

1. For starters: producing and supplying food to the army in the Roman north-west provinces

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“The huge quantity of resources needed by the army and the impact this might have had on the local native populations seem to me to be areas which cry out for investigation”
(Reece 2002: 187)

Introduction

Recent years have seen growing awareness of the significance that studies of the production/acquisition, supply, preparation and consumption of food have in aiding our understanding of the nature of past societies. Beyond physiological necessity, anthropological and archaeological research has demonstrated the way in which patterns of food preparation and consumption can reflect upon multiple, often intersecting aspects of past communities, including group identities, gender relations, religious/ritual practices and status differences (*e.g.* Daróczy-Szabó 2004; Goody 1982; Hastorf 1990; Scott 2007; Thomas 2007). Moreover, studies of food acquisition/production and supply have been used to reveal evidence for interaction both within and between past societies through trade, distribution, exchange and market networks, for example, as well as the demands and responses consequent to the development of such relationships (*e.g.* Boenke 2005; Landon 1997; Schia 1994; Van der Veen 1996). This volume contributes to the growing literature on the latter topic through the consideration of the nature of military food production and supply in the Roman north-west provinces (Fig. 1.1).

The success of the Roman army was clearly predicated upon the adequate provision of supplies. Indeed, the supply needs of the army, whether on campaign, during periods of conquest or settled occupation were considerable (*e.g.* Roth 1999). But what form did those supply networks take? Did the army rely on long distance supply lines, or were basic provisions acquired regionally or from local communities, and to what extent was this dependent on the nature of particular foodstuffs (*e.g.* bulk, cost, preservation qualities)? Following on from this, what was the nature of procurement strategies (*e.g.* compulsory requisition, direct purchase, taxation/tribute collection, military contracts) and what impact did these have on different communities within the provinces (urban, rural and military), and the relationships between them? Were procurement policies dictated centrally, or orchestrated regionally or locally? Did the presence of the Roman army stimulate economic development and specialised modes of production at local, regional or provincial levels, or lead to unsustainable pressure being placed on resources and/or the destabilisation of local production? Alternatively, were the occupying forces met with an agricultural landscape already capable of surplus production and able to absorb the increased demands placed upon it? To what extent was the production and supply of

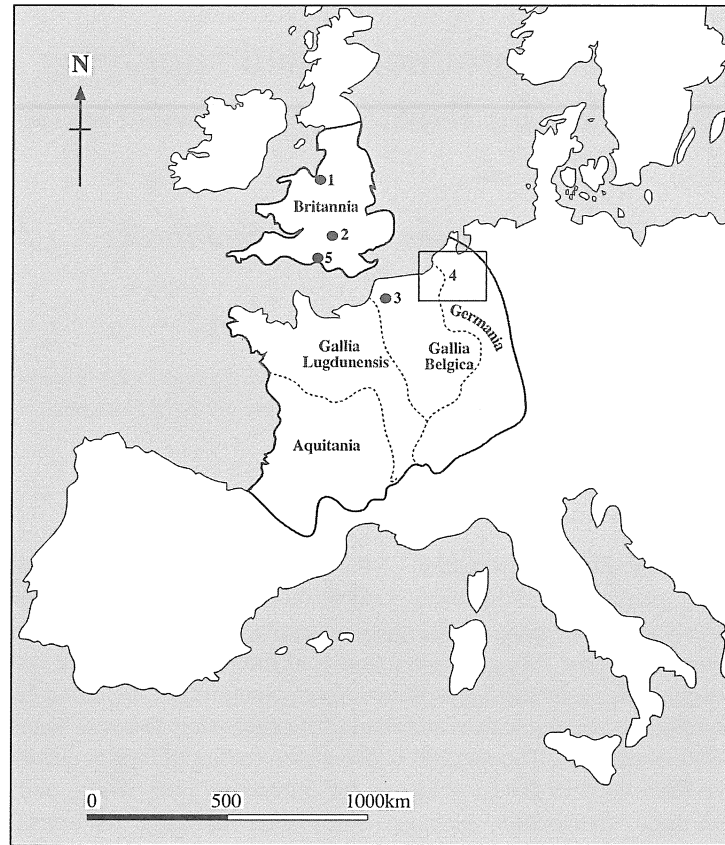


Figure 1.1. Map of the Roman north-west provinces c. A.D. 120 with the principal sites mentioned in this volume highlighted. Key: 1: Chester; 2: Alchester; 3: Arras; 4: Dutch River Area (see Cavallo *et al.* and Groot, this volume, for more detailed maps of this area); 5: Isle of Purbeck, Dorset.

food to the Roman army situational and constrained or aided by local circumstances, such as the environment, pre-conquest patterns of production and the fluctuating fortunes of the military presence in the north-west frontier? These are some of the questions that this volume hopes to begin to address, through the consideration of multiple lines of archaeological evidence.

Sources of evidence

The range of archaeological sources that can be employed to tackle questions connected to the production and supply of food is diverse. They include direct evidence in the form of the remains of plants, animals and processed food products that were supplied to military settlements (*e.g.* Cavallo *et al.*, Derreumaux *et al.*, Filean, Groot, Thomas this volume; Kimpe *et al.* 2002) and written records (*e.g.* Pearce 2002; Whittaker 2002) as well as indirect evidence for foodstuffs, such as the vessels used to store and transport food and even food-pest infestations (*e.g.* Buckland 1981; Gerrard this volume; Peacock 1986). Numismatic evidence, changing settlement patterns,

the presence of particular archaeological features within settlements (*e.g.* field boundaries, horticultural terraces, corn driers and storage facilities), palynological analysis, and material culture can also be used to elucidate aspects of agricultural production and supply (*e.g.* Carrington this volume; Dark and Dark 1997; Greene 1986; Maguire 1983; Morris 1979; Rees 1979; Van der Veen 1989), while both direct and indirect evidence for different modes of transportation can be identified archaeologically (*e.g.* Johnstone this volume; Parker 1992).

Unfortunately, as Cool (2006: 1) has recently emphasised, specialist reports on direct evidence (plant and animal remains, ceramics *etc.*) are often hidden away at the end of excavation reports. They are seldom integrated into comprehensive discussions concerning wider theoretical questions within Roman archaeology. This is for a range of reasons, many relating to working conditions and publication formats in contract archaeology, where the majority of studies are now conducted. Specialists working with one class of evidence often do not have the opportunity to work alongside those dealing with other types of material, and may have to work with ‘their’ material from a very wide range of sites and periods. This can lead to a lack of awareness of what the major research questions are for any particular type and period of site, and to a specialist rather than holistic basis to interpretations. Moreover, the existence of many specialist reports as ‘grey literature’ *i.e.* client and archive reports that are not available as publications with ISSN or ISBN registrations makes it difficult even for specialists to be aware of what other relevant data exist (*e.g.* Lauwerier and de Vries 2004; Van der Veen *et al.* 2007). This isolated mode of working together with the incomplete publication of data has undoubtedly contributed to the absence of synthetic accounts that explicitly deal with the archaeology of Roman military food production and supply, despite the recognised centrality of these issues to military studies (*e.g.* Reece 2002: 187). Through this volume, therefore, we hope to demonstrate not only the wider economic and social significance of studying the nature and impact of the production and supply of food to the Roman military in the north-west provinces, but also demonstrate the importance of using multiple classes of archaeological evidence in testing theoretical models. Studies of plant and animal remains feature strongly in the volume, since these are classes of archaeological evidence that have been under-utilised in the past (Cool 2006), and we hope to raise their profile for non-environmental specialists and environmental specialists alike, but the main aim is to illustrate the academic value of integrating a range of different types of evidence to address key research questions.

Research context

Introduction

In order to contextualise the new research presented within this volume it is apposite to provide a brief overview of some of the key themes that have emerged from previous studies of military food production and supply in the Roman north-west provinces.

Regional trends

Although the application of broad-scale regional analyses are not unproblematic, not least because they likely disguise more subtle patterns of inter- and intra-regional variation, neglecting the subtleties of environmental context and spatial variation within sites, for example, they do serve to illustrate wider patterns in military procurement strategy. Currently, the number of regional studies into the nature of Roman military food provisioning within the north-west provinces is

limited; however, there is evidence to suggest that broader scale analyses are increasingly being adopted (Campbell and Hammon in prep.; Cavallo *et al.* this volume; Livarda in prep).

While clear regional differences in the proportions of different cereal crops have been identified on Roman settlements within the north-west provinces (Van der Veen 1988: 363), comparison of the archaeobotanical evidence from military settlements in Scotland, Wales, northern England and Germany has revealed remarkable conformity in the range of staple plant foods consumed (Dickson and Dickson 1988; Dickson 1989). Previous archaeobotanical and palynological research has demonstrated that the primary staple crops of the Roman north-west provinces were two glume wheats (emmer: *Triticum dicoccum* and spelt: *Triticum spelta*), a free-threshing wheat (bread wheat: *Triticum aestivum*) and barley (*Hordeum vulgare*), with oats (*Avena sativa*) and rye (*Secale cereale*) of lesser significance (*e.g.* Cool 2006: 69–71; Dark 1999).

Such broad conformity is supported to a certain extent by the analysis of the relative proportions of the three major domestic mammals: cattle, sheep and pig (King 2001: 220). This is a diet that consisted mostly of beef, with a greater emphasis on mutton on British sites, and pork in Germany, possibly reflecting pre-conquest patterns of food consumption and the origins of the soldiers (King 2001; Mattingly 2006: 222). A combination of differences between military and non-military sites (*contra* Davies 1971: 136) and the broad similarity of the military diet in the north-west provinces had led King (2001: 220) to conclude that ‘for the most part...the army, particularly the legions, would have been able to adopt a command economy, and exercise dietary preferences’. Despite King’s observation that legionary garrisons may have had some privileges regarding the supply of resources, there has been a tendency for sites to be classified on a rather simple basis as ‘military’ or ‘civilian’. Many forts saw changes in their garrisons, particularly between initial campaigns of invasion and conquest that often featured legionary forces in considerable strength, and subsequent ‘peace-keeping’ occupation which often made comprehensive use of auxiliary forces. Many of the forts in the north-west provinces had relatively short-lived or small-scale legionary garrisons, and these troop movements may be reflected in changes in food supply. A further complication concerns the relationship between military establishments such as forts and fortresses and urban settlements. The Roman military forces moved relatively swiftly through parts of the north-west provinces, such as southern and eastern England. Here, urban settlements developed that can be regarded as civilian towns (Burnham and Wachter 1990; Wachter 1995) and considerations of how the Roman army was supplied is simplified by the fact that it is possible to consider rural settlements, villas, towns and forts (*cf.* King 1999a) as relatively discrete entities, although this not to completely deny the presence of military personnel at such sites (*e.g.* Bishop 1991; Miles *et al.* 2007: 348). In the frontier provinces, however, such as northern England and the lower Rhine, the military occupation persisted for centuries, and the relationship of the forts to the *vici* that developed immediately outside their gates is still unclear, with recent investigations highlighting the interdependence of the sites, and the possibilities that some civilians lived in the forts and that some retired soldiers lived in the *vici* (James 2006; Scheidel 1996).

One common pattern seen on many military sites in the north-west provinces is higher proportions of pig bones, compared with neighbouring rural sites (*e.g.* Alchester: Thomas this volume; Nijmegen, The Netherlands: Lauwerier 1988; Oedenburg, France: Schibler *et al.* 2005). It is of course essential to consider the norms for each area that is being investigated: in Italy, a ‘high’ proportion of pig bones might comprise over 60%, whereas in Britain a proportion greater than 20% might be considered unusually high (King 1999b). That said, the consumption of relatively larger quantities of pork meat has often been viewed as characteristic of highly

‘romanised’ diets, because pig is often the most abundant domestic mammal on sites in western central Italy (King 1999b, 2001; Mackinnon 2004). However, there are other explanations which could account for their prevalence on military sites. For example, the fecundity and large litter size of pigs has been cited as a factor that may have contributed to their prevalence on early military sites, in addition to its suitability for preservation (Cavallo *et al.* this volume; Grant 2004: 373; Thomas this volume), an idea supported by the sharp decline in the proportions of pig bones seen at some military sites in later periods (Grant 1989: 137; King 2001: 217–8). In some localities the high proportions of pigs may reflect environmental factors (*e.g.* Luff 1982: 248) and/or earlier traditions. The three Gauls (*Belgica, Lugdunensis, Aquitania*), for example, are characterised by high proportions of cattle and pigs, the latter of which may have had a middle-late Iron Age origin (King 1984, 1999b). Social status and ethnicity might also be influential factors since auxiliary sites and their *vici* tend to show lower proportions of pigs than legionary fortresses; in Britain, legionary sites often have more than 20% pig bones (out of the total number of cattle, sheep/goat and pig) and fewer sheep/goat bones than auxiliary sites (King 1984: 189). Certainly, the edict of Diocletian (A.D. 301) provides support for the idea that pork was highly esteemed, since it is listed as the most expensive of meats (Graser 1940).

Long distance trading

In recent years there has been much debate regarding the extent to which the importation of food was necessary to meet the alimentary needs of the Roman military (*e.g.* Frere and Fulford 2001; Sauer 2002), particularly within the context of invasion. While some have argued for the importation of food and fodder (*e.g.* Fulford 1984, 2000; Peddie 1997) others have argued that the population impact of the Roman army would have been insufficient to place too great a strain on local resources (*e.g.* Sauer 2002: 347), and/or that the conquest was met in some regions with an agricultural landscape already capable of producing a surplus (*e.g.* Groenman-van Waateringe 1980; Haselgrove 1989). Certainly, in some of these areas, client or friendly kingdoms were already producing a surplus that was being supplied as tribute or trade prior to ‘official’ Roman conquest (Mattingly 2006).

Clear archaeological evidence for the supply of imported grain exists at a number of military sites in the north-west provinces, as evidenced by the presence of non-native plants and insect pests. In Britain the importation of grain has been identified at pre-Boudiccan contexts in London (Straker 1984), in a store within a military annexe dating to the Flavian period at Caerleon (Helbaek 1964), from a military warehouse in York dating from A.D. 70–120 (Kenward and Williams 1979), and from an early third century A.D. granary at South Shields that was used as a supply base for the army as part of the re-conquest of Scotland (Van der Veen 1988). In The Netherlands, imported grain has been significantly linked to the military presence in the region (Kuijper and Turner 1992; Pals and Hakbijl 1992), while the presence of rice at the Roman castellum of Neuss on the German *limes* (Knörzer 1970) further testifies to long distance transportation.

Such evidence implies that in certain circumstances local production, even in regions that had pre-conquest evidence for a developing economy, may not have been capable of producing a sufficient surplus to meet the needs of the Roman military (Dark and Dark 1997: 109; Mattingly 2006: 511). This may in part have reflected the unsuitability of the local environment (*e.g.* Kooistra 1996); however, it could also attest to the size of the invading army and its destabilising effects on local production (Mattingly 2006: 511). Alternatively, military commanders may

have considered it prudent (for political, tactical or fiscal reasons) to avoid reliance upon local resources for essential supplies, regardless of whether or not production requirements could be met. Of course, evidence for imports also implies that a surplus was being produced elsewhere, an idea supported by the presence of large granaries at both military and non-military sites (Bakels 1996; Derremaux *et al.* this volume), and that the Roman administrative and military organisations not only had access to it but also had the logistical infrastructure to move it to where it was required.

At South Shields, the evidence for importation was based on the presence of bread wheat (*Triticum aestivum*), which was not previously known in the region; thus, it was not possible to establish whether it was imported from another region within the same province (*i.e.* southern England) or further afield (Van der Veen 1988). However, in London the identification of minor quantities of einkorn (*Triticum monococcum*), lentils (*Lens culinaris*) and bitter vetch (*Vicia ervilia*) led to the suggestion that the source of the crop was the Mediterranean or the Near East (Straker 1984). That some foodstuffs were moved considerable distances is also supported by the presence of weed seeds native to Eastern Europe amongst a cargo of grain in a wreck off the Dutch island of Texel (Manders 1993).

It is worth observing that we cannot exclude the possibility that some provinces may have been engaged in both the importation and exportation of grain at various times. Although as yet unsubstantiated by archaeobotanical evidence, historical evidence points to the export of cereals and cattle from Britain from the early first century, while in the Julian period (mid fourth century) later Roman sources indicate the reinstatement of grain exports to supply the army along the Rhine frontier (Mattingly 2006: 491, 505).

In terms of staple animals, much of the archaeological evidence indicates the presence of local supply (see below); it is possible that preserved meat was being transported some distance, but archaeologically this is very difficult to detect if it was transported off the bone. Due to problems with meat spoilage, meat is best transported either in a processed form (*e.g.* salted, dried, smoked or pickled) or 'on the hoof' as live animals, unless the supply source is very close. The presence of shoulder bones with characteristic 'hook damage' on military sites (*e.g.* Luff 1982: 252) indicates that some meat had been preserved by smoking or salting (although see Nicholson 1996). Unfortunately, it is not possible with standard zooarchaeological techniques to ascertain whether this occurred at the site on which the scapulae are found or whether they were imported after processing somewhere else. Stable isotope analysis might offer a means by which this could be established in the future, however, and this technique could also be applied to investigate the possibility of long-distance droving of livestock. Based on the variability in sheep tooth-wear patterns from Roman Portchester, Grant (1989: 138) has postulated that military sites were supplied with food from a number of farmers, exploiting different environments or relying on stock with different genetic constitutions, but how far these animals were transported is much harder to ascertain. From the German provinces, evidence for intra-regional exchange does exist, however. For example, in Tolsum, The Netherlands, a wax tablet records the purchase of cattle from Frisia by a military purchaser in the first century A.D. (Carroll 2001: 97; see also Johnstone this volume).

While evidence for the importation of meat is difficult to discern, there is some potential evidence for the importation of live animals. One well recognised feature of faunal assemblages of Roman date is the increased average size and increased diversity in size of domestic stock (*e.g.* Lauwerier 1988; Maltby 1981; Teichert 1984; von Petrikovits 1980). The importation of new stock is one explanation to account for these changes, a theory that has been convincingly

argued at some sites (e.g. Murphy *et al.* 2000). However, this is not necessarily the only explanation; other causes of size changes include selective breeding of existing stock, improved nutrition, changed management practice or even changes in sex ratios represented in the death assemblage (e.g. Filean this volume). It should be noted that in some areas, such as northern England and Wales, there is a paucity of data for pre-Roman Iron Age livestock, and the few sites that have provided animal bones show that some larger animals already existed in the region (Stallibrass 1995) which may indicate that the situation varied geographically. Moreover, the extent to which the presence of larger animals was a phenomenon that can be linked solely to the military presence is unclear. In Britain, for example, the trend towards larger domesticates occurs more extensively in what King (1991: 17) terms the most ‘highly romanised area’ of the south-east compared with the ‘most militarised area’ – the north. There is also the possibility that larger animals were required for specific circumstances such as religious sacrifices, rather than as a staple commodity for standard consumption. At the site of Great Holts Farm, Essex, UK, for example, one particular deposit which contained metapodials belonging to very large cattle, also included the bones of a sparrowhawk, and a botanical assemblage containing olive stones and stone pine bracts, suggesting ritual activity – although this was not a conclusion drawn out by the individual specialists in the report (Germany 2003: 196, 208–9). If larger livestock individuals were imported, it is unlikely that Britain consistently received substantial numbers due to the logistical problems of importing large live animals via a sea crossing. It is much more likely that, if animals were imported rather than developed locally, then they would have been imported in small numbers and kept as breeding stock, at which point they would have become a ‘local’ supply rather than an import. Clearly, this is a complex issue requiring multiple lines of evidence and tight chronological control.

With respect to non-staple food stuffs, military sites have produced a range of both local and imported plants. At the mid-second century A.D. fort of Bearsden located along the Antonine Wall in Scotland, the range of additional plant foods included: lentil, horse bean (*Vicia faba*), dill (*Anethum graveolens*), wild celery (*Apium graveolens*), coriander (*Coriandrum sativum*), fig (*Ficus carica*), strawberry (*Fragaria vesca*), blackberry/raspberry (*Rubus* sp.), and hazel (*Corylus avellana*; Dickson 1989). The presence of lentil, dill, fig, and coriander probably testify to the presence of imported foodstuffs, although it is not possible to completely discount the local cultivation of coriander and dill. Similar evidence has also been found on native settlement sites in The Netherlands; at De Horden (Province of Utrecht), the presence of dill, coriander and lentil which were not known from pre-Roman contexts provide possible evidence of exchange with the Roman military in the first and second centuries A.D. (Lange 1990).

Some of these exotic plants appear very early in the post-conquest period. Coriander, poppy (*Papaver* sp.), celery and dill have all been found on a range of military sites in Britain from the late first century to the mid-second century A.D., while figs and grape (*Vitis vinifera*) have been found in the earliest post-conquest levels alongside local fruits – elderberry (*Sambucus nigra*), raspberry and cherry (*Prunus avium*) – at Colchester (A.D. 44–49; Cool 2006: 120, table 7.3). It is possible that the presence of these plant foods represent requirements of a new dietary tradition brought with the invading army; however, their long distance transport may have conferred upon them a luxury status (Van der Veen 2007), and their consumption may have been restricted to certain members of military communities or may reflect personal purchases rather than staple supplies.

While less extensive, potential evidence for the long distance supply of animals for food also exists. The identification of garden dormouse (*Elomys quercinus*) from a third-fourth century

A.D. context at the Roman fort of South Shields, may testify to the importation of this animal for food, and is supported by an additional find from the early third century A.D. in York (O'Connor 1988; Younger 1994). However, further work on climate and environmental change is required to investigate the potential viabilities of some of the exotic plant and animal remains found beyond their twenty-first century distributions. Kenward (2004), for example, has argued for warmer climates in the Roman period based on the habitat requirements of various invertebrate species. The presence of shellfish on inland sites on the other hand, is incontrovertible evidence for long distance movement of animal foods. For example, the oysters (*Ostrea edulis*) from Benwell fort on Hadrian's Wall are believed to have been harvested from southern England (Davies 1971: 129). In a first century A.D. context from the military settlement at Nijmegen (The Netherlands), imported food was found in the form of the brisquets of song thrushes, which are thought to have come from the Ardennes or Eifel and complete, probably salted, chub mackerels (*Scomber japonicus*) from the Mediterranean (Lauwerier 1993).

Further evidence for the long-distance supply of foodstuffs derives from the vessels in which plants and plant-food products were transported. Evidence for dates, for example, comes largely in the form of particularly shaped amphorae, which are common on early military sites in Britain (e.g. Carlisle, Exeter and Kingsholm). Olives (*Olea europaea*), too, are known by the presence of the amphorae they were transported in (as well as by their stones), and in Britain these are also primarily found on first-century A.D. sites. The origins of the amphorae at Colchester (A.D. 44–60/1) for example, show food imports from Spain, France, Italy and Greece (Cool 2006: 175; Sealey 1985). Amphorae containing olive oil and wine were also shipped from the Mediterranean to the German provinces via the Rhône, Rhine and inland waterways (Carroll 2001: 84) and it seems likely that these trade routes may have been used to supply Britain with luxuries in the early post-conquest period (Jones and Mattingly 1990: 197).

In addition to illuminating aspects of longer distance transportation, the movement of these items can also inform upon wider economic systems. For example, in Britain both date and olive amphorae begin to disappear around the middle of the second century A.D. (Cool 2006: 124), in a phenomenon that may be linked to a reduction in military personnel at this time (Fulford 1989: 183, 1991: 44). However, this may have also partly reflected the growing 'economic independence' of the province, with the successful substitution of Mediterranean products by British equivalents (Mattingly 2006: 594). In either case, there appears to have been a reduction in the scale of importation of olive amphorae during the third century in Britain associated with a switch in source area from Baetica in Spain to localities in North Africa. This switch has been variously connected to the rise in production of olive oil in north Africa, the accession of an African emperor (Septimus Severus) and the proximity of Africa to Rome (Williams and Carreras 1995: 235).

The movement of processed animal products can also be detected through the presence of the vessels in which they were transported. Fragments of amphorae containing fish sauce (e.g. *garum* or *allec*) are present in abundance on early military assemblages in Britain (e.g. Kingsholm, Exeter and Wroxeter; Cool 2006: 60). Intriguingly, there appears to be no evidence for the Iberian fish sauce amphorae by the later second century in Britain. This mirrors the trend observed for olive and date amphorae, and these imports may too have been superseded by indigenous production in Britain (Cool 2006: 61–62).

Local production/supply

While the archaeological evidence demonstrates the importation of particular foodstuffs, especially small luxury items such as herbs, spices and sauces, the over-riding mode of supply to military sites within the north-west provinces appears to have been reliant upon local produce. In some regions, this dependence can be identified in the immediate aftermath of the conquest. The evidence from the earliest sites following the Roman invasion of Britain in A.D. 43, for example, reveals relative proportions of domestic mammals that are almost identical to native sites (King 1978: 211; 1984: 193; Thomas this volume). This conclusion is also supported by the analysis of the distribution of body parts, which indicates that whole animals were being transported to military sites for consumption ‘on the hoof’.

Reliance on local produce has also been identified in archaeobotanical assemblages in the north-west provinces. In Britain, at the early military levels in Castleford, West Yorkshire, barley is the dominant cereal suggesting a dependence on what was immediately available in quantity in the aftermath of the conquest (Bastow 1999; Cool 2006: 186). Such a pattern supports the animal bone evidence from the same site, which reveals that the age profile of the cattle in the earliest military contexts (early 70s – mid 80s A.D.) was broader than in later military levels (c. mid 80s – mid 90s), possibly indicating that soldiers were getting what they could, rather than considering the longevity of the herd (Berg 1999; Cool 2006: 186). The more restricted ranges of ages at death observed by the later first century may indicate that husbandry had been adapted to provide a sustainable surplus. A similar shift in practice from an initial ‘take what is there’ policy to a more controlled system in which specific products were targeted is also seen in the nature of timber supplies to the forts along Hadrian’s Wall. Timber foundations for ramparts have been found at several forts with low-lying, damp locations that have permitted long-term preservation of wood through waterlogging. These timbers were taken from a variety of species that were mostly abundant locally and included high quantities of alder (*Alnus glutinosa*). Conversely, later constructions tended to concentrate more on oak, which has better construction qualities (Huntley *et al.* in press).

Further evidence for local supply exists in the form of hunting and fishing. While the hunting of game typically appears to have formed only a very minor addition to military diet (e.g. Grant 1981; Thomas this volume), at the third to fourth century A.D. forts in Britain at Caister-on-Sea, Norfolk, and Segontium, Gwynedd, high proportions of deer have been recorded. Relatively high numbers of red deer bones have also been observed at Vindolanda, Northumberland, U.K. (Hodgson 1977). Cool (2006: 113) notes that both Caister and Segontium are located in marginal areas and suggests that the consumption of wild taxa is perhaps reflective of their local availability. Certainly at Vindolanda, which is located in an upland area, the pollen and timber evidence indicates that woodland continued to provide suitable habitats for wild animals. However, an increasing reliance on wild resources might also indicate a weakening of supply chains, or disruption to agricultural production, which necessitated a broadening of the resource base; the putative consumption of badger (Caister) and seal (Segontium) could be used to support this hypothesis, although they may equally indicate a desire for a change in diet and the serendipitous exploitation of local fauna. The presence of bones of black grouse at many sites in the Hadrian’s Wall area certainly indicates a willingness of soldiers to procure fresh, tasty meat (Stallibrass 1995). The presence of fresh-water fish and locally-available shellfish at some sites also testifies to the exploitation of local resources (Davies 1971: 129). The degree to which fish were exploited is difficult to assess for many sites due to a paucity of

sieved samples, but where comprehensive sieving programmes have been instigated, it seems clear that some regions bordering the North Sea and the Atlantic obtained remarkably few fish from local waters (*e.g.* Huntley *et al.* in press; Stallibrass 2002: 402). This under-exploitation is also observed in Britain and Belgium during the preceding late Iron Age but, interestingly, not in The Netherlands where various freshwater and marine species were exploited prior to the Roman invasion (Dobney and Ervynck 2007).

In addition to identifying the importance of locally available foodstuffs, archaeological research has ascertained something of the impact that the establishment of military settlements had on local production. At the site of Noordbarge (The Netherlands), for example, the presence of the army for approximately 15 years coincided with the increased production of rye, reflecting the short-term pressure that was imposed by the presence of a military intent on absorbing available surplus (Van Zeist 1981). Elsewhere, however, the short-term impact of the military appears to have been either non-existent or archaeologically invisible. For example, the macrobotanical remains from the cover-sand area west of Breda (Noord-Brabant province, The Netherlands) showed no substantial difference in the plants recovered from rural contexts of Roman date compared with the preceding late Iron Age (Kooistra in press). In Britain too, there appears to be little indication that the presence of military settlements resulted in an immediate change in the manner of local production (Grant 1989: 138; Jones 1991: 25). Indeed, Jones (1981) has argued that the conquest marked a period of stagnation and that agricultural intensification did not occur until 200 years after the incorporation of Britain into the Roman Empire (*i.e.* from the later third century). It has been subsequently suggested that it was only extensification (the introduction of production to previously uncultivated areas) that enabled the demands of the Roman army to be met (Jones 1991: 26), an idea that is supported by the extensive evidence for wetland drainage in this period and the changes to field patterns and cultivation practices in the limestone uplands of the central Pennines (Rippon 1999; Van der Veen and O'Connor 1998). However, we must also consider the possibility that productivity may have been aided by a climatic amelioration across Europe in this period (Kenward 2004; Lamb 1981, 1982).

Certainly, there is some indirect, palynological, evidence for woodland clearance and the expansion of arable cultivation following the Roman conquest (Dark 1999: 264) although it must be noted that this is a continuation of later Iron Age land clearance (*e.g.* Hanson and Macinnes 1991: 88) and not a sudden phenomenon (Huntley 1999, 2007). At some sites, such as Fozy Moss (only 200 m north of Hadrian's Wall), forest clearances appear to have been extensive and to have continued into the post-Roman period, and may have resulted from the military requirements of timber and possibly the freeing up of this land for arable cultivation (Dumayne 1993). Localities which experienced limited Roman military influence, however, appear to show no palynological change (*e.g.* Fyfe *et al.* 2003). But the associations of Roman invasions and increased land clearance are complex, and many areas demonstrate continued use of cleared land for a couple of centuries after the Roman army had left the region, with regeneration of woodland not occurring until the early Medieval period (*e.g.* sixth or seventh centuries AD in northern England: Huntley 1999). We are not yet in a position to assess the quantities and potential productivity of 'extra' arable and pastureland cleared during the Roman period: could they have been used to produce sufficient 'extra' resources to feed the immigrant population of soldiers and associated civilians in the military zones?

While the nature of the foodstuffs supplied to military sites in the early post-conquest period appears to have been largely conditioned by what was locally available, changes in both production and supply do appear to have resulted from the longer-term presence of the military

in the north-west provinces. At the rural settlement site of Feddersen Wierde, north Germany, for example, an increase in the number of animal stalls from 98 to 443 by the second and third centuries A.D. has been taken to indicate the intensification of cattle husbandry sometime in the first or beginning of the second century A.D. (Wells 1996). At the Batavian settlement at De Hordern (Province of Utrecht, The Netherlands), situated on the border of the Roman empire, a rise in grassland and a decline in cereals indicated improved care for livestock and a shift away from arable husbandry in the first and second centuries A.D., which has been interpreted as a shift from subsistence to commercial production with a focus on meat and hides for the Roman market (Lange 1990: 146).

In Britain, changes in the meat diet have been detected at Flavian period (A.D. 69–96) military sites (e.g. King 1991; Hamshaw-Thomas and Bermingham 1993). From this period, military sites exhibit high proportions of cattle and pig bones and relatively few sheep/goat bones, with the former reaching 90% of the total number of cattle, sheep/goat and pig at some sites. Moreover, the cattle and sheep/goats were slaughtered at an older age than they were in the preceding Iron Age. King (1984: 198, 1991: 17) argues that this shift reflects a process of ‘romanisation/gallicisation’ of diet following the establishment of supply networks geared to providing preferred stock, which enabled the military to transfer an already ‘institutionalised’ diet reflecting their own origins in Germany and Gaul, into Britain. By the late third and fourth centuries A.D. in Britain the differences between military and civilian settlements in terms of food consumed becomes much less marked because of the shift towards a higher proportion of cattle amongst civilian settlements, which has been taken to indicate civilian emulation of a military diet (King 1984: 193). However, it should also be remembered that by this period, many civilians in the frontier zones had family connections with army personnel, and similarities may reflect ambiguous identities rather than conscious emulation. It is also possible that people’s choices were simply constrained by production systems designed to provide military supplies.

As Grant (1989: 139) observes, caution must be exercised in assuming that the plants and animals present on a site only reflect dietary preference (*sensu* King). Thus, the increased proportion of cattle might be linked to the increased necessity for cattle to pull ploughs on heavier soils and/or increased/more intensively cultivated land (Grant 1989: 138; Murphy *et al.* 2000; Van der Veen and O’Connor 1998: 132). The trend towards increasing proportions of cattle may also be part of a longer-term trajectory of development, since in some places it appears to have originated in the late Iron Age (Grant 1989: 137). In addition, other forms of evidence would suggest that socio-economic developments occurring in the Flavian period may have facilitated the development of a market economy and resulted in the observed changes in animal husbandry practice (Fulford 1989; Hamshaw-Thomas 2000: 168). We must also consider the possibility that the military demand for leather may have partly conditioned the nature of animal husbandry regimes (Grant 1989: 140).

Volume structure

Taking on board this background of previous research, this volume seeks to synthesise different strands of evidence in the consideration of the production and supply of food to the Roman army in the north-west provinces through the use of worked-through case studies. The volume is structured in a broadly chronological fashion. The second chapter provides a general introduction to the issues surrounding the reconstruction of military supply in frontier societies, by applying existing economic models to explore the social and economic relationship between a military

settlement located in north-west Britain and its hinterland (Carrington). This is followed by three chapters which present the archaeobotanical and archaeozoological evidence from sites dated to the earliest stages of Roman conquest (Thomas, Derremaux *et al.*, Cavallo *et al.*), and permit comparison with late Iron Age sites in the same regions to understand the nature and impact of early military supply. The latter of these papers (Cavallo *et al.*), together with the contributions of Groot and Filean, form a trilogy of papers which detail the nature of food supply to sites along the Dutch *limes* from the point of conquest through to the fourth century A.D. The next two papers detail indirect evidence for food supply within the Roman north-west provinces, using the movement of ceramics (Gerrard) and the use of equids (Johnstone). The final chapter (Stallibrass and Thomas) considers the sum of new knowledge demonstrated by this research and our previous understanding, highlights existing gaps in our understanding and offers suggestions for the direction of future research.

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Bibliography

- Bakels, C.C. 1996. Growing grain for others or how to detect surplus production. *Journal of European Archaeology* 4: 329–336.
- Bastow, M.E. 1999. The botanical material. In P. Abramson, D.S. Berg and M.R. Fossick (eds) *Roman Castleford. Excavations 1974–85 Volume II: the Structural and Environmental Evidence*. Yorkshire Archaeology 5. Wakefield: West Yorkshire Archaeology Service: 163–222.
- Berg, D.S. 1999. The mammal bones. In P. Abramson, D.S. Berg and M.R. Fossick (eds) *Roman Castleford. Excavations 1974–85 Volume II: the Structural and Environmental Evidence*. Yorkshire Archaeology 5. Wakefield: West Yorkshire Archaeology Service: 223–279.
- Bishop, M.C. 1991. Soldiers and military equipment in the towns of Roman Britain. In V.A. Maxfield and M.J. Dobson (eds) *Roman Frontier Studies 1989. Proceedings of the XVth International Congress of Roman Frontier Studies*. Exeter: University of Exeter Press: 21–27.
- Boenke, N. 2005. Organic resources at the Iron Age Dürrenberg salt-mine (Hallein, Austria) – long-distance trade or local sources? *Archaeometry* 47 (2): 471–483.
- Buckland, P. 1981. The early dispersal of insect pests of stored products as indicated by archaeological records. *Journal of Stored Products Research* 17: 1–12.
- Burnham, B.C. and Wachter, J.S. 1990. *The 'Small' Towns of Roman Britain*. London: Batsford.
- Campbell, G. and Hammon, A. in prep. Plant and animal husbandry. In B. Cunliffe and C. Poole (eds) *The Danebury Environs Roman Project: Introduction*. Oxford: English Heritage/Oxford University Committee for Archaeology, Monograph.
- Carroll, M. 2001. *Romans, Celts & Germans: the German Provinces of Rome*. Stroud: Tempus.
- Cool, H. 2006. *Eating and Drinking in Roman Britain*. Cambridge: Cambridge University Press.
- Dark, P. 1999. Pollen evidence for the environment of Roman Britain. *Britannia* 30: 247–272.
- Dark, K. and Dark, P. 1997. *The Landscape of Roman Britain*. Stroud: Sutton Publishing.

- Daróczy-Szabó, L. 2004. Animal bones as indicators of *kosher* food refuse from 14th century A.D. Buda, Hungary. In S.J. O'Day, W. Van Neer and A. Ervynck (eds) *Behaviour Behind Bones: the Zooarchaeology of Ritual, Religion, Status and Identity*. Oxford: Oxbow Books: 252–261.
- Davies, R.W. 1971. The Roman military diet. *Britannia* 2: 122–142.
- Dickson, C. 1989. The Roman army diet in Britain and Germany. *Archäobotanik. Dissertations Botanicae* 133: 135–154.
- Dickson, C. and Dickson, J. 1988. The diet of the Roman army in deforested central Scotland. *Plants Today* July-August: 121–126.
- Dobney, K. and Ervynck, A. 2007. To fish or not to fish? Evidence for the possible avoidance of fish consumption during the Iron Age around the North Sea. In C. Haselgrove and T. Moore (eds) *The Later Iron Age in Britain and Beyond*. Oxford: Oxbow Books: 403–418.
- Dumayne, L. 1993. Invader or native? – vegetation clearance in northern Britain during Romano-British time. *Vegetation History and Archaeobotany* 2 (1): 29–36.
- Frere, S.S. and Fulford, M. 2001. The Roman invasion of A.D. 43. *Britannia* 32: 45–55.
- Fulford, M.G. 1984. Demonstrating Britain's economic independence in the first and second centuries. In T.F.C. Blagg and A.C. King (eds) *Military and Civilian in Roman Britain: Cultural Relationships in a Frontier Province*. Oxford: British Archaeological Reports British Series 136: 129–142.
- Fulford, M. 1989. The economy of Roman Britain. In M. Todd (ed.) *Research on Roman Britain 1960–89*. London: Society for the Promotion of Roman Studies: 175–201.
- Fulford, M. 1991. Britain and the Roman Empire: the evidence for regional and long distance trade. In R.F.J. Jones (ed.) *Roman Britain: Recent Trends*. Department of Archaeology and Prehistory, University of Sheffield: J.R. Collis Publications: 35–47.
- Fulford, M. 2000. The organisation of legionary supply: the Claudian invasion of Britain. In R.J. Brewer (ed.) *Roman Fortresses and their Legions*. London: Society of Antiquaries: 41–49.
- Fyfe, R., Brown, A.G. and Rippon, S.J. 2003. Mid- to late-Holocene vegetation history of Greater Exmoor, UK: estimating the spatial extent of human-induced vegetation change. *Vegetation History and Archaeobotany* 12: 215–232.
- Germany, M. 2003. *Excavations at Great Holts Farm, Boreham, Essex, 1992–94*. Chelmsford: East Anglian Archaeology 105.
- Goody, J. 1982. *Cooking, Cuisine and Class. A Study in Comparative Sociology*. Cambridge: Cambridge University Press.
- Grant, A. 1981. The significance of deer remains at occupation sites of the Iron Age to the Anglo-Saxon period. In M. Jones and G. Dimbleby (eds) *The Environment of Man: the Iron Age to the Anglo-Saxon Period*. Oxford: British Archaeological Reports British Series 67: 205–213.
- Grant, A. 1989. Animals in Roman Britain. In M. Todd (ed.) *Research on Roman Britain 1960–89*. London: Society for the Promotion of Roman Studies: 135–146.
- Grant, A. 2004. Domestic animals and their uses. In M. Todd (ed.) *A Companion to Roman Britain*. Oxford: Blackwell Publishing: 371–391.
- Graser, E.R. 1940. The edict of Diocletian on maximum prices. In F. Tenney (ed.) *An Economic Survey of Ancient Rome Volume V. Rome and Italy of the Empire*. Baltimore: The John Hopkins Press: 305–421.
- Greene, K. 1986. *The Archaeology of the Roman Economy*. London: B.T. Batsford Ltd.
- Groenman-van Waateringe, W. 1980. Urbanization and the north-west frontier of the Roman empire. In W.S. Hanson and L.J.F. Keppie (eds) *Roman Frontier Studies 1979: Papers Presented to the 12th International Congress of Roman Frontier Studies*. Oxford: British Archaeological Reports International Series 71: 1037–1044.
- Hamshaw-Thomas, J. 2000. When in Britain do as the Britons: dietary identity in early Roman Britain. In P. Rowley-Conwy (ed.) *Animal Bones, Human Societies*. Oxford: Oxbow Books: 166–169.
- Hamshaw-Thomas, J.F. and Bermingham, N. 1993. Analysis of faunal remains. In A.R. Hands (ed.) *The Romano-British Roadside Settlement at Wilcote, Oxfordshire. I. Excavations 1990–1992*. Oxford: British

- Archaeological Reports British Series 232: 167–210.
- Hanson, W.S. and Macinnes, L. 1991. Soldiers and settlement in Wales and Scotland. In R.F.J. Jones (ed.) *Roman Britain: Recent Trends*. Department of Archaeology and Prehistory, University of Sheffield: J.R. Collis Publications: 85–92.
- Haselgrove, C. 1989. The later Iron Age in Southern Britain and beyond. In M. Todd (ed.) *Research on Roman Britain 1960–89*. London: Society for the Promotion of Roman Studies: 1–18.
- Hastorf, C.A. 1990. Gender, space and food in prehistory. In J.M. Gero and M.W. Conkey (eds) *Engendering Archaeology: Women and Prehistory*. Oxford: Basil Blackwell Press: 132–159.
- Helbaek, H. 1964. The Isca grain, a Roman plant introduction in Britain. *New Phytologist* 63 (2): 158–164.
- Hodgson, G.W.I. 1976. *Vindolanda II: The Animal Remains 1970–1975*. Haltwhistle: Barcombe Publications.
- Huntley, J.P. 1999. Environmental evidence from Hadrian's Wall. In P. Bidwell (ed.) *Hadrian's Wall 1989–1999. A Summary of Recent Excavations and Research*. Carlisle: Cumberland and Westmorland Antiquarian and Archaeological Society and Society of Antiquaries of Newcastle upon Tyne: 48–64.
- Huntley, J.P. 2007. Environmental evidence from the Iron Age in north central Britain: putting archaeology in its place. In C.H. Haselgrove and R. Pope (eds) *The Earlier Iron Age in Britain and the Near Continent*. Oxford: Oxbow Books: 135–143.
- Huntley, J., Gates, T. and Stallibrass, S. in press. Landscape and environment. In M. Symonds and D. Petts (eds) *A Research Framework for Hadrian's Wall World Heritage Site*. London: English Heritage.
- James, S. 2006. Engendering change in our understanding of the structure of Roman military communities. *Archaeological Dialogues* 13 (1): 31–36
- Jones, B. and Mattingly, D. 1990. *An Atlas of Roman Britain*. Oxford: Basil Blackwell.
- Jones, M.K. 1981. The development of crop husbandry. In M.K. Jones and G.W. Dimbleby (eds) *The Environment of Man: the Iron Age to the Anglo-Saxon Period*. Oxford: British Archaeological Reports British Series 67: 95–127.
- Jones, M. 1991. Food production and consumption – plants. In R.F.J. Jones (ed.) *Roman Britain: Recent Trends*. Department of Archaeology and Prehistory, University of Sheffield: J.R. Collis Publications: 21–27.
- Kenward, H.K. 2004. Do insect remains from historic-period archaeological occupation sites track climate change in Northern England? *Environmental Archaeology* 9: 47–59
- Kenward, H. and Williams, D. 1997. *Biological Evidence from the Roman Warehouses in Coney Street*. The archaeology of York. 14: the past environment of York 2. London: Council for British Archaeology.
- Kimpe, K., Jacobs, P.A. and Waelkens, M. 2002. Mass spectrometric methods prove the use of beeswax and ruminant fat in late Roman cooking pots. *Journal of Chromatography A* 968: 151–160.
- King, A. 1978. A comparative survey of bone assemblages from Roman Britain. *Bulletin of the Institute of Archaeology, London* 15: 207–232.
- King, A. 1984. Animal bones and the dietary identity of military and civilian groups in Roman Britain, Germany and Gaul. In T.F.C. Blagg and A.C. King (eds) *Military and Civilian in Roman Britain: Cultural Relationships in a Frontier Province*. Oxford: British Archaeological Reports British Series 136: 187–217.
- King, A. 1991. Food production and consumption – meat. In R.F.J. Jones (ed.) *Roman Britain: Recent Trends*. Department of Archaeology and Prehistory, University of Sheffield: J.R. Collis Publications: 15–20.
- King, A. 1999a. Animals and the Roman Army In A. Goldsworthy and I. Haynes (eds) *The Roman Army as a Community: Including Papers of a Conference held at Birckbeck College, University of London on 11–12 January 1997*. Portsmouth: Rhode Island. *Journal of Roman Archaeology Supplementary Series* 34: 139–149.
- King, A. 1999b. Diet in the Roman world: a regional inter-site comparison of the mammal bones. *Journal of Roman Archaeology* 12: 168–202.
- King, A. 2001. The Romanization of diet in the Western Empire: comparative archaeozoological studies.

- In S. Keay and N. Terrenato (eds) *Italy and the West: Comparative Issues in Romanization*. Oxford: Oxbow Books: 210–223.
- Knörzer, K.–H. 1970. *Novaesium IV: Römerzeitliche Pflanzenfunde aus Neuss*. Berlin: Mann. Limesforschungen 10.
- Kooistra, L.I. 1996. *Borderland Farming. Possibilities and Limitations of Farming in the Roman Period and Early Middle Ages Between the Rhine and the Meuse*. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek.
- Kooistra, L. in press. Vegetation history and agriculture in the cover-sand area west of Breda (province of Noord-Brabant, The Netherlands). *Vegetation History and Archaeobotany*.
- Kuijper, W.J. and Turner, H. 1992. Diet of a Roman centurion at Alphen aan de Rijn, The Netherlands, in the first century A.D. *Review of Palaeobotany and Palynology* 73: 187–204.
- Lamb, H.H. 1981. Climate from 1000 BC to 1000 AD. In M.K. Jones and G.W. Dimbleby (eds) *The Environment of Man: the Iron Age to the Anglo-Saxon Period*. Oxford: British Archaeological Reports British Series 67: 53–65.
- Lamb, H.H. 1982. *Climate, History, and the Modern World* (second edition). London and New York: Routledge.
- Landon, D.B. 1997. Interpreting urban food supply and distribution systems from faunal assemblages: an example from colonial Massachusetts. *International Journal of Osteoarchaeology* 7 (1): 51–64.
- Lange, A.G. 1990. De Horden Near Wijk Bij Duurstede. *Plant Remains from a Native Settlement at the Roman Frontier: a Numerical Approach*. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek. Nederlandse Oudheden 13. Kromme Rijn Project 3.
- Lauwerier, R.C.G.M. 1988. *Animals in Roman Times in the Dutch Eastern River Area*. Nederlandse Oudheden 12. Amersfoort: Rijksdienst voor Oudheidkundig Bodemonderzoek.
- Lauwerier, R.C.G.M. 1993. Twenty-eight bird briskets in a pot; roman preserved food from Nijmegen. *Archaeofauna* 2: 15–19.
- Lauwerier, R.C.G.M. and de Vries, L.S. 2004. Lifting the iceberg – BoneInfo and the battle to save archaeological information. In R.C.G.M. Lauwerier and I. Plug (eds) *The Future from the Past. Archaeozoology in Wildlife Conservation and Heritage Management*. Oxford: Oxbow Books: 167–175.
- Livarda, A. in prep. *Introduction and Dispersal of Exotic Food Plants into North-West Europe During the Roman and Medieval Periods*. University of Leicester: Unpublished PhD. Dissertation.
- Luff, R.-M. 1982. *A Zooarchaeological Study of the Roman North-West Provinces*. Oxford: British Archaeological Reports International Series 137.
- MacKinnon, M. 2004. *Production and Consumption of Animals in Roman Italy: Integrating the Zooarchaeological and Textual Evidence*. Portsmouth: Rhode Island. Journal of Roman Archaeology Supplementary Series 54.
- Maguire, D.J. 1983. The identification of agricultural activity using pollen analysis. In M. Jones (ed.) *Integrating the Subsistence Economy*. Oxford: British Archaeological Reports International Series 181: 5–18.
- Maltby, M. 1981. Iron Age, Romano-British and Anglo-Saxon animal husbandary – a review of the faunal evidence. In M. Jones and G. Dimbleby (eds) *The Environment of Man: the Iron Age to the Anglo-Saxon Period*. Oxford: British Archaeological Reports British Series 87: 185–190.
- Manders, M. 1993. Twee graanschepen. Een botanische studie van de lading. In R. Reinders and A. van Holk (eds) *Scheepslading*. Groningen: Inleidingen gehouden tijdens het zesde Glavimans symposium: 19–31.
- Mattingly, D. 2006. *An Imperial Possession: Britain in the Roman Empire, 54 BC-A.D. 409*. London: Allen Lane.
- Miles, D., Palmer, S., Smith, A. and Jones, G.P. 2007. *Iron Age and Roman Settlements in the Upper Thames Valley: Excavations at Claydon Pike and Other Sites Within the Cotswold Water Park*. Oxford: Oxbow. Thames Valley Landscapes Monograph 26.

- Morris, P. 1979. *Agricultural Buildings in Roman Britain*. Oxford: British Archaeological Reports British Series 70.
- Murphy, P., Albarella, U., Germany, M. and Locker, A. 2000. Production, imports and status: biological remains from a late Roman farm at Great Holts Farm, Boreham, Essex, UK. *Environmental Archaeology* 5: 35–48.
- Nicholson, R.A. 1996. Butchery versus biostratigraphy. A short note on a perforated goat (*Capra*) scapula. *Circaea* 12 (2): 248–249.
- O'Connor, T.P. 1988. *Bones from the General Accident Site*. The Archaeology of York 15/2. London: Council for British Archaeology.
- Pals, J-P. and Hakbijl, T. 1992. Weed and insect infestation of a grain cargo in a ship at the Roman fort of Laurium in Woerden (Province of Zuid-Holland). *Review of Palaeobotany and Palynology* 73: 287–300.
- Parker, A.J. 1992. *Ancient Shipwrecks of the Mediterranean and the Roman Provinces*. Oxford: British Archaeological Reports International Series 580.
- Peacock, D.P.S. 1986. *Amphorae and the Roman Economy: an Introductory Guide*. London: Longman.
- Pearce, J. 2002. Food as substance and symbol in the Roman army: a case study from Vindolanda. In P. Freeman, J. Bennett, Z.T. Fiema and B. Hoffmann (eds) *Limes XVIII. Proceedings of the XVIIIth International Congress of Roman Frontier Studies held in Amman, Jordan (September 2000) Volume II*. Oxford: British Archaeological Reports International Series 1084 (II): 931–944
- Peddie, J. 1997. *Conquest: the Roman Invasion of Britain*. Stroud: Sutton.
- Petrikovits, H. von. 1980. *Die Rheinlande in Römischer Zeit mit einem Überblick über die Rheinische Urgeschichte*. Düsseldorf: Schawann.
- Reece, R. 2002. The future of Roman military archaeology... In R.J. Brewer (ed.) *Birthday of the Eagle. The Second Augustan Legion and the Roman Military Machine*. Cardiff: National Museums & Galleries of Wales: 179–191.
- Rees, S. 1979. *Agricultural Implements in Prehistoric and Roman Britain*. Oxford: British Archaeological Reports British Series 69.
- Rippon, S. 1999. Romano-British reclamation of coastal wetlands. In H. Cook and T. Williamson (eds) *Water Management in the English Landscape*. Edinburgh: Edinburgh University Press: 101–121.
- Roth, J.P. 1999. *The Logistics of the Roman Army at War (264 B.C.–A.D. 235)*. Leiden: Brill. Columbia Studies in the Classical Tradition 23.
- Sauer, E. 2002. The Roman invasion of Britain (A.D. 43) in imperial perspective: a response to Frere and Fulford. *Oxford Journal of Archaeology* 21(4): 333–363.
- Scheidel, W. 1996. The demography of the Roman imperial army. In W. Scheidel (ed.) *Measuring Sex, Age and Death in the Roman Empire. Explorations in Ancient Demography*. Ann Arbor, Michigan: Journal of Roman Archaeology Supplementary Series 21: 95–138.
- Schia, E. 1994. Urban Oslo and its relation to rural production in the hinterland – an archaeological view. In A.R. Hall and H.K. Kenward (eds) *Urban-Rural Connexions: Perspectives from Environmental Archaeology*. Oxford: Oxbow Books. Symposia of the Association for Environmental Archaeology No. 12: 1–12.
- Schibler, J., Ginella, F. and Hüster-Plogmann, H. 2005. La Faune. In M. Reddé (ed.) Oedenburg: une agglomération d'époque Romaine sur le Rhin Supérieur. *Gallia* 62: 257–265.
- Scott, E.M. 2007. Pigeon soup and plover in pyramids: French foodways in New France and the Illinois Country. In Twiss, K. (ed.) *The Archaeology of Food and Identity*. Carbondale: Center for Archaeological Investigations Occasional Publication No. 34: 243–259.
- Sealey, P.R. 1985. *Amphoras from the 1970 Excavation at Colchester, Sheepen*. Oxford: British Archaeological Reports British Series 142.
- Stallibrass, S. 1995. Review of the vertebrate remains. In J.P. Huntley and S. Stallibrass (eds) *Plant and Vertebrate Remains from Archaeological Sites in Northern England: Data Reviews and Future Directions*. Durham: Architectural and Archaeological Society of Durham and Northumberland, Research Report No. 4: 84–198