indicate their final place of acquisition or consumption. Stri values provide a useful counterpart to the values derived from SNA. Stri reflects the rarity of the assemblage present at a record as a whole taking into account the variety of the exotics found and how uncommon these were in *Britannia*. Thus, it provides an indication of the status of a site independently of the relation with other sites and to the particularities of the exotics' assemblage in London. In this way Stri can be used to weight the significance of the betweenness values of the links (which give an indication of the shared use of rare species within London) and the centrality values of the records.

3. Results and discussion

3.1. The Early Roman phase

The distribution of sites with exotics in the ER phase (Fig. 1) shows their widespread presence within the town and its immediate suburbs. Almost every site sampled for archaeobotanical remains yielded some exotics. The Stri interpolation map (Fig. 1) highlights two main areas of exotics' concentration. The first one is the open market area and to the south near the main road that led to the port front. However, the area where the rarest species concentrate is just to the west of the point where *Londinium*'s main east-west road bridged the Walbrook (Thames' tributary at the time). Southwark on the other hand does not seem to be particularly significant in terms of rare exotics, although some found their way there. Spatially, the core town of *Londinium* retained high centrality in regards to acquisition of exotics, having an overall picture of a consumption site.

SNA metrics show a complex set of inter-relations with certain sites having higher degree and betweenness centrality. Regis House (KWS94) and Billingsgate Buildings 'triangle' (TR74) near the port, No. 1 Poultry (ONE94) at the west crossing area (west edge of the ER town delimited by the Walbrook), and Borough High Street (BGH95) in Southwark are such sites, having the highest access to exotics. KWS94, TR74 and ONE94 additionally display a higher presence of rare exotics as indicated by the Stri and the highest number of shared exotics, and these are highlighted as the main (re)distribution centres of these foods. Most rare exotics are concentrated in the broader market and the west crossing areas. Interestingly, the links' betweenness suggests that sites with few but rare exotics, such as 8-10 Throgmorton Avenue (TGM99) and 15–23 Southwark Street (SKS80), are only linked to these three sites (KWS94, TR74, ONE94), reinforcing the idea that these were the main distributing centres of exotics within London.

Some dumping of material at the edges of the settlement in the Walbrook valley from the east core of the town has been suggested (Hill and Rowsome, 2011, 439) and the occurrence of food refuse in these areas may have been partly caused by such activities, inflating their centrality and betweenness. At the same time Hill and Rowsome (2011, 439) argue that the condition and completeness of the pottery deposited at the west crossing indicated that the refuse was not being transported long distances, and other material (e.g. Samian bowls) exhibited little or no signs of use. The much higher concentration of exotics in this area (compared to the core of the city) seems more likely to be due to certain related commercial activities even if some such refuse was deposited there, with the market area possibly trading more staple foods and grains (see, e.g. Sidell, 2008, 66).

In the western area of the city, where more roundhouses typical of the pre-Roman style were found, introduced food plants were also present. Excavations at Gresham Street (GSM97), for instance, indicated the use of several new ingredients, such as coriander, fig and mulberry (Roberts, 2004). The port area maintained a central position where all goods seem to arrive for further redistribution, via mainly the west crossing in the case of rare exotics on current evidence. Consumption of all types of introduced food plants seem to be regular within the city. The results are significant as they demonstrate that various imported foods in this early phase were quite widespread and were neither insignificant nor largely inaccessible compared to locally gathered or grown ones as sometimes suggested (Hill and Rowsome, 2011, 439).

The results obtained in London seem to fit within the broader context of commerce in *Britannia*. SpNA analysis suggests that several southwestern and southern roads were in use for the movement of imports (Fig. 1). Silchester seems to hold a quite central position in the exotics' network and it is closely linked to London. The latter, although being a significant node, occupies a more marginal place in this distribution network. It has a high Stri value compared to other nodes of this network, highlighting the presence of a wide range of exotics, but at the same time SpNA betweenness centrality values of the Roman transport network stretches around London have lower values that indicate its more marginal role in linking sites with imports (Orengo and Livarda, forthcoming). This corroborates its main role as a consumption (possibly related to London's high concentration of immigrants), rather than distribution site, receiving these foods from both the sea through Thames and the southern ports.

3.2. The Middle Roman phase

In this phase *Londinium*'s flavourscape changes significantly as indicated by the SNA and Stri values (Fig. 2). The presence of rare and other exotics near the port increases and extends to the other side of the bridge to Southwark. Of the five sites on the riverfront with exotics, Arthur Street (AUT01), Governor's House (SUF94), New Fresh Wharf (NFW), and Billingsgate Buildings 'triangle' (TR74), display an elevated Stri value. The last two also exhibit high degree centrality but rather low betweenness. This suggests that most exotic types can be found there, including rare ones, but these sites are not directly in charge of their distribution. The strength of the links between the port sites and sites with both high degree and betweenness centrality, that is ONE94 at west crossing, BGH95 and 1–7 St Thomas Street in Southwark (THO), and 15–35 Copthall Avenue (OPT81) in the upper Walbrook valley, a suggested craft/industrial area (Gray, 2002) near the north entrance/exit and the fort, suggests that these were possibly redistribution nodes, where exotics would have been transported in bulk for further distribution. ONE94, in particular, increased its centrality displaying the highest values for degree and betweenness centrality but also for

Stri and can be considered a particularly significant redistribution centre for exotics. In contrast, the Forum area becomes marginal in the exotics' network in this phase.

At the west crossing, the archaeology indicates a commercial zone with some residences. Shops, bakeries, taverns, craft places, including a pottery shop with imported wares, were dominating until about the mid-3rd century AD, from which point onward activities were reduced, following the general pattern in the town (Hill and Rowsome, 2011, 441–443). In regards to possible refuse dumping, the analysis of the botanical data shows a rather distinct picture in terms of exotics between the centre and the west crossing and other areas further in the margins, which argues against substantial dumping of this class of material from the core of the city.

In the upper Walbrook valley a planned programme of reclamation and drainage had begun by the early 2nd century AD and two major roads of north/northeast-south/southwest orientation were constructed through the valley. These were exits to the cemeteries and possibly to a market garden to the north (Maloney, 1990, x), which may have partly played a role in the high density of exotics in this area. Within the walls there is no archaeological evidence of markets being set up in the area so it seems possible that this was also a 'consumption' area of exotics. The settling of skilled craftsmen and other people in the area could have been one of the triggers of such imported tastes. Several other consumption sites are found within the town. An example is Plantation House (FER97), including probably a high status building (Giorgi, 2005), which has a rather high degree centrality but fewer rare exotics and weak links in terms of shared species with the port area, and seems to be thus, consumption rather than distribution site of exotics. Similar is the case of KWS94, which however, includes more rare exotics as indicated by its Stri value.

Outside the wall of the town exotics are found in sites with low centrality, but as indicated by Stri values, with generally rarer exotics than those inside the town. The occurrence of few but rare exotics can be related to the character of certain sites. For instance, selected exotics were found associated with funerary contexts, such as at HOO88 in the eastern cemetery. This site has a high degree of link betweenness with redistributive sites and, particularly with ONE94, from where some of the rarest exotics could have been acquired.

Overall, the picture is that of a prominent position of the port area and its role as the first entry point of exotics, a few other particularly significant centres of consumption and redistribution, and a more restricted acquisition and use of new foods across sites within the core of the city. *Londinium* seems, therefore, to transform from a mainly consumption place in the ER phase to a mainly redistribution centre of exotic food plants, fully engaged in the commerce activities of *Britannia*. Exotics came into the city but they were mostly moving away from its core. The focus seems to have shifted towards the entrance/exit points while the reclamations and new revetment constructions on both banks of the waterfront during the 2nd century AD (Rowsome, 2008, 30–31) seem to have helped boosting its activities.

The increased exotics' commercial activities in London in the MR phase seem to be key in their overall trade within *Britannia* (Fig. 2). It is in this phase when the exotics' circulation reaches its maximum extent. London forms what can be described as a radiocentric network and appears to be the main (re)distribution centre at least in the south-east of *Britannia*, controlling access to the north and most other places inland, with the SpNA values of its related transport network stretches acquiring high values (Orengo and Livarda, forthcoming). The road crossing Southwark may have been thus used also for the export and redistribution of exotics arriving through the port, and similar could be the function of other main roads, as *Londinium* became one of the key transit places. The location of redistributive sites on a more or less north–south axis, close to the main road entrances/exits of the city, seems to add to this hypothesis.

3.3. The Late Roman phase

Important changes in the exotics' flavourscape are observed in the LR phase (Fig. 3). Although the number of sites with exotics is similar to that in the ER phase, the number of links and the number of shared species between sites is much lower, as is the variety of exotics. These changes indicate a rather reduced use of exotics during this period. The west crossing area maintains its prominent position in terms of node centrality and exhibits the highest values of betweenness in links, which suggests that it continued being a significant distribution point for the rarest species. At the port, exotics are found at several sites but only one, NFW, has a quite high degree centrality value, although its links' betweenness value is relatively low. This site also displays high values of shared species and rather high Stri. It seems, therefore, that the port was still acting as an important entrance and distribution centre of exotics, but the more unusual, rare ones seem to have been redistributed from the west crossing area.

Another important change is the relative loss of importance of Southwark in terms of exotics, with only the warehouse at Courage Brewery (CO88B, Davies, 2003) exhibiting a higher node centrality. More significantly, the area of the town east of Walbrook, does not seem to participate into the exotics network, with only '41 East Cheap' (EAE01) further east including a few of the most common ones, and indeed few records in this area have yielded food plant debris altogether in the LR phase. Overall, the spatial focus of exotics' consumption in the town seems to change.

While in the previous phases most and rarer exotics were found in central positions delimited by the port and the west crossing, in the LR phase exotics are concentrated in previously marginal consumption areas: the eastern and western suburbs. In the western suburbs several new sites with exotics appear for the first time on the city map, while others with previously low access to exotics, such as GSM97, boost their centrality metrics and Stri values. The centrality metrics and Stri of the Bowbells House, Bread Street (BBB05) record indicate the presence of few but rare exotics, with its rarity index increased due to the presence of a single possible specimen of lupin (cf. *Lupinus albus*) among other exotics, the only one available from Roman British contexts. BBB05, however, included also activity layers of Saxon, medieval and modern date (Davis, 2009), and given historical records suggesting lupin's introduction in Britain during the medieval period, its Roman occurrence, and thus the role of this site in the exotics network, needs to be treated with caution. GSM97 displays high degree centrality with strong connections to the port, suggesting increased adoption of standard common exotics. The high betweenness of the link between these two sites, however, also indicates shared access to rare exotics. Additionally, GSM97 displays a strong relation to Fenchurch Street (FCC95) at the eastern suburbs, stressing the use of a similar package of exotics at both sites. FCC95, nevertheless, is much more central (only second to ONE94), having access to most species, and is particularly rich in terms of rare exotics. These new consumption 'centres' seem to be also associated with the eastern and western entrances/exits of the city, which, together with their centrality values and strong connections to the port, might suggest a connection to trade activities. A third site with rare exotics but without much diversity, OPT81, seems to follow a similar pattern with its position at one of the northern entrances/exits of the city.

Overall, although exotic food plants did not cease to be brought into London until its final decline, these do not seem to have been

aimed only for its inhabitants but also for others further afield. The change in the distribution of exotics inside the city might be related to this process with a higher presence of exotics close to the entrances/exits of the city and in previously marginal areas, such as the western suburbs. These observations could tie also with Fulford's (2008, 45) suggestion that the disturbance and changes in the south-east from the mid-3rd century onwards could be related to the end of the old elite and its replacement by a new one. In the case of London here this might have been reflected in the changes in the distribution of Stri values within its townscape.

In the LR phase London remained a rather important administrative centre and prestigious city but archaeology suggests that it had lost much of its commercial and social vigour. Interestingly, however, commercial activity in terms of exotic food plants appears to continue on current evidence, albeit on a reduced scale. The exotics' trade in *Britannia* also continues its regular inflow, but now, an increased activity is witnessed again in the southern coast and the Mouth of the Severn and on the eastern south-north route passing through London (Fig. 3). London is not anymore the main port of entry of imports or the key centre in the exotics' distribution. Imports seem to be largely entering from the south, but the pre-existing transport network, as established during previous phases, may have encouraged transit through London to reach the centre and the north of the island. Thus, the acquired London transport network's high betweenness centrality seems to have contributed to the city's maintenance as an important node in this commerce (Orengo and Livarda, forthcoming). The disruption of the imperial economy in the LR phase and the recovered importance of the southern ports might have potentiated a change in the consumption of imports and other exotics, linked to the emergence of local, well-connected, individuals or groups, some of which may have been located in previously marginal areas of London, who took over the control of this commerce.

4. Conclusion

This study has contributed significant new insights into the fortunes of commerce of Roman London and its position within that of *Britannia*. Exotics were entering London from its inception and until its finale demise. Different areas of usage/consumption of these plants became more prominent at different times, reflecting new activities and new groups of people and their tastes in the townscape. West crossing appears to be an important area in terms of exotics since the early days of London, retaining this character throughout the period despite the fluctuation in the 'epicentres' of exotic food access within the rest of the city. This was a topographically privileged area as it was lying in very close proximity to the Walbrook that was navigable to there. This point may have thus been nodal for the redistribution, provision and access of rare spices and other imports, perhaps following a tradition established in the beginning of the ER phase. The port area, unsurprisingly, is another focal area of exotics that maintained its central role throughout. After disembarking in the port and the west crossing area, some of these goods may have ended up in shops for further distribution and/or houses in this area, a picture possibly intensified in the MR phase. Preservation issues may have contributed to the higher visibility and prominent role of these two areas, but the presence of excavated sites across the Roman city has ensured a rather reliable picture in terms of exotics' fluctuations in the different phases. The market/forum area, on the other hand, seems to gradually lose its importance in terms of exotics and the focus shifts to areas outside the original core of the city. Further study of the taphonomic parameters can provide more nuanced information towards this direction (Livarda, Orengo and Davis in preparation).

The MR phase was the one with the most nuclei of exotics, attesting the role of London as their key distribution centre in Britain. Southwark and other places outside the walls increased their 'flavour' activity in this phase, which is possibly a testimony to increased related commercial activities and/or a change in the social make-up of their inhabitants and in their tastes. Circulation of imported food plants was maintained to some extent even in later periods when other commercial activities seem to decrease substantially. In the later part of the Roman period although archaeology suggests that London saw an overall decline, our analysis suggests that it maintained a central role in the exotics' commerce, being an important redistribution node of the imported food plant trade network in the island. This study has demonstrated how *Londinium*'s flavourscape changed, with the city developing from a mainly consumption to a largely redistribution centre of exotics until its final decline. Certain groups in *Britannia* sharing the same tastes seem to have valued these as important aspects of their social being, and thus, maintained and reinforced a continuous inflow of exotics and their associated communication/trade links. As more data are being compiled, investigation of the individual nodes in the commerce network of Britannia using network analysis and density surfaces has a great potential to illuminate how economic and social relations shaped the life of the island.

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References

Bakels, C., Jacomet, S., 2003. Access to luxury foods in Central Europe during the Roman period: the archaeobotanical evidence. World Archaeol. 34, 542–557.
Carreras Monfort, C., Funan, P.P.A., 1998. Britannia y el Mediterraneo. Estudios sobre el abastecimiento de aceite Betico y Africano en Britannia. University of Barcelona, Barcelona.
Davies, A., 2003. The plant remains. In: Cowan, C. (Ed.), Urban Development in North-west Roman Southwark. Excavations 1974–90, MOLAS Monograph, vol. 16. London.
Davis, A., 2009. Plant Remains from Bowbells House, Bread Street (BBB05). MOLA archive report 05/09.
De Nooy, W., Mrvar, A., Batagelj, V., 2005. Exploratory Social Network Analysis with Pajek. Cambridge University Press, Cambridge.
Dobres, M.A., Robb, J.E., 2005. "Doing" agency: introductory remarks on methodology. J. Archaeol. Method Theory 12 (3), 159–166.
Fulford, M., 2008. *Imperium Galliarum, Imperium Britanniarum*. Developing new ideologies and settling old scores: abandonments, demolitions and new building in south-east Britain, c AD 250-300. In: Clark, J., Cotton, J., Hall, J., Sherris, R., Swain, H. (Eds.), Londinium and beyond. Essays on Roman London and its Hinterland for Harvey Sheldon, CBA Research Report, vol. 156. Council for British Archaeology, York, pp. 41–45.
Giorgi, J., 2005. The Plant Remains from Plantation House (Roman Period) (FER97). MOLA archive report 13/05.
Gray, L., 2002. The Plant Remains from Northgate House and Kent House – Roman (MRG95 and KHS98) in the City of London. MOLA Archive Report 05/02.
Hall, J., 2008. The port, trade and work. In: Ross, C., Clark, J. (Eds.), The Illustrated History. Penguin, London, pp. 36–37.

Hill, J., Rowsome, P., 2011. Roman London and the Walbrook Stream Crossing. In: MOLA Monograph, vol. 37. London.
Jacomet, S., Kučan, D., Ritter, A., Suter, G., Hagendorn, A., 2002. *Punica granatum* L. (pomegranates) from early Roman contexts in Vindonissa (Switzerland). Veget. Hist. Archaeobot. 11, 79–92.
Jones, B., Mattingly, D., 1993. An Atlas of Roman Britain. Blackwell, Oxford.
Knappett, C. (Ed.), 2013. Network Analysis in Archaeology. New Approaches to Regional Interaction. Oxford University Press, Oxford.
Livarda, A., 2008a. Introduction and Dispersal of Exotic Food Plants into Europe during the Roman and Medieval Periods. Ph.D. diss.. Univ. of Leicester.
Livarda, A., 2008b. New temptations? Olive, cherry and mulberry in Roman and medieval Europe. In: Baker, S., Allen, M., Middle, S., Poole, K. (Eds.), Food and Drink in Archaeology I. Prospect Books, Totnes, pp. 73–83.
Livarda, A., 2011. Spicing up life in northwestern Europe: exotic food plant imports in the Roman and medieval world. Veget. Hist. Archaeobot. 20, 143–164.
Livarda, A., 2013. Date, rituals and socio-cultural identity in the northwestern Roman provinces. Oxf. J. Archaeol. 32 (1), 101–117.
Livarda, A., van der Veen, M., 2008. Social access and dispersal of condiments in North-West Europe from the Roman to the medieval period. Veget. Hist. Archaeobot. 17 (Suppl. 1), 201–209.
Maloney, C., De Moulins, D., 1990. The Archaeology of Roman London Volume 1: the Upper Walbrook Valley in the Roman Period. In: Council for British Archaeology Research Report, vol. 69. York.
Mattingly, D., 2006. An Imperial Possession. Britain in the Roman Empire, 54 BC-AD 409. Penguin, London.
Millett, M., 1994. Evaluating Roman London. Archaeol. J. 151, 427–435.
Orengo, H.A., Livarda, A., 2015. The Seeds of Commerce: a Network Analysis-based Approach to the Romano-British Transport System (forthcoming).
Pelling, R., Campbell, G., Carruthers, W., Hunter, K., Marshall, P., 2015. Exploring contamination (intrusion and residuality) in the archaeobotanical record: case studies from central and southern England. Veg. Hist. Archaeobot. 24 (1), 85–99.
Perring, D., 2011. Two studies on Roman London: a. London's military origins – B. Population decline and ritual landscapes in Antonine London. J. Roman Archaeol. 24 (1), 249–282.
Roberts, K., 2004. Report on the Plant Remains from Gresham Street. MOLA archive reports 08/04.
Rowsome, P., 2008. Mapping Roman London: identifying its urban patterns and interpreting their meaning. In: Clark, J., Cotton, J., Hall, J., Sherris, R., Swain, H. (Eds.), Londinium and beyond. Essays on Roman London and its Hinterland for Harvey Sheldon, Council for British Archaeology Research Report, vol. 156, pp. 25–32. York.
Shannon, P., Markielm, A., Ozier, O., Baliga, N.S., Wang, J.T., Ramage, D., Amin, N., Schwikowski, B., Ideker, T., 2003. Cytoscape: a software environment for integrated models of biomolecular interaction networks. Genome Res. 13 (11), 2498–2504.
Sidell, J., 2008. Londinium's landscape. In: Clark, J., Cotton, J., Hall, J., Sherris, R., Swain, H. (Eds.), Londinium and beyond. Essays on Roman London and its Hinterland for Harvey Sheldon, CBA Research Report, vol. 156. Council for British Archaeology, York, pp. 62–68.
Sindbæk, S.M., 2013. Broken links and black boxes: material affiliations and contextual network synthesis in the Viking world. In: Knappett, C. (Ed.), Network Analysis in Archaeology. New Approaches to Regional Interaction. Oxford University Press, Oxford, pp. 71–94.
Tomlinson, P., Hall, A., 1996. A review of the archaeological evidence for food plants from the British Isles: an example of the use of the Archaeobotanical Computer Database (ABCD). Internet Archaeol. 1. http://intarch.ac.uk/journal/issue1/tomlinson_index.html.
Van der Veen, M., Livarda, A., Hill, A., 2007. The archaeobotany of Roman Britain: current state and identification of research priorities. Britannia 38, 181–210.
Van der Veen, M., Livarda, A., Hill, A., 2008. New plant foods in Roman Britain – dispersal and social access. Environ. Archaeol. 13 (1), 11–36.
Wacher, J.S., 1975. The Towns of Roman Britain. University of California Press, Berkeley.
Wallace, L., 2013. The foundation of Roman London: examining the Claudian fort hypothesis. Oxf. J. Archaeol. 32 (3), 275–291.
Willcox, G.H., 1977. Exotic plants from Roman waterlogged sites in London. J. Archaeol. Sci. 4, 269–282.