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ORIGINAL ARTICLE

Indian Ocean Food Globalisation and Africa

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Abstract While Africa has sometimes been peripheral to accounts of the early Indian Ocean world, studies of food globalisation necessarily place it centre stage. Africa has dispatched and received an extraordinary range of plants, animals and foodstuffs through Indian Ocean trade and other avenues. Here we explore these patterns of food globalisation vis-à-vis Africa, focusing in particular on the arrival of new food crops and domesticated animals in Africa, but also touching on flows from Africa to the broader Indian Ocean world. We look at archaeological evidence, drawing in particular on new datasets emerging through the increasing application of archaeobotanical and zooarchaeological methods in African and Indian Ocean archaeology, and also draw on historical and ethnographic sources. We argue that the evidence points to a broadly Medieval and post-Medieval pattern of introduction, with little evidence for the earlier arrivals or culinary impacts argued by some. We also undertake consideration of questions about how and why new crops, animals, spices, and agricultural and culinary technologies come to be accepted by African societies, issues that are often overlooked in the literature.

Résumé Bien que l'Afrique soit parfois placée à la périphérie du monde de l'océan Indien, les études de la mondialisation alimentaire placent ce continent au centre de la scène. L'Afrique a exporté et reçu un extraordinaire éventail de plantes, d'animaux et de denrées alimentaires à travers le commerce de l'océan Indien. Ici, nous explorons

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ces modèles de mondialisation alimentaire. Plus particulièrement, nous nous concentrons sur l'arrivée de nouvelles cultures alimentaires et d'animaux domestiques en Afrique, et examinons les flux au départ de l'Afrique vers le reste du monde de l'océan Indien. Nous prêtons attention aux sources archéologiques, et passons notamment en revue les nouvelles données générées par l'application croissante des méthodes archéobotaniques et archéozoologiques en Afrique et dans l'océan Indien. Nous nous appuyons également sur les sources historiques et ethnographiques. Nous soutenons que ces données suggèrent que ces éléments furent introduits largement au cours des périodes médiévales et postmédiévales, et que peu de preuves pointent vers des arrivées antérieures. Nous explorons également comment et pourquoi ces nouvelles cultures, espèces animales, épices et technologies agricoles et culinaires furent acceptées par les sociétés africaines, des questions que la littérature archéologique a souvent tendance à négliger.

Keywords Cuisine · Species translocation · Prehistory · Medieval period · Maritime trade

Although Africa has sometimes been peripheral to historical accounts of the Indian Ocean world (Alpers 2009; Boivin *et al.* 2013), studies of food globalisation in the Old World necessarily place it centre stage. Not only has Africa dispatched a range of native plants, animals and foodstuffs to other parts of the world, it has also received an astounding array of biological species and culinary introductions from neighbouring and distant realms through Indian Ocean trade and other avenues (Boivin *et al.* 2013). This paper will focus on the exchange of plants and animals, both as foods and translocated species, between Africa and the Indian Ocean world, loosely defined, covering the period from the earliest transfers up to Medieval times. It will offer a broad overview, focusing on a selection of examples, rather than providing a comprehensive account.

The concept of food globalisation (Bonanno *et al.* 1994; Goodman and Watts 1997; Inglis and Gimlin 2009) recognises the historical and contemporary connections and flows that characterise regional cuisines and food economies. It more frequently focuses on modern or recent historical examples of food exchanges (*e.g.*, Mintz 1985; Cook and Crang 1996; Mintz and Dubois 2002; Phillips 2006; Carney and Rosomoff 2009; Gupta 2012), but earlier processes of food globalisation are increasingly at the heart of historical and archaeological research agendas (*e.g.*, Kiple 2007; Jones *et al.* 2011; Boivin *et al.* 2012). The topic of food globalisation touches on a broad array of themes and issues, ranging from the regional and long-distance transfer of foodstuffs and the agents and economic infrastructures that enable them, to the internationalisation of cuisines, the transfer of agricultural technologies and the impacts of introduced plants and animals on local ecosystems. While we will touch on a number of these themes, limitations of current evidence for the region and periods of interest will necessitate a focus on the movement of plant and animal species. Our sources are primarily archaeological, but we also draw on textual, ethnohistoric and ethnographic evidence. The focus on archaeological data is aimed at highlighting datasets, many new, that have featured less frequently in discussions of food globalisation, particularly in the Indian Ocean region. We address foods that have an Indian Ocean origin as well as others that originate elsewhere but arrive *via* Indian Ocean routes or become part of

Indian Ocean cuisines. In what follows, we explore some of the mechanisms that drive Indian Ocean food transfers, and then examine food transfers in pre-Medieval and then Medieval times, noting the sharp contrast across these broad phases in the intensity of Indian Ocean influence on foodways. In the final section, we explore some of the wider cultural, economic and ecological impacts of Indian Ocean plants and animals introduced to Africa.

Mechanisms of Indian Ocean Food Transfers

Food, and the plant and animal species from which it is made, moves for a whole variety of reasons. One obvious motive for transporting food from one region to another is to address food shortages. These might be occasional, as when natural catastrophes lead to famine, or they might be chronic, as was often the case as societies became increasingly urbanised and began to outstrip the capacity of local production to support them. But the transport of foodstuffs was driven just as often by indulgent as by practical motivations. The famous and very ancient spice trade provides an obvious example (Miller 1968; Turner 2004), but a wide variety of today's staples were transported as luxury goods in the ancient world, including, for example, sugar and rice. Rare or exotic food items and species often acquired symbolic meanings that drove long-distance acquisition and trade (Boivin *et al.* 2012). Its centrality to sustenance and capacity for elaboration have ensured that food has long constituted a fixture in the human symbolic universe, finding meaning in ethical, religious, social and cosmological systems of understanding, behaviour and materiality (Farb and Armelagos 1980; Goody 1982; Counihan and Van Esterik 2012; Douglas 2013). Certain foods have therefore come to imply as well as to impart purity, aestheticism, godliness or high status as well as decadence, depravity or low status. Though processes of semiosis are of course relevant, the power of food comes not just from processes of abstract symbolisation (see also Lupton 1996; Holtzman 2006). By becoming part of our fundamental physical make-up, food has the power to transform our very matter. It is for this reason that the boundaries between food and medicine have always been (and continue to be—think about the newly designated "superfoods" or rise of food intolerances in the West) extremely hazy. Both sugar and rice were accordingly funnelled through channels of trade and travel not just as high status foods but also as medicines, as was the case, for example, in the Classical world (Boivin *et al.* 2012).

It is not just foods that move, however, but the plant and animal species from which they are derived. The ancient world saw the transport of grain, processed fish, oil and wine, and containers of spices, but it also witnessed the movement of an equally vast array of live species, many of which became established in new regions very far from their original range. Live species were transported for a variety of reasons. They were moved as food sources, but plants were also used as sources of fibre, dye, perfume, oil, fodder, wood and (as we have seen) medicine, and animals were used for transport, traction, pest control, musk perfume and sport, for example. Species movements were associated with a range of human activities. Colonisation, for example—either initial colonisations or the subsequent arrival of new groups—invariably involved the movement of live plants and animals. Alfred Crosby (2004) referred to as "portmanteau biota" the species of domesticated crops, animals and weeds that Europeans brought with them and established in the New World and elsewhere. Such a portmanteau biota, including dogs, chickens, banana, yam and taro, also travelled with Austronesian voyagers many thousands of years ago and co-settled the islands of the Pacific (Kirch 1997). Austronesian language-speakers are also suggested to have brought some of these same species across the Indian Ocean to Africa (Blench 1996; Fuller and Boivin 2009; Beaujard 2011; Boivin *et al*. 2013). There is emerging evidence to suggest that colonies of Indian craftspeople transplanted native crops across the Bay of Bengal to mainland Southeast Asia by the end of the first millennium BC (Castillo and Fuller 2010). Whether Indian colonists did the same at Red Sea ports around the same time period is less clear. Sites such as Berenike and Quseir al-Qadim appear, like Khao Sam Kaeo in Thailand, to possess quarters occupied by people from India (Tomber 2008; Sidebotham 2011), but it seems less likely that any of the Indian foods found at the Egyptian port sites were actually grown locally; much more probable is that they were all imported as part of a burgeoning maritime trade at the start of the first millennium AD. Not only traders and craftsmen but also sailors, pilgrims, slaves, political envoys and monks were all active travellers who likely helped transport food and species long before the modern era.

There was also a booming trade in exotic species in the ancient world, beginning as early as the Bronze Age, when they often served as gifts or tribute (Foster 1998). Species from distant lands frequently stood as symbols of power and status, and processes of "botanical imperialism" led to the import of plants for royal gardens, which in some cases came to serve as "warehouses of biodiversity" (Pollard 2009). Many plants began the often long journey from exotic to cash crop through this process (see also Schiebinger and Swan 2007). Live animals were also shipped in surprisingly large numbers all around the ancient world, most notably in the Roman period when coliseum events, for example, sometimes involved thousands of live animals imported from various corners of the empire (Hughes 2003). Other animals were used in hunting (as prey or assistants) but many domesticated animals also moved, often to provide new exotic varieties or to replace animals that did not thrive in local habitats—as illustrated by the hundreds of thousands of horses transported to China over the millennia. Import substitution—where species initially imported as food became locally established—was an important process that might see plants and animals established centuries after they first appeared as food items. It is important to bear in mind that translocation was only sometimes an elite or structured process, however. It also occurred as a part of everyday processes of travel, interaction and exchange. Translocation might happen when food provisions remained at the end of a sea voyage, for example, enabling leftover seeds to be planted or live animals to be introduced into a new environment.

Differentiating between imported foods and imported live species in the archaeological record is not necessarily straightforward, and most archaeological analyses rely on the assumption that very small quantities of non-native plant and animal remains in early phases possibly signal imports while larger quantities indicate locally raised and grown foods. For example in Harappan-era Gujarat, small quantities of barley grains alongside thousands of millets, ubiquitous across samples, have been taken to suggest import of barley from Indus Valley production areas (Weber 1991; Fuller and Madella 2001). Crop-processing remains, from early crop-processing stages, might be taken to argue for local production, although even crop-processing by-products may sometimes be exchanged, for example as fodder (see, *e.g.*, van der Veen 2007). The evidence of landscapes or ecological transformations associated with the cultivation of introduced crops might also indicate their local production; for example, paddyfield systems for rice production have been reported from parts of Asia (Barnes 1990; Fuller and Qin 2009) and can be used in some cases to map the spread of rice cultivation. Nevertheless, field systems known from Africa remain ambiguous with regards to the crop types grown (*e.g.*, Stump 2006). Mechanisms of food and species transport are even more elusive, particularly in prehistoric periods, though various clues can be drawn upon to suggest more or less likely interpretations.

The Earliest Evidence

Probably the earliest example of Indian Ocean food globalisation involving Africa took place by around four thousand years ago and involved the translocation of five African crops to India (Fig. 1). The crops, consisting of sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum glaucum*), finger millet (*Eleusine coracana*), cowpea (*Vigna unguiculata*) and hyacinth bean (*Lablab purpureus*), were domesticated in different parts of sub-Saharan Africa, but it is unclear whether they moved to India *via* the same route or along different pathways (Fuller 2003; Fuller and Boivin 2009). Indeed their very translocation at this early date has been controversial, since the domesticated forms of these plants in India appear for the most part thousands of years before similar evidence in Africa. This led to the suggestion that sorghum was moved as a wild plant, domesticated in India and then re-introduced to Africa in the first millennium BC (Haaland 1999). The current absence of domesticated sorghum in Africa at the relevant time period almost certainly reflects the lack of excavated sites bearing sorghum remains, however, rather than a real absence of the domesticated forms. This has begun to be demonstrated through new studies that have led to finds of pearl millet and cowpea in western Africa (Ghana and/or Mali) that predate those of India (D'Andrea *et al*. 2001, 2007; Manning *et al*. 2011; Manning and Fuller 2014), and that have now pushed back evidence of sorghum in Sudan to at least 1500 BC (Beldados and Costantini 2011; Fuller 2014) (Fig. 1). Nevertheless, evidence for the dispersal of pearl millet and cowpea across Africa to the east (between Ghana and the Red Sea) is still lacking, as are assemblages with domesticated sorghum remains that predate their appearance in Indian contexts (by 1700 BC).

The five African crops arrived initially in Gujarat in western India during the Late Harappan period (2000–1700 BC) and gradually spread to other parts of the subcontinent (Fig. 1). Some of them had reached peninsular India by 1600–1500 BC, and all of them were reasonably widespread in India by *ca*. 1000 BC (Fuller and Boivin 2009). A single find of castor oil seed (*Ricinus communis*) from the Chalcolithic of the Ganges plains (dating to the later second millennium BC) could also represent an early translocation from Africa (Fuller 2003). The routes and agents of these crops' eastward dispersal out of Africa remain enigmatic. Their absence from archaeobotanical assemblages on the Arabian peninsula until centuries or even millennia later might suggest a more direct sea route (Boivin and Fuller 2009). Certainly sea trade between the eastern Arabian peninsula and western India (and present-day Pakistan) was very active from the latter half of the third millennium BC until the end of the first quarter of the second millennium BC, involving precious goods, but also basic foodstuffs and other organics

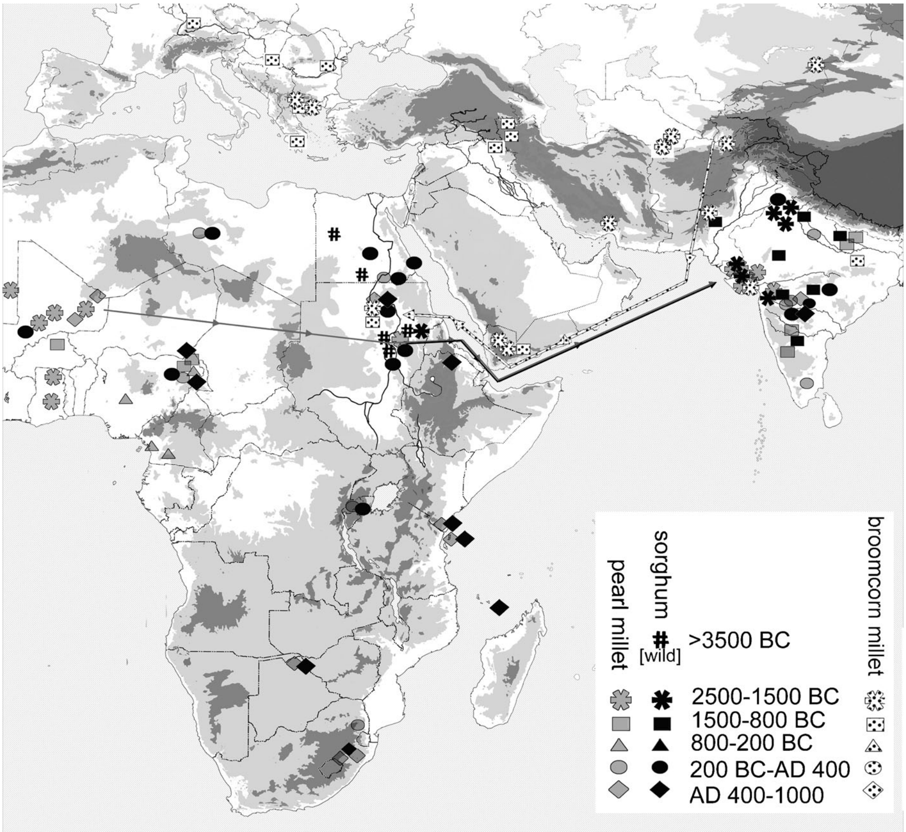

Fig. 1 Distribution of early archaeobotanical evidence for sorghum, pearl millet and broomcorn millet. *Arrows* indicate probable Indian Ocean maritime dispersal trajectories. Note that dispersal of pearl millet and sorghum from northern African savannahs to India was earlier than southern dispersal trajectories within sub-Saharan Africa (see references in text; also Boivin *et al*. 2013). Early finds of broomcorn millet in Yemen and Sudan pre-date evidence for overland adoption in Mesopotamia and Egypt, suggesting a similarly maritime route once the crop reached South Asia. On the dispersal of pearl millet see Manning *et al*. (2011), Logan and D'Andrea (2012), Fuller and Hildebrand (2013), Kahlheber *et al*. (2014); on the dispersal of sorghum see Fuller and Hildebrand (2013), Fuller (2014); on the dispersal of broomcorn millet see Fuller and Boivin (2009), Valamoti (2013), Motuzaite-Matuzeviciute *et al*. (2013)

such as wood (Oppenheimer 1954; Possehl 1996; Ratnagar 2004; Boivin and Fuller 2009). However, it is important to emphasise the lack of evidence for any maritime contact farther west, though we might speculate on the possibility of exploration of the African coast by Indian ships, using coastal routes along the northern edge of the Arabian Sea. Coastal Gujarati communities have a long history of seafaring and trading; even after the Harappan civilisation began to decline, Gujarati communities continued to trade with the Gulf (Carter 2001; Boivin and Fuller 2009; Potts 1994), and Gujarati merchants dominated the Indian Ocean trade in the fourteenth and fifteenth centuries (Alpers 2009). The incense sources of southwestern Arabia may have been a draw for early Indian explorers, as might such African commodities as ivory, tortoise-shell and exotic slaves (Boivin and Fuller 2009; Boivin *et al*. 2013).

While the case for Bronze Age crop translocations from Africa to India is now well established, food and food species translocations in the other direction at this time period are far less clear. There is, however, at least one Asian crop, broomcorn millet (*Panicum miliaceum*), that came to Yemen and the Nubian Nile from Central Asia in part *via* an Arabian Sea route (Fuller and Boivin 2009) (see also Fig. 1). There are also suggestions, not yet supported by robust evidence, for the early arrival in Africa of two Asian domesticates, chicken and zebu cattle. Zebu (*Bos indicus*, domesticated in South Asia) may be present in Egypt by the second millennium BC and in the Chad basin of northeastern Nigeria by the sixth century BC, based on the presence of humped clay figurines (Epstein 1971, p. 513; Magnavita 2006; see discussion in Fuller and Boivin 2009). However, Magnavita (2006) has argued that these were quite limited in number relative to taurine cattle, and in Epstein's view (1971, p. 513), zebu were likely rare until the seventh century AD (also Gifford-Gonzalez and Hanotte 2011). It is important to note that using osteological criteria, no unequivocal zebu remains have been identified anywhere on the continent prior to the second millennium AD (Grigson 1991; Magnavita 2006). The early presence of chicken (*Gallus gallus*) in Egypt is meanwhile suggested by a few skeletal remains and depictions dating to the later second millennium BC; however, these are rare until after 650 BC (Coltherd 1966; Darby *et al*. 1977). Thus, it seems the earliest chickens in Egypt were exotic imports destined for menageries and cockfighting rather than culinary consumption (Houlihan and Goodman 1986). This status may explain why fowl are depicted on a queen's tomb in seventh century BC Nubia (Dunham 1955). It is only in the last centuries BC that faunal remains start to indicate incorporation of the chicken into local cuisine (MacDonald and Edwards 1993). Suggestions that chicken was present on Zanzibar by the first millennium BC and possibly much earlier at sites like Machaga Cave and Kuumbi Cave (Chami 2001, 2007) have been questioned (*e.g*., Sutton 2002) and have not been upheld by some recent research (Sinclair 2007; though see Mbassa and Assey 2009).

Another exotic food plant that showed up in Egypt in the Bronze Age was black pepper (*Piper nigrum*), native to southwestern India. However, its only known occurrence of this time period is in the mummy of Ramses II, placing its date at around 1200 BC (Plu 1985; Boivin and Fuller 2009) and marking it as an exceedingly rare import, probably used for ritual rather than culinary purposes. Sesame (*Sesamum indicum*) is also known from Egypt, from Tutankhamun's tomb, but this species plausibly spread from the Indus region overland as there is evidence of it in Mesopotamia by 2000 BC (Bedigian 2004a; Weisskopf and Fuller 2014). Sesame might have been used for its oil, but its seeds were also a nutritious condiment and could be ground into a protein-rich flour. In many parts of western Africa, from the west-central savannahs to parts of eastern Africa, native wild relatives of sesame (*e.g*., *S. radiatum*, *S. angustifolium*, *Ceratotheca sesamoides*) have long been used as green vegetables for their mucilaginous leaves (Burkill 1997; Bedigian 2004b). In many areas, introduced domesticated sesame (*S. indicum*) became as important as a leafy vegetable as it was a source of flavourful, oily seeds (Blench 1997; Bedigian 2004b). From the point of view of Asian traditions of sesame use, this represents a culinary innovation or culinary "Africanization" of sesame.

The recent identification of possible cinnamon (*Cinnamomum* sp.) residues (specifically cinnamaldehyde) from Early Iron Age (eleventh to mid-ninth century BC) Phoenician flasks in Israel (Namdar *et al*. 2013) might further support precocious establishment of a spice trade that saw the first trickle of Asian spices into North Africa and the Levant. Many of these would later become staple flavourings of Classical and Medieval cuisine in the Mediterranean, Middle East and parts of Africa. Other Asian species that may have appeared in Egypt in the second millennium BC (although probably not as food) are the commensal black rat (*Rattus rattus*) and the house mouse (*Mus musculus*), though again the few rare finds are disputed (Boivin *et al*. 2013). We have the vague sense of a possible coastal corridor linking Egypt to the Indian Ocean world, undoubtedly through a range of intermediaries.

One final crop that needs mentioning is the banana (*Musa* sp.). Two potential early findspots for banana in Africa have recently come to light. The earliest, and most controversial, is the site of Munsa in Uganda where banana phytoliths were identified in swamp core sediments dating to the fourth millennium BC (Lejju *et al*. 2006); the stratigraphic integrity and taxonomic identification of these samples have, however, been placed in doubt (Fuller and Boivin 2009; Neumann and Hildebrand 2009). A later, mid-first millennium BC, find of banana phytoliths has also been made from an Iron Age site in Cameroon (Mbida *et al*. 2000, 2001, 2006). Although this example has generally been seen as more secure (*e.g.*, Neumann and Hildebrand 2009), and in apparent agreement with linguistic and botanical evidence suggesting that bananas reached western Africa by 3000 BP (De Langhe *et al*. 1994–95; De Langhe 2007), this finding has also been disputed (Vansina 2003; *cf*. Mbida *et al*. 2004, 2005). More recent archaeobotanical work in the region has not revealed banana phytoliths in any other deposits of this time period (Neumann *et al*. 2012). Until more finds come to light, it is difficult to draw firm conclusions about the timing or routes of arrival of banana to Africa, though the variety of bananas present in the continent, as well as the pattern of their present-day distribution, clearly suggests multiple dispersals at different time periods and *via* varying routes. It seems likely, on the basis of emerging genetic data (Perrier *et al*. 2009, 2011), that the banana arrived *via* both direct sea voyage from Southeast Asia, and through Middle Eastern and Indian routes of trade in the Arabian Sea.

Spurred by the secure evidence of early botanical translocations between Africa and India, a significant body of literature now postulates a broader set of early translocations spanning the entire Indian Ocean and beyond (Blench 1996, 2010; Sorenson and Johannessen 2009; Fuller *et al*. 2011; Rangan *et al*. 2012). Significant social and economic impacts, such as the suggested role of the banana in fuelling Bantu migrations, have sometimes even been hypothesised (*e.g.*, Blench 2009). Overall, however, and despite a growing archaeobotanical and zooarchaeological corpus, firm evidence for Indian Ocean impacts on African culinary and economic pathways is exceedingly minimal and sporadic during the period outlined. The primary external influences on African foodways were rather from the Near East and the Mediterranean region (*e.g.*, Clutton-Brock 1993; Pelling 2005; Pereira *et al*. 2009; van der Veen 2011; Muigai and Hanotte 2013), and predominantly relegated until the late centuries BC to North Africa. This mirrors a broader Indian Ocean pattern of minimal long-distance connectivity. The fluorescence of coastal trade between Mesopotamia, the Gulf and the Harappan societies of South Asia in the later third and early second millennia BC appears to have been limited in both time and space. While maritime connections were active across Southeast Asia in the last millennia BC (and earlier) (*e.g.*, Solheim 2006; Bulbeck 2008; Denham and Donohue 2009; Denham 2010; Spriggs *et al*. 2011), neither the Bay of Bengal nor the Arabian Sea have provided evidence of significant long-distance connectivity or interaction prior to the latter half of the first millennium BC. Pre-first millennium AD Austronesian migrations to eastern Africa and

Madagascar remain entirely hypothetical and are not currently supported by solid evidence (Boivin *et al.* 2013).

Later Evidence

Political stabilisation, growing urbanisation and improvements in transport infrastructure saw an increase in Old World cultural exchange, trade and migration from the second half of the first millennium BC, culminating in the most extensive and far-reaching exchange and commercial networks to date. By the first century AD, ships regularly traversed both the Arabian Sea and the Bay of Bengal, and coastal trading networks were supported by a growing number of port towns and cities (Ray 1994; Tomber 2008; Sidebotham 2011). The first–century AD *Periplus of the Erythraean Sea* (Casson 1989) and other textual sources provide insights into a thriving commercial trade in a range of goods from metal to used clothing, and including wood, spices, incense, food and biological species. Yet the degree to which local culinary practices were transformed by wider Indian Ocean contacts remains unclear, especially given the dearth of archaeobotanical and zooarchaeological studies from relevant Indian Ocean regions. The limited evidence we have would suggest that impacts were minimal, with exotic plants and animals presenting in minor quantities in most assemblages.

In Africa, some of the best archaeobotanical and zooarchaeological evidence for this time period comes from Egypt, and particularly sites along the Red Sea coast. Vibrant sea trade with ports in the Arabian Sea and particularly southwestern India promoted the growth of a number of port sites in Roman Egypt (Sidebotham 2011). Arid desert conditions have encouraged the preservation of crop and animal remains at these and nearby inland sites, and several key archaeobotanical and zooarchaeological studies have been conducted, at port sites like Berenike (Cappers 1999, 2006) and Myos Hormos (Quseir al-Qadim) (van der Veen 2003, 2004, 2011; van der Veen *et al.* 2006), and such Eastern Desert sites as Mons Claudianus (van der Veen 1996, 1998, 1999, 2007). These demonstrate the clear presence in the Roman period of Asian plants like black pepper, rice (*Oryza sativa*), coconut (*Cocos nucifera*), mung bean (*Vigna radiata*), belleric myrobalan (*Terminalia bellirica*) and citron (*Citrus medica*) (Cappers 2006; van der Veen 2011). Exotic animals of Asian origin included black rat and chicken (van Neer and Lentacker 1996; Hamilton-Dyer 1997, 2001, 2011; van der Veen 2011). But despite these eastern introductions, van der Veen emphasises how very Mediterranean in character foodways at Myos Hormos remained. While a few Egyptian foods also supplemented the diet, basic staples were durum wheat (*Triticum durum*), barley (*Hordeum vulgare*) and lentils (*Lens culinaris*), while vegetables such as onions (*Allium sepa*) and garlic (*Allium sativa*) were common; oils and fats were provided by walnut (*Juglans regia*), pine nut (*Pinus pinea*), hazelnut (*Corylus avellana*) and sesame (*Sesamum indicum*); the most common fruits were grapes (*Vitis vinifera*), figs (*Ficus carica*), olives (*Olea europaea*), capers (*Capparis spinosa*) and dates (*Phoenix dactylifera*); and seasonings consisted primarily of black mustard (*Brassica nigra*), coriander (*Coriandrum sativum*) and fennel (*Foeniculum vulgare*) (van der Veen 2011, p. 233). Abundant amphora sherds evidence the quantities of Mediterranean wine, olive oil and fish sauce that were consumed at the site (van der Veen 2011, p. 233). As in the Mediterranean world (*e.g.*, van der Veen 2011; Livarda 2011), Indian Ocean foods remained rare luxuries and constituted a minor proportion of the diet (and some may have been focused predominantly on a particular group, for example rice and mung bean may have been imported primarily as provisions for Indian ships and traders; van der Veen 2011). This seems to have been the case for animal foods as well, the focus being on marine resources and Near Eastern domesticates (Van Neer and Lentacker 1996; Van Neer 1997; Van Neer and Ervynck 1998, 1999; Hamilton-Dyer 2011; Thomas 2012). Chicken, an Asian species, is present in minor quantities in Red Sea zooarchaeological assemblages and there is suggestion of both secular and ritual usage of this domesticate from various Egyptian sites in this time period (MacDonald and Edwards 1993; Hamilton-Dyer 1997, 2001, 2007).

Beyond the Egyptian evidence, few African sites bear traces of pre-Medieval Indian Ocean food links. There is little evidence for Indian Ocean food crops in the Horn of Africa and neighbouring Sahelian regions. Archaeobotanical assemblages from Ethiopia and Eritrea, including those from both pre-Aksumite and Aksumite phases, are dominated by Near Eastern winter crops (wheat, barley, chickpea, lentil) alongside small quantities of local African domesticates such as tef (*Eragrostis tef*) and finger millet (*Eleusine coracana*). No Indian Ocean plants have been identified in archaeobotanical assemblages of this period (*e.g.*, Boardman 1999; D'Andrea 2008). Chicken remains, however, have recently been reported from both pre-Aksumite and Aksumite contexts at Mezber in northern Ethiopia, dating between the early first millennium BC and early first millennium AD (D'Andrea *et al*. 2011). They also appear at the site of Aksum, albeit some centuries later in the Late Aksumite phase (sixth century AD) (Cain 2000). Evidence for zebu cattle in Aksumite-era sites is quite limited, despite arguments suggesting that contact between the Horn and Arabia was the source of the species' introduction to Africa (Payne 1964; Epstein 1971), a scenario also supported by genetic data. A figurine of a humped cow from Zeban Kutur in Eritrea dates to the second century AD (Ricci 1955–1958), while another at Matara likely dates to the sixth century AD (Anfray 1967). Rock paintings of humped cattle are documented at the sites of Adi Quanza and Laga Oda in Ethiopia and Addi Gelemo in Eritrea, but their dates are unknown. Beef was clearly a major food, judging by the cattle dominance in bone assemblages from Axum (Cain 1999), but this was likely based on long-established African cattle breeds. Milk products too may have been important, since historical linguistics reconstructed curds to a prehistoric period in Cushitic languages (Ehret 2011). Evidence from farther west in the Sudanese/Nubian region suggests similar absences of Indian Ocean food items, a notable exception being finds at post-Meroitic (AD 300–500) Qasr Ibrim of sesame seeds and black pepper (Clapham and Rowley-Conwy 2007).

Farther south, the coast known as Azania in Classical sources, south of the Horn and into central Tanzania, is described in the *Periplus* as regularly visited by ships from southeastern Arabia, but archaeobotanical and zooarchaeological studies of pre-Swahili sites, in particular by the Sealinks Project, have failed to find evidence of early non-African crops or livestock (Helm *et al*. 2012; Boivin *et al*. 2013; Shipton *et al*. 2013; Crowther *et al*. 2014, forthcoming). Flotation and archaeobotanical analysis across a range of island, coastal and coastal hinterland sites have not so far identified exotic crops prior to the eighth century. Nor has it so far been possible to confirm occasional reports of pre-seventh century exotic domesticates like chicken and zebu. Chickens are securely documented only after *ca*. AD 800 at Unguja Ukuu on Zanzibar (Prendergast and Quintana-Morales, forthcoming). Prior identifications of chicken in fifth/sixth–century contexts at this site (Juma 2004) should perhaps be treated cautiously in light of chronometric issues surrounding these early dates, and for chicken, the challenges of identification.

In western and southern Africa, evidence for pre-Islamic Indian Ocean plants and animals is similarly minimal. In western Africa, the only known Indian Ocean introduction from this time period is chicken, for which most evidence has only recently come to light. Skeletal remains and in some cases eggshell have been identified at sites dating to the first millennium AD, including Jenne-jeno in Mali (MacDonald 1992) and Kirikongo in Burkina Faso (Dueppen 2011). At the latter, chicken remains are dated to the sixth century AD and possibly four centuries earlier. This strengthens previous claims for first millennium AD chickens at Daboya in Ghana (Shinni and Kense 1989) and Kissi 22 in Burkina Faso (Linseele 2007). In southern Africa, chicken remains are not documented until the eighth–ninth century AD at Chibuene in Mozambique (Badenhorst *et al.* 2011). At Ndondondwane in South Africa, chicken and Asian rat remains (Voigt and Von den Driesch 1984) would appear to be stratigraphically later than a radiocarbon date of 1190±50 bp (cal AD 867–974; Pta-2389) (Maggs 1984, p. 78; Fowler and Greenfield 2009). Chicken and rat were also identified at Bosutswe in Botswana (Plug 1996), but radiocarbon inversions make dating dependent on pottery, firmly dated to AD 1000–1300 (E. Wilmsen, personal communication). Chickens and Asian rats thus do not appear on present evidence to have arrived in southern Africa earlier than the mid-tenth century AD. The archaeobotanical record has not produced any evidence of pre-Islamic Asian crop introductions in these regions.

It is thus not until the Medieval/Islamic period that we begin to see contact with the Indian Ocean world begin to make any kind of significant impact on African foodways. During this phase, the evidence for Indian Ocean influences becomes overwhelming, however, reflecting burgeoning trade and increasingly cosmopolitan regional cuisines. Islam helped bring together and spread the gastronomic influences of a range of disparate cultures, and also left behind the world's richest medieval food literature (Zaouali 2007). Medieval movements of foods and species had implications not just for culinary practices but also human health, agricultural systems and landscapes. The Medieval culinary shift in eastern Africa is illustrated most powerfully at the Egyptian port site of Myos Hormos, abandoned at the end of the Roman period but reoccupied by the beginning of the second millennium, when it became known as Quseir al-Qadim. The Islamic period, beginning in the eleventh century, saw the introduction of a range of new crops at Quseir al-Qadim and a radical reorientation of culinary habits away from the Mediterranean world and towards the Indian Ocean one (van der Veen 2011). A variety of summer crops, driven by the seasonality not of the northern hemisphere but rather of the monsoon, begin to appear in the archaeobotanical assemblages of this period at the site, often in significant quantities. Many of these crops are of Asian origin, and some certainly arrived *via* Indian Ocean routes. The crops include such grain and legume crops as rice, sorghum, pearl millet and cowpea; tree crops like citrus (lime, *Citrus aurantifolia*, appears for the first time), the vegeculture crops taro (*Colocasia esculenta*) and banana, the garden crops watermelon (*Citrullus lanatus*) and aubergine (*Solanum melongena*), and potential cash crops such as cotton (*Gossypium* sp.) and sugarcane (*Saccharum* sp.). At the same time, classic Mediterranean foods, including wine, olive oil, olives, pine nuts and figs, are found in greatly reduced quantities compared to Roman levels, while fava beans (*Vicia faba*) and chickpeas

(*Cicer arietinum*) supercede the lentils and termis beans (*Lupinus albus*) common in Roman assemblages. Coriander and cumin (*Cuminum cyminum*) increased in popularity in the Medieval period at Quseir al-Qadim, and foods of Middle Eastern origin such as sumac (*Rhus coriaria*) and pistachio (*Pistacia vera*) were introduced. Van der Veen (2011, p. 238) notes that not only did the inhabitants of Quseir al-Qadim embrace these new foods, they also transformed agricultural systems to incorporate as many of them as possible within local farming practice. Animal husbandry and consumption practices similarly changed from the Roman to Islamic occupations: pigs disappeared, fish consumption declined, herd composition shifted from a balance of goat, sheep and cattle to a clear dominance of sheep; and chickens, though still a minor presence, became relatively more abundant (Wattenmaker 1979; Hamilton-Dyer 2011). Overall, there was a marked decline in faunal diversity at Medieval Egyptian Red Sea sites compared to the previous period. All of this coincides with a shift in ceramic assemblages away from the Mediterranean and towards the Indian Ocean world. Overall, Quseir al-Qadim shows all the signs of a site that is becoming incorporated into an emerging Islamic culinary sphere.

Farther south, the Swahili coast also demonstrates evidence for the beginnings of a transformation of foodways in association with increasing Indian Ocean interaction. Emerging trade relations are indicated by the presence of imported ceramics from China, India and particularly the Middle East, the latter mostly storage jars that probably contained oils and other liquids (Fleisher 2010), much of it for culinary consumption. Nonetheless, while new species do appear in the archaeobotanical record, these new trade links are not immediately followed by radical dietary transformations. Small quantities of Asian rice, probably indicative of imported foods, begin to show up in archaeobotanical assemblages at sites like Unguja Ukuu on Zanzibar and Chwaka on Pemba, and in larger quantities at sites in the Comores, in the final centuries of the first millennium AD (Wright 1984, 1992; Walshaw 2010; Crowther *et al.* forthcoming). A range of other Indian Ocean crops also begin appearing at the same time, likewise in small quantities. These include Asian millets (*Setaria* cf. *verticillata*, *Setaria* cf. *italica*), mung bean, sesame (*Sesamum* cf. *indicum*) and possibly citrus (*cf.* Rutaceae), which appear alongside Near Eastern crops such as wheat (*Triticum* sp.). Coconut (*Cocos nucifera*) also appears to have begun its rise to importance on the eastern African coast from this time period, being identified in archaeobotanical assemblages at sites dating from at least the eighth century AD onwards. While archaeobotanical evidence is still patchy, the overall pattern that is emerging suggests that this early phase of culinary experimentation and diversification was nonetheless very protracted and spatially varied—that is, the uptake of exotic crops was slow, and foreign plant foods rarely, if ever, appeared at sites other than major ports. Rather, African crops such as sorghum and pearl millet continued to be preferred for many centuries, demonstrating a strong and persistent preference for local foods by these coastal communities. Access to, or interest in, foreign foods was perhaps restricted in large part to the trading elite.

Initial appearances of chicken similarly indicate limited incorporation into local diets. By the eighth–tenth century AD, chicken seems to be present at Shanga (Horton and Mudida 1993), Pate (Wilson and Omar 1997) and Manda (Chittick 1984) in the Lamu archipelago; at Mgombani and Chombo in the Kenyan coastal hinterland (Helm and Mudida 2000); at Mtambwe Mkuu (Mudida and Horton 2014), Unguja Ukuu and possibly Fukuchani (Prendergast and Quintana-Morales forthcoming) in the Zanzibar archipelago; and at Mpiji on the central Tanzanian coast (Chami 1994). However, except at Shanga, chicken remains comprise just 1–2 % of the faunal assemblages. Identifying Asian zebu on the Swahili coast is complicated by ambiguous osteological criteria and the prevalence of taurine breeds on the mainland at this time. Thus, no attempts have been made to identify zebu at sites in Kenya and Tanzania. At Dembeni in the Comores, two specimens were attributed to zebu (Allibert *et al*. 1989), though neither has features to enable clear differentiation. Zebu have also been reported from the earliest settlement phase at the Indian Ocean trading port of Mahilaka on Madagascar, but the dating of this initial occupation is still unclear (Radimilahy 1998).

More radical transformations take place on the eastern African coast in the first half of the second millennium AD, when a major shift to rice consumption is seen, at least at the site of Chwaka on Pemba. This is accompanied by the more widespread use of open bowls for food consumption, suggesting a greater emphasis on communal consumption and possibly also feasting (Fleisher 2010; Walshaw 2010). Imported trade wares from AD 1000 onwards no longer focus on large storage jars but on serving vessels that seem to suggest a shift to publicly oriented consumption, as part of “empowering feasts” that helped to convert privileged trade relations into local symbolic capital (Fleisher 2010). New exotic Indian Ocean foods probably had a role to play in such processes. To the complement of exotic crops mentioned above, Swahili coast sites now add evidence for small quantities of poppy (*Papaver somniferum*, domesticated in central Asia) and pea (*Pisum sativum*, from southwest Asia), and possibly also foxtail millet (*Setaria* cf. *italica*, from north China) and black gram (*cf. Vigna mungo*, from South Asia) on Pemba (Walshaw 2005). Broad bean (*Vicia faba*, southwest Asia) appears slightly later (late fourteenth to early sixteenth century) at Songo Mnara (Walshaw and Pistor 2010). Comparative archaeobotanical data from the adjacent mainland coast and hinterland from the early second millennium AD are minimal, but it is noted that Indian Ocean influences in general appear less transformative there than on the offshore islands (*e.g.*, Pawlowicz 2011; Helm *et al*. 2012). Further inland in the Great Lakes region, however, historical linguistic evidence indicates that the banana also underwent a major phase of development during this period, involving varietal diversification, agricultural intensification and culinary elaboration. This process appears to have lasted several centuries, up to the mid-second millennium AD, and provided the basis for the banana-focused cuisine still apparent there today (Schoenbrun 1998, pp. 79–83). Some of this diversification was doubtlessly local, but some may also relate to continued introduction of new banana varieties from Asia.

By the early to mid-second millennium AD, chicken also appears at more sites across eastern and central Africa (Boivin *et al*. 2013), and is a significant component of faunal assemblages at a few coastal sites, such as Shanga and Tumbatu (Horton and Mudida 1996; Mudida and Horton 2014). At the same time, there is a decline in the proportion of wild fauna in coastal assemblages and important changes in livestock herd composition. Cattle began to outnumber caprines at a number of sites (Horton and Mudida 1996; Helm and Mudida 2000; Fleisher 2003), some of which are located on islands, such as Pemba, that are far better suited for grazing than other coastal areas. It is possible that the development of cattle pastoralism on the coast was enabled by cross-breeding imported zebu with local taurines to produce cattle that would be both drought- and disease-resistant; however, as noted above, osteological evidence to support such a proposition is sorely lacking.

There are some parallels here, at least in the zooarchaeological evidence, to the dietary shifts noted above at such Egyptian sites as Quseir al-Qadim in that there is a move away from a diverse diet—in the eastern African case, one based on hunting and fishing, with herding dominated by goats—to a more homogeneous diet, here based on mixed, cattle-dominated pastoralism and fishing. However, this is not true for all site types and locations, and diverse fishing–foraging–herding adaptations continued to thrive on the Swahili coast. In terms of the archaeobotanical remains, unfortunately too little flotation and analysis have been conducted at post-AD 1000 sites to gain a sense of broader patterns (*cf.* Walshaw 2010). We may nonetheless turn to the texts of Islamic and other travellers for insights into the consumption and cultivation of Indian Ocean crops, provided we recognise their biases and limitations, and the need for archaeobotanical sources of data before any firm conclusions can be reached. Al-Masudi, for example, stated that the banana was as abundant on Zanzibar as in India in the tenth century (Watson 1983, p. 54), while coconut was one of the main foods of the region (Watson 1983, p. 56), although millets were still seen as the primary staple. Sugarcane was also seen on the coast of eastern Africa in the tenth century, and according to Abu al-Hanifa, the finest sugar came from this region (Watson 1983, p. 30). By the twelfth century, according to al-Idrisi, many varieties of bananas were grown, as was rice (descriptions that might relate specifically to the Comores) (Freeman-Grenville 1975, pp. 19–24). Marco Polo observed that rice was the staple food of people in eastern Africa in the thirteenth century (Watson 1983, p. 17). In the mid-fourteenth century, the traveller Ibn Battuta described the lavish feast he was served by the sultan of Mogadishu, which included large platters of cooked rice served with relishes made of chicken, fish and vegetables, alongside dishes containing banana, lemon, ginger, mango, areca nut and betel leaf (Hamdun and King 1998, pp. 17–18). These descriptions in particular reveal the social importance of the consumption of exotic "luxury" foods and their role in feasting activities. Ibn Battuta also observed banana and citrus trees growing on the island of Mombasa, the former of which was described as a staple (Hamdun and King 1998, p. 22).

Some local culinary traditions continued despite newly introduced taboos: for example, turtles, widely considered *haram* by Muslims, were clearly exploited at Shanga, Fukuchani, Unguja Ukuu and Chibuene in contexts dating to and after the seventh–ninth century, at which point Islam would have been influential in at least some regions of the coast; turtle consumption continued at later sites such as Ras Mkumbuu, Mtambwe Mkuu and Tumbatu. Cut-marked turtle remains suggest consumption, though harvesting for tortoiseshell is also possible. Hyrax and giant rat—also considered *haram*—are found throughout the occupations at Fukuchani and Unguja Ukuu, and in part of the fourteenth century site of Tumbatu. In the ethnographic recent past and present, Walsh (2007) documents defiance of taboos on sea turtle, terrapin and bat consumption by Muslims on Pemba.

Given the broader patterns of plant and animal introductions and culinary change in eastern Africa, there is surprisingly little parallel evidence in the Horn of Africa. General patterns of Near Eastern and African crop consumption continued in the Horn, and Indian Ocean crops are so far absent from medieval plant assemblages in Sudan (Fuller and Edwards 2001; Clapham and Rowley-Conwy 2007). There is similarly minimal evidence for dietary shifts and Indian Ocean influences in southern Africa. As noted above, chicken is found at multiple sites after AD 1000 (Voigt and Von den

Driesch 1984; Plug 1996), but otherwise the domestic faunal assemblages of precolonial southern Africa are dominated by sheep, followed by cattle and goats (Smith 2000). Evidence for zebu or "sanga" crossbreeds is controversial, with a number of eighth–eleventh century sites in Zimbabwe, Botswana and South Africa producing thickened or bifid vertebral spines, humped figurines or both (Robinson 1958, 1959; Voigt 1983, 1986; Denbow and Wilmsen 1986); however, interpretations are problematic (Magnavita 2006). The dominant picture in southern Africa from both faunal and botanical evidence is of continued reliance on traditional African staples, with little outside influence (see review in Boivin *et al*. 2013). This is true even for sites with clear evidence for Indian Ocean trade, such as Chibuene, where chicken plays a minor role in the later phase (Badenhorst *et al*. 2011).

In western Africa, chicken becomes widespread after AD 1000 (Dueppen 2011) and is also found at this point in several central African contexts, including at least one ritual context, a Kisalian grave in the Upemba Depression, Congo (Van Neer 2000). Magnavita (2006) also notes an increase in figurative evidence for humped cattle in the Chad basin, perhaps as early as the eleventh century. Indian Ocean crops, on the other hand, are thus far absent from archaeobotanical assemblages (*e.g.*, Fuller 2000; Nixon *et al*. 2011). As in eastern Africa, the literary descriptions of Arab travellers such as al-Zuhri, al-Idrisi and Ibn Battuta can be used to augment the archaeological records. These sources indicate, for example, that sesame and sugar cane were both present in western Africa in the twelfth century (Burkill 1997; Alpern 2008), although these were more likely introduced *via* the Mediterranean. The presence of sour orange was also noted by travellers to the region in the fourteenth and sixteenth centuries (Watson 1983, p. 46).

African Crops in Asia

While African crops arrived much earlier in the Indian subcontinent than most Asian species reached Africa, we nonetheless observe a similar pattern there of significant culinary and agricultural transformations only in the Medieval period. Previous generations of scholars hypothesised that the early African crop introductions to India (which included sorghum, pearl millet and finger millet, as discussed above) were of great significance, providing the basis not only for summer (and thus two–season) cropping in South Asia but perhaps also initial farming in the peninsular region (*e.g.*, Hutchinson 1976; Possehl 1986). The accumulation of more systematic archaeobotanical data, however, has undermined this view. Early farming in peninsular and western India, for example, was based on indigenous summer crops (Fuller and Madella 2001; Fuller 2006), and African crops were probably somewhat later and much less significant in agricultural production and diet than previously supposed. As noted by Weber (1998), the African crop introductions can rather be seen as supplementing pre-existing indigenous millets (and pulses) that were adapted to the monsoon zone. It is also likely that they were incorporated into well-established, indigenous South Asian systems of millet processing and cuisine (Fuller 2005).

Mapping of archaeological identifications of African crops on early South Asian sites indicates that they did occur as a package, but generally appeared alongside already established crops (Fuller and Boivin 2009). Where better quantitative data are available, African crops appear to be a very minor component of early subsistence, and to increase in importance gradually into the Early Historic period (~2000 years ago) and thereafter. This trend is illustrated by data on regional ubiquity from South India (Fig. 2), which show the percentage of sites with crop data at which species have been reported. It is evident that African crops are much less often encountered than native crops overall, and while they become more common in the Early Historic contexts, they are still not amongst the most frequent crops recovered. While ubiquity is a blunt measure of how widespread a crop was, relative frequency of total seed counts provides some approximation of how much a species was used relative to other taxa. Summaries of data from three South Indian Neolithic sites in Karnataka and three phases of Early Historic Paithan, in Maharashtra, show that African crops remain quite infrequent compared to native millets, wheat, barley or rice (Fig. 3). This pattern is true through the Paithan sequence up to AD 700, although there is a trend for the African crops to increase. The dominance of dry cropping in peninsular India by sorghum, pearl millet and finger millet, which is found in modern and colonial times, would appear to have developed only sometime after AD 700, although we have no hard archaeobotanical evidence for this period in southern India.

There are a number of other crops of African origin that have come to India, for which we lack any archaeological evidence whatsoever. It is tempting to suggest that most of these may be later arrivals, given their absence in earlier assemblages in South Asia, though the lack of archaeobotanical study of post AD 300 contexts in the subcontinent precludes any firm conclusions. Another confounding factor is that there are several species of interest for which regions of origin remain open to debate, with both tropical Africa and tropical Asia being suggested. These include cultivars such as okra (*Abelmoschus esculentus*), brown mustard (*Brassica juncea*) and kenaf (*Hibiscus cannabinus*) suggested by Blench (2003) to have moved from Africa to India, as well as the tamarind tree (*Tamarindus indica*), widely claimed to be of African origin. A strong case can be made from ecology, historical linguistics (proto-Dravidian and Sanskrit) and

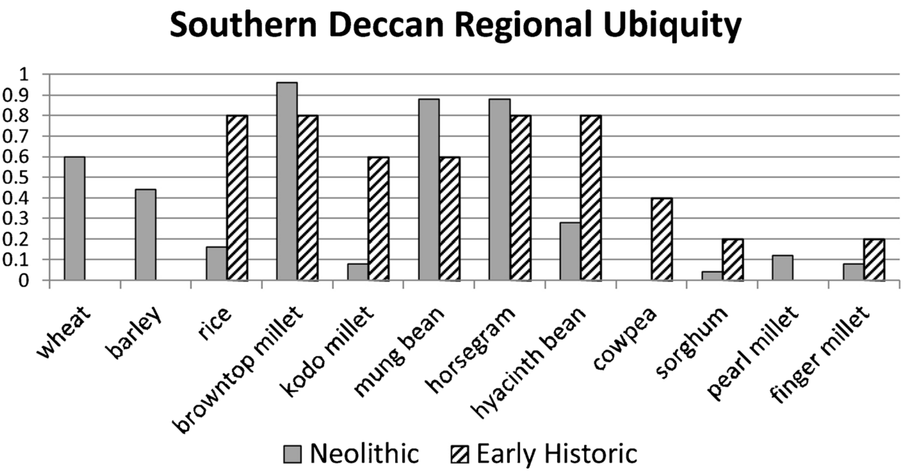

Fig. 2 A comparison of the regional ubiquity (% of sites on which a particular crop is present) of selected crops at Neolithic versus Early Historic period sites in the Southern Deccan region of India. Note the generally limited presence of African crops (hyacinth bean, cowpea, sorghum, pearl millet and finger millet), although these show increases towards later time periods

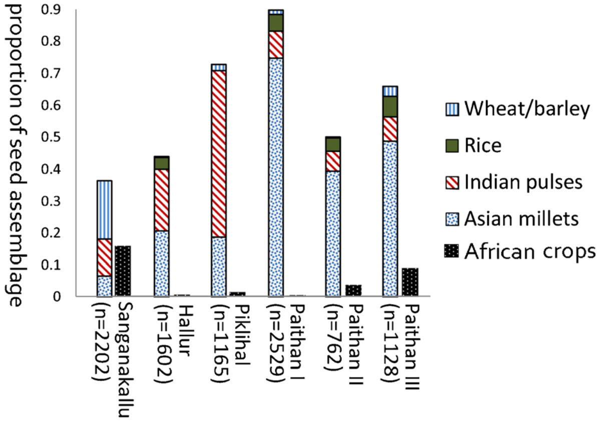

Fig. 3 Graph of the relative proportion of total site seed assemblages of selected Asian and African crops from three South Indian prehistoric sites in Karnataka (Sangakallu, 2000–1400 BC; Hallur, 2000–900 BC; and Piklihal, 1500–500 BC), and three phases of the Early Historic site of Paithan, Maharashtra (Paithan I, 300–0 BC; Paithan II, AD 1–300; Paithan III, AD 400–700). (Data from studies of D.Q. Fuller)

wood charcoal finds that tamarind is native to India, and that its Arabic name (*tamr hindi*, "date of India") might indeed be a useful marker for its introduction into northeast Africa (Asouti and Fuller 2008, p. 104). Brown mustard is now widely regarded as wild in central, southern and eastern Asia (Prakash 2011). The case of okra is complex as modern cultivars are hybrids between two species, *A. tuberculatus*, which is wild in Uttar Pradesh, India, and *A. ficulneus*, which is found in both western India and sub-Saharan Africa (Hamon and van Sloten 1995). While African *A. ficulneus* has certainly contributed its genome to modern okra cultivars, sea translocation must have carried Indian cultivars with *A. tuberculatus* chromosomes to Africa. There are reports, meanwhile, of archaeological okra from two Iron Age sites in west–central Africa (Nigeria) (Zach and Klee 2003; Bigga and Kahlheber 2011). It is plausible that these represent domesticated *A. ficulneus*, but it is less clear whether these reflect local domestication or introduction of and/or hybridisation with early Indian cultivars already by 2000 years ago, and further research on this matter is needed.

Crops that are more clearly of African origin include tubers, oilseeds, legumes, fibre crops and trees. Noog oilseed, native to Ethiopia, is important in India but its antiquity there is unknown. Its Indian names are normally compounds based on sesame, *e.g.*, "black sesame", indicating that it was probably adopted as a supplement to this long-established oilseed crop. Amongst the minor legumes of African origin cultivated in India are the winged bean (*Psophocarpus tetragonolobus*), the guar bean (*Cyamopsis tetragonoloba*) and the velvet bean (*Mucuna puriens*), which is now widely naturalised in anthropogenic habitats across tropical Asia. The dispersal histories of all these are completely unknown (Smartt 1990).

Another African plant that moves eastwards is baobab. Baobab is a cultivated tree of western African origin that was translocated across Africa and into the Indian Ocean through human activities. In the Indian Ocean, the tree is found in Madagascar, southern Arabia and parts of India and Sri Lanka, as well as in other regions as an ornamental (Wickens 1982; Pock Tsy *et al.* 2009). It is usually suggested to have been transported by Arab traders, although archaeological and historical evidence for the routes and chronology of its translocations is lacking (Burton-Page 1969). The concentration of Sri Lanka's baobab trees at Mannar in the northwest of the island is revealing, however, since the region's port, Mantai, was a major entrepôt of Indian Ocean trade, particularly from the second half of the first millennium AD. Baobab may also have moved across the Indian Ocean in association with slave movements, as it was in the Atlantic. Use of the tree as a food source is much more limited outside Africa (*e.g.*, Wickens 1982).

It was also sometime during the Medieval period that contacts between the Middle Eastern world and Africa brought one of the modern world's most important plantation crops out of its African wild habitat into trade and cultivation, namely coffee (*Coffea arabica*). Coffee is native to the lower slopes of the southwest Ethiopian plateau. There are a few controversial references in Arab sources that might refer to coffee as early as AD 1000. More clear is that its ritual drinking for night worship had become well established amongst Sufis in Yemen by the mid-fifteenth century, and that subsequent exports from the Middle Eastern world introduced the drink to Europe in the seventeenth century (Wild 2004). Expanding demand saw this wild Ethiopian bush translocated to European colonies across tropical Asia, Latin America and elsewhere in Africa, which fed the growing demand for coffee in Europe and in European trading enclaves, with coffee houses a venue for brokering trade in the sixteenth through seventeenth centuries.

Oil palm (*Eleais guineensis*) was another native of Africa that eventually developed into a plantation crop in tropical Asia. Oil palm had a long prehistory of use in West Africa, with archaeological and palynological evidence for widespread consumption and cultivation in west tropical Africa (*e.g.*, Ghana, Nigeria) starting between 2000 and 1500 BC (Sowunmi 1999; Logan and D'Andrea 2012; Orijemie and Sowumni 2014). This species was first introduced to a botanical garden in Dutch Java in 1848, while plantation cultivation began in 1905 and has massively expanded since (Berger and Martin 2000).

African crops have made important contributions to the cuisines, agro-biodiversity and landscapes of both South and Southeast Asia. This is more evident in South Asia, where some of these crops have been longer established. In the case of Southeast Asia, it is likely that field crops such as hyacinth bean, cowpea, sorghum and finger millet were introduced *via* India, and thus the presence of African plant domesticates in Southeast Asia does not attest to direct translocation from Africa to Southeast Asia.

Cultural and Ecological Impacts

The foods, plants and animals that moved around the Indian Ocean in antiquity gradually came to transform and shape local cuisines, food technologies, agricultural practices and landscapes. However, far from leading to a homogenisation of Indian Ocean foodways, new introductions were inevitably drawn into unique sets of associations, hybridising with local cosmologies, beliefs, processing technologies and agricultural practices. Nonetheless, we may observe recurrent patterns in the way that many new foods and species entered into Indian Ocean societies, in Africa and beyond. Such patterns, which may be modelled in three-dimensional space as shown in Fig. 4 (and discussed previously in Boivin *et al.* 2013), highlight some significant differences between the way that newly introduced crops and domestic animals entered into social, economic and agricultural practice in antiquity and in the pre-modern and modern eras. Whereas crop exchanges between the Old and New Worlds in the period after 1492, for example, frequently led to rapid uptake and planting on a significant scale, addressing subsistence and economic requirements, early crop exchanges often entailed much more gradual processes of uptake, with crops finding value in the social arena long before they became economically significant. We have reviewed these tendencies elsewhere (Boivin *et al.* 2013) but here focus on the meanings and impacts of foods, plants and animals introduced into Africa in antiquity. We also make a few observations about those that move in other directions, from Africa to other parts of the Indian Ocean world.

As the data discussed in previous sections make clear, many of the plants and animals that entered Africa from the Indian Ocean world in the pre-modern period, and for which we have at least some archaeological or other data, appear (1) to have entered initially in small quantities, in some cases probably as food imports, with significant quantities appearing in the archaeological record usually only centuries later; and/or (2) to have acquired special social or symbolic meanings. This is the case for Asian rice in several very different African contexts for example. It is found in both the Roman and Islamic periods in very small quantities in Egypt, but van der Veen suggests that it shifts in the Islamic period from being a rare imported commodity to a small-scale crop (van der Veen 2011, pp. 77–83). She suggests it is used primarily as a medicine in the Roman period (see also Boivin *et al.* 2012).

Archaeobotanical studies on the Swahili coast are fewer in number, but a similar trend may be noted. Rice initially appears in archaeobotanical assemblages dominated by African crops, and its low numbers suggest that it was perhaps primarily an imported commodity for several hundred years. From the eleventh century onwards, however, at least on Pemba, rice became a dominant staple and was clearly locally grown (Walshaw 2010). Whether this was the case at other Swahili sites remains unknown due to a lack of archaeobotanical investigation, though Marco Polo reported in the thirteenth century that rice was a staple for the people of eastern Africa (Watson 1983, p. 17). Walshaw (2010) has noted that rice specialisation was a somewhat risky undertaking on Pemba given the island's geology and geography and has argued that strong social rewards, including identification with Islam and the Indian Ocean world, encouraged the shift to rice and other Asian crops (like coconut) that clearly became more important in the second millennium AD. Across the Medieval Islamic world, however, rice seems to have been associated with a range of social meanings and uses. In some regions, it appears to have been a key crop and perhaps even a staple (Watson 1983), though in Medieval Islamic recipe books it is often associated with sweet dishes and/or recipes aimed at elite diners (Canard 1959; Samuel 2001; Zaouali 2007). Some textual sources describe it as food for the poor or famine food (or even practically a poison) (Canard 1959; Samuel 2001). What may have been more significant in the eastern African context than identification with Islam was the use of Indian Ocean foods and plants by increasingly urbanised and cosmopolitan Swahili societies to differentiate themselves from other African communities. That the Asian plants that were concentrated along the eastern African coast made Swahili settlements special is attested by ethnohistorical sources that describe how inland communities tried to give their towns a more coastal, and hence prestigious, appearance by importing from the coast and cultivating such trees as mango and coconut (Alpers 1969, p. 419, cited in Helms 1993, p. 20).

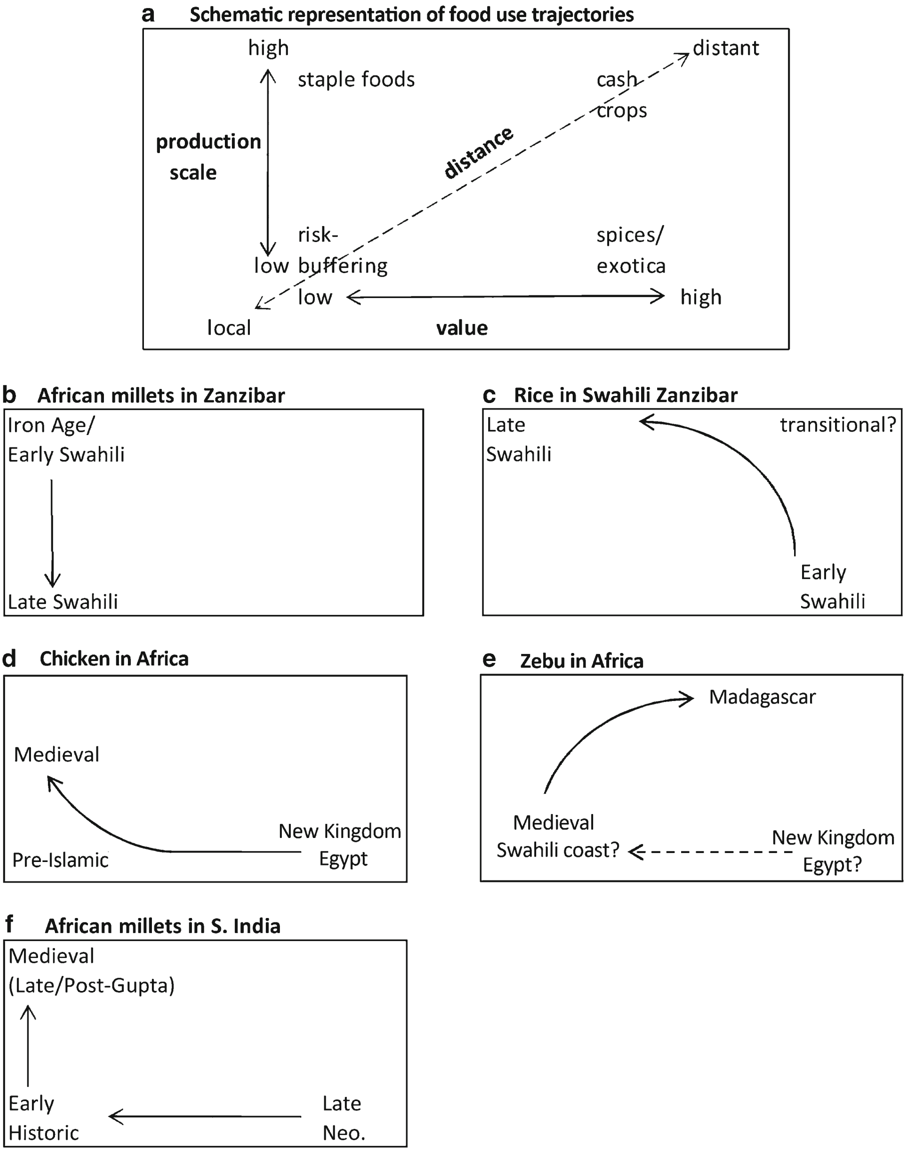

Fig. 4 **a** Schematic representation of the relationship between basic food use categories (cash-crops, spices/exotica, risk-buffering and staple foods) and three interacting variables: the social value placed on a food (from lesser to greater), the scale of production (from low to high) and the distance from which a food item is obtained by direct trade for consumption (from local to more distant), against which the historical trajectories of introduced foods can be charted (from Boivin *et al.* 2012). **b**–**f** Regional historical trajectories of various translocated African and Asian food species

Various Indian Ocean crops also acquired prestige associations in Madagascar. Certain yams, for example, and particularly those grown to a large size, symbolised royal power in Madagascar in the seventeenth century (Beaujard 2011). In this case, it is likely that such associations were transferred alongside the plants themselves, through Austronesian colonisation, since very similar associations are ethnographically documented in Melanesia today (Coupaye 2009; Beaujard 2011) and may once have extended into Island Southeast Asia. In the eighteenth century, the symbolic meanings attached to yams were transferred to cassava (Beaujard 2011), but tubers in general (yam, taro and such American plants as manioc and sweet potato) have come to be symbolically depreciated in Madagascar, where rice is now the primary crop associated with royalty and elites (Beaujard 2011).

These examples highlight the way that Indian Ocean crop plants in Africa have found not just social but also a variety of ritual uses. The banana also illustrates this point. For the Nyakyusa of southern Tanzania and northern Malawi, for example, the banana is a key staple crop as well as a meaningful symbol, with the fruit as well as other plant parts like the leaves frequently playing a role in symbolic and ritual activity (Wilson 1954). Groups in other parts of Africa also draw upon the banana in ritual; amongst its many symbolic uses by the Beti of Cameroon, for example, is as a material metaphor for human beings, such that the banana is accordingly capable of playing various roles in lifecycle rituals, and particularly funerals, where the banana tree can symbolically stand in for humans themselves (Ngomou 2010, p. 196). Whether its symbolic role in certain African communities derives at all from its original exotic status is unclear given the paucity of archaeological and historical evidence but seems possible, and it is intriguing that the Nyakyusa and the Beti are located in areas where the banana is suggested to have arrived earliest into Africa (De Langhe 2007).

Another Indian Ocean species that acquired symbolic meaning in Africa is the chicken. Its earliest appearances in Egypt are connected to elite status (menageries, royal tomb decor) and sport (cockfighting). However, the meanings of chicken and stimuli for their spread in the rest of the continent remain unclear. Chickens in Africa today are not only a low-maintenance, cheap form of protein, they also serve important social functions, with rules often dictating the appropriate breed, colour and sex for a given purpose (MacDonald 1995; Guèye 1998; Sonaiya *et al.* 1999; Kondombo *et al.* 2003; Dueppen 2011). They are commonly exchanged as gifts or payments, including for medicines or marriage agreements, given to newlyweds as "starting capital," used to honour special guests, and sacrificed in ceremonies. In Senegal, chickens are protectors who divert bad spirits from a targeted family to themselves. Many archaeological occurrences of chicken seem to be connected to ritual practices, including a clear example of sacrifice at Kirikongo, where Dueppen (2011) argues that chicken exchange and sacrifice can be linked to relatively egalitarian social structures, in contrast with more differentiated livestock-based economies. Frequent movements of chickens across social networks in the past may partially explain the complex introgression patterns apparent from genetic studies (Mwacharo *et al.* 2013). Indeed, non-dietary uses of chicken may have been the main mechanism for their spread, as egg and meat production levels are generally low.

Chickens—indeed most domesticates—are also linked to specific gendered practices in Africa. Chickens are overwhelmingly owned by women and kept by them and their children (Guèye 1998). Meat and egg consumption may be conditioned by culturally specific rules, often directed at women and girls (Sonaiya *et al.* 1999). Cockerels, on the other hand, are globally associated with men and their virility. This is expressed particularly through the practice of cockfighting, in which the birds and their owners may become inextricably linked (Geertz 1973) or alternatively, interpersonal conflicts may be displaced onto the birds, and thus diffused (Marvin 1984). The extent to which cockfighting prompted the spread of fowl in sub-Saharan Africa is not yet determined, though the sport has been cited as a major driver of the animal's spread through the Near East and Mediterranean in pre-Roman and Roman times (Sykes 2012).

The symbolic status of zebu in Malagasy cultures is also worthy of mention. In Madagascar, zebu cattle not only represent power, prosperity and prestige but also provide important living intermediaries with the ancestor and spirit worlds (Mack 1986). As such, zebu are commonly sacrificed during ceremonies to celebrate birth, marriage and death (with the horns often placed on the grave as a symbol of the deceased family's wealth), as well as in rituals to ask the ancestors for rain or to restore order following the violation of a taboo (Kouwenhoven and Raharison 1995; Tengö and von Heland 2011). Their blood in particular takes on powerful cleansing and purification properties. Zebu are thereby not only desired economically as beasts of burden or a source of meat but are essential for the accumulation of social and spiritual capital in a society governed as much by the living as the dead.

While the social and symbolic meanings attached to introduced Indian Ocean foods and species often remained important, other factors also became increasingly relevant as they moved from being rare commodities to locally grown and increasingly more intensively produced and consumed foods. Health benefits, for example, would have been seen with the increasingly regular consumption of a more varied diet, as Indian Ocean crops and domesticates began to feature more regularly in local cuisine. The increased production and consumption of a range of Indian Ocean species in various African locales from the Medieval period onwards may well have helped address the range of health issues that often attended the introduction of agriculture and associated reduction in dietary breadth. Van der Veen (2011, p. 235) notes that Islamic period archaeobotany at Quseir al-Qadim reflects the ingestion of a greater range of fruits and vegetables, and thus availability of essential vitamins, especially vitamin C (from limes and peaches for example).

Indian Ocean species and foods also possessed important medicinal properties. A wide variety of native wild and domesticated plant species were employed in traditional African pharmacopoeias of course (Oliver-Bever 1986; Iwu 2014), but non-African species also had a place. Banana, for example, is listed amongst the medicinal plants of western Africa, and the pharmaceutical properties of its ripe and unripe fruit, flowers and leaves discussed (Oliver-Bever 1986; see also Neuwinger 1996). The wild banana plants that were translocated at some unknown period to Pemba and Madagascar may have had particular medicinal qualities, as suggested by modern studies (Kennedy 2009; Slesak *et al*. 2011). In parts of western Africa, taro is seen primarily as a medicinal plant rather than a food source (Grimaldi 2013), and Medieval Islamic sources also emphasise its pharmaceutical qualities alongside its role as a food (Grimaldi 2013). It is also used as a hunting poison in Africa and elsewhere (Neuwinger 1996). Lime, a Southeast Asian cultivated plant, probably diffused through sub-Saharan Africa as a result of Islamic trade (Watson 1983), as likely did ginger (*Zingiber officinale*, from South Asia) and garlic (a southwest Asian plant that became part of cuisines in various parts of the Indian Ocean). All three plants are used for a variety of purposes in traditional medicine in Africa and elsewhere, and their efficacy, like that of other traditional pharmacopeia, is increasingly backed up by scientific study (Onyeagba *et al*. 2005). Some of these plants subsequently moved to the New World with

African slaves, becoming part of folk medical traditions (Carney 2003; Carney and Rosomoff 2009).

New Indian Ocean plants also served as spices, adding strong flavours to dishes, as was the case for South Asian plants like ginger, sesame, black pepper, cardamom, cinnamon and basil; Southwest Asian plants like garlic, ginger, coriander and cumin; and Southeast Asian plants like cassia, cardamom and cloves. Dating the arrival of these plants in Africa is difficult, except at arid North African sites with excellent botanical preservation like Quseir al-Qadim in Egypt where some have, as we note, been documented back to Roman times (van der Veen 2011). We have noted archaeobotanical evidence where it is available, but preservation conditions at tropical African sites, together with limited archaeobotanical study, mean that such data cannot be taken as authoritative as to spice presence or absence. Many spices undoubtedly became essential ingredients in African cuisine, as is the case today. Basil and ginger, for example, are central components of Ethiopian spice repertoires, alongside native Ethiopian spices like Karum seed (*Trachyspermum ammi*) and Ethiopian cardamom (*Aframomum corrorima*) (Jansen 1981). Turmeric, coriander, ginger, cinnamon, clove, nutmeg and other spices, together with foods like lime and particularly coconut, are all central to cuisine on the Swahili coast. Spices would have been grown on a small scale, at least until the rise of eastern African slave-based plantations in the European era, when spices like vanilla, cloves, pepper, cardamom and nutmeg were produced for commercial export, along with crops like sugarcane, rice and coconut.

The integration of new animals into husbandry practices also had practical benefits. Chickens, for example, are important fall-back foods for sedentary populations when drought or disease affects livestock. Zebu are better able than taurines to maintain weight and milk production in the face of dry conditions and nutrient stress, and they are more resistant to ticks, rinderpest and parasites, though taurines are more resistant to trypanosomiasis (Marshall 1989). Interbreeding has thus strengthened both drought resistance and trypanotolerance (Gifford-Gonzalez and Hanotte 2011). Crossbreeds would have enabled a higher quality diet and more food security for drylands mobile pastoralists, and could have been easily incorporated into existing systems (Marshall 2000). As such, crossbreeds likely fuelled the expansion of long-distance trade networks in western Africa in the late first and early second millennia AD (Linseele 2010). By contrast, exotic animals not perceived as useful likely remained marginal to local economies. This may explain why the camel, which would also become key to Sahara–Sahel trade routes, never spread in eastern Africa beyond the coast, as its food and water needs are quite different from those of the livestock favoured by eastern African herders (Marshall 2000).

New foods and species that arrived in Africa were also sometimes accompanied by new technologies for growing and processing. For example, Asian rice also brought Asian rice-growing technologies, and the different rice-growing practices in different regions provide insights into routes of transmission. In Madagascar, interestingly, both distinctly Southeast Asian and South Asian methods of rice production are practiced (Dahl 1991; Koji 1997), reflecting the arrival of different rice varieties from different regions, probably *via* distinct routes. Other plants also brought specific processing technologies. Aubergines, for example, had to be prepared in a particular way to remove impurities, and cooking practices probably travelled with the plant (Waines 2003), which arrived in Egypt and northern Africa with the Medieval trade

(Watson 1983; van der Veen 2011) and subsequently spread south (Watson 1983), though archaeobotanical evidence for the plant is currently lacking. Detoxification technology may have likewise accompanied taro, which requires extensive cooking and/or leaching of oxalates to render the corms edible.

Van der Veen (2011) suggests significant transformation of Egyptian agricultural practices and infrastructure with the arrival of summer crops, which came to be grown on a significant scale from Medieval times. These necessitated long-term investment in large-scale and permanent irrigation systems, as well as the digging and maintenance of irrigation canals and the construction and maintenance of waterwheels (van der Veen 2011, p. 232). Fields that no longer lay fallow over the summer also required fertilizers. Overall, Egyptian farmers had to devote much more time and labour to crop production, with agricultural production following a year-round schedule (van der Veen 2011). Elsewhere in Africa, many Indian Ocean food crops were not necessarily widely adopted as major staples, and would have been suited, at least initially, to cultivation in gardens adjacent to fields and close to homes, providing a more diverse array of dietary supplements, snacks and fall-back foods.

Crops of African origin have had impacts on the economies and landscapes of tropical Asia, especially in South India. Although, as noted above, the African grain crops (notably sorghum, pearl millet and finger millet) rose to quantitative significance only gradually, they ultimately supplanted most of the native Asian millets in subsistence farming throughout the Deccan and drier western India, such that traditional agriculture and maps of agricultural systems recognise peninsular India as a millet zone, in which sorghum, pearl millet and finger millet predominate, and the more ancient indigenous millets are regarded as “minor crops” (*e.g.*, Randhawa 1958). The African pulses, cowpea and hyacinth bean, have also been transformed to better suit Asian cuisine. Thus, while these are used as dry pulses throughout India (in *dahl*), vegetable varieties cultivated for larger, succulent green pods, and harvested before maturity evolved in northern/eastern India and came to be the predominant form in which these species were used in China and southeast Asia (*i.e.*, *Lablab purpureus* subsp. *bengalensis* and *Vigna unguiculata* subsp. *sesquipedalis* (syn. *Vigna sinensis*)). The green pod vegetable forms do not occur in Africa and are rare west of Bengal, but are a routine component of gardens from the Yellow River to the Malay Peninsula (Smartt 1990). Several African introductions into Asia also acquired traditional medicinal uses, including *Ricinus communis*, *Psophocarpus tetragonolobus*, *Lablab purpureus*, *Vigna unguiculata*, *Mucuna puriens* and baobab, with curative uses reported from India and Southeast Asia (Burkill 1966; Sala 1994). Despite these species having Sanskrit names and being used in Ayurvedic formulations, this need not attest to great antiquity, since even some New World species, *e.g.*, papaya, have been adopted into the Ayurvedic system and have Sanskrit names. The extent to which knowledge of medicinal uses might have been transferred from Africa to Asia requires further investigation.

Conclusions

Major gaps remain in our understanding of the history of food globalisation in Africa and in the Indian Ocean more widely. Most regions have still seen far too little systematic archaeobotanical and zooarchaeological analysis, let alone application of more advanced isotopic, phylogenetic, ancient DNA or morphometric methods. Temporally uneven sampling across different regions also presents challenges in charting long-term processes of food adoption, adaptation and abandonment, including the changing roles of exotic crops and animals as they move through different social and economic trajectories of use. Beyond this, the challenge of invisible taxa has barely begun to be addressed. Starch-rich vegetative crops, which are so critical to debates about the formative stages of Indian Ocean food globalisation in Africa and beyond, have seldom been addressed through starch grain and phytolith analysis in the Indian Ocean region. Key faunal species like zebu also elude study due to issues of identification that hinge on a few key, and poorly represented, skeletal elements.

While these challenges and limitations are recognised, however, it is also acknowledged that a range of recent and current archaeobotanical and zooarchaeological studies in Africa are beginning to yield a more complete picture of the continent's past, and its place in processes of culinary and biological globalisation. Recent years have seen concerted efforts at systematic sampling on more sites and in more countries of Africa (*e.g.*, Fuller 2008; Walshaw 2010; Fahmy *et al*. 2011; Helm *et al*. 2012; Fuller *et al*. 2014; Stevens *et al*. 2014). Preliminary genetic, phytolith and morphometric studies are also underway. Thus, while our current understanding is certainly subject to change, there is at least an emerging dataset on which to build. This dataset offers challenges to a range of hypotheses and suppositions that have been built in the absence of archaeological data.

One key pattern that appears increasingly robust is the very slow and limited uptake of Indian Ocean crops and domesticates at sites in Africa and beyond. In contrast to the species exchanges between the Old and New Worlds after 1492, which rapidly transformed agricultural, economic and social trajectories, the species of earlier Indian Ocean exchanges were taken up only gradually. They often spent numerous centuries as high value and/or low production crops and domesticates whose primary impacts were symbolic and social rather than economic and ecological. While food and species circulated widely between increasingly cosmopolitan societies around the Indian Ocean rim, particularly from the beginning of the first millennium BC, their major transformative impacts and uptake occurred primarily in the Medieval period and later. This says much about the nature and limitations of early connectivity, trade, production and economic integration in the Indian Ocean region. While certain lines of evidence make clear that early first–millennium AD trade involved more than just luxuries (*e.g.*, Casson 1989; Bentley 1993), as has sometimes been implied, the flows of goods, both exotic and mundane, in the Medieval period and particularly after AD 1000 were significantly greater than those before (Curtin 1984; Chaudhuri 1985; Bennison 2002; Northrup 2005). In addition, the post-AD 1000 period also witnessed increasingly specialised production of commodities, including various kinds of crops and foods (Chaudhuri 1985; Hoffmann 2001), and stimulation of wider shared consumer tastes, for example for foods like tea, sugar and later coffee (Mintz 1985; Stearns 2010). Such transformations set the stage for the emergence of commercial agriculture and cash-cropping, large-scale production of foodstuffs, and intensive agricultural specialisation in concert with the new capital flows and labour relations of capitalism (Wolf 1997). These changes meant that by 1833 there were more than a million coffee trees in Java (Wolf 1997, p. 336) while the United Fruit Company, incorporated in 1889, produced approximately 2 billion bunches of bananas on its far-flung estates in Costa Rica, Panama, Honduras, Colombia and Ecuador over the next 35 years (Wolf 1997, p. 324). Such unprecedented production and commoditisation of Old World crops ushered in a new era of globalisation that nonetheless built on the foundations of earlier processes of interaction, exchange and integration. The centrality of food and food species to these processes, and of Africa itself in emerging webs of connectivity, and culinary and biological flow, demonstrate the need for archaeological studies, in Africa and beyond, that are fully informed by the latest scientific methods and approaches. The early history of Africa's food globalisation merits the kind of systematic study that it is finally starting to receive, and that will be critical to the demarginalisation of Africa within studies of an emerging and transforming Indian Ocean world.

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References

Allibert, C., Argant, A., & Argant, J. (1989). Le site de Dembeni (Mayotte, archipel des Comores), mission 1984. *Etudes Océan Indien, 11*, 63–172.

Alpern, S. B. (2008). Exotic plants of western Africa: Where they came from and when. *History in Africa, 35*, 63–102.

Alpers, E. A. (1969). Trade, state, and society among the Yao in the nineteenth century. *The Journal of African History, 10*(3), 405–420.

Alpers, E. A. (2009). *East Africa and the Indian Ocean*. Princeton: Markus Wiener.

Anfray, F. (1967). Matara. *Annales d'Ethiopie, 7*, 33–88.

Asouti, E., & Fuller, D. Q. (2008). *Trees and woodlands of South India: Archaeological perspectives*. Walnut Creek: Left Coast.

Badenhorst, S., Sinclair, P., Ekblom, A., & Plug, I. (2011). Faunal remains from Chibuene, an Iron Age coastal trading station in central Mozambique. *Southern African Humanities, 23*(1), 1–15.

Barnes, G. L. (1990). Paddy soils now and then. *World Archaeology, 22*(1), 1–17.

Beaujard, P. (2011). The first migrants to Madagascar and their introduction of plants: Linguistic and ethnological evidence. *Azania: Archaeological Research in Africa, 46*, 169–189.

Bedigian, D. (2004a). History and lore of sesame in Southwest Asia. *Economic Botany, 58*(3), 329–353.

Bedigian, D. (2004b). Slimy leaves and oily seeds: Distribution and use of wild relatives of sesame in Africa. *Economic Botany, 58*(1S), S3–S33.

Beldados, A., & Costantini, L. (2011). Sorghum exploitation at Kasala and its environs, north eastern Sudan in the second and first millennia BC. *Nyame Akuma, 75*, 33–39.

Bennison, A. K. (2002). Muslim universalism and western globalization. In A. G. Hopkins (Ed.), *Globalization in world history* (pp. 74–97). London: Pimlico.

Bentley, J. H. (1993). *Old World encounters: Cross-cultural contacts and exchanges in pre-modern times*. Oxford: Oxford University Press.

Berger, K. G., & Martin, S. M. (2000). Palm oil. In K. K. Kiple & K. C. Ornelas (Eds.), *The Cambridge world history of food* (pp. 397–411). Cambridge: Cambridge University Press.

Bigga, G., & Kahlheber, S. (2011). From gathering to agricultural intensification: Archaeobotanical remains from Mege, Chad Basin, NE Nigeria. In A. G. Fahmy, S. Kahlheber, & C. D'Andrea (Eds.), *Windows on the African past: Current approaches to African archaeobotany. Reports in African Archaeology 3* (pp. 19–65). Frankfurt: Africa Magna.

Blench, R. M. (1996). The ethnographic evidence for long-distance contacts between Oceania and East Africa. In J. Reade (Ed.), *The Indian Ocean in Antiquity* (pp. 417–438). London: Kegan Paul International.

Blench, R. M. (1997). A history of agriculture in northeastern Nigeria. In D. Barreteau, R. Dognin, & C. von Graffenried (Eds.), *L'Homme et le milieu végétal dans le Bassin du Lac Tchad* (pp. 69–112). Paris: ORSTOM.

Blench, R. M. (2003). The movement of cultivated plants between Africa and India in prehistory. In K. Neumann, A. Butler, & S. Kahlheber (Eds.), *Food, fuel and fields: Progress in African archaeobotany* (pp. 273–292). Köln: Heinrich-Barth-Institute.

Blench, R. M. (2009). Bananas and plantains in Africa: Re-interpreting the linguistic evidence. *Ethnobotany Research and Applications, 7*, 363–380.

Blench, R. M. (2010). Evidence for the Austronesian voyages in the Indian Ocean. In A. Anderson, J. H. Barrett, & K. V. Boyle (Eds.), *The global origins and development of seafaring* (pp. 239–248). Cambridge: McDonald Institute.

Boardman, S. (1999). The agricultural foundation of the Aksumite Empire, Ethiopia: An interim report. In M. van der Veen (Ed.), *The exploitation of plant resources in ancient Africa* (pp. 137–147). New York: Kluwer/Plenum.

Boivin, N., & Fuller, D. Q. (2009). Shell middens, ships and seeds: Exploring coastal subsistence, maritime trade and the dispersal of domesticates in and around the ancient Arabian Peninsula. *Journal of World Prehistory, 22*, 113–180.

Boivin, N., Fuller, D. Q., & Crowther, A. (2012). Old World globalization and the Columbian exchange: Comparison and contrast. *World Archaeology, 44*, 452–469.

Boivin, N., Crowther, A., Helm, R., & Fuller, D. Q. (2013). East Africa and Madagascar in the Indian Ocean world. *Journal of World Prehistory, 26*, 213–281.

Bonanno, A., Busch, L., Friedland, W. H., Gouveia, L., & Mingione, E. (Eds.). (1994). *From Columbus to ConAgra: The globalization of agriculture and food*. Lawrence: University of Kansas Press.

Bulbeck, D. (2008). An integrated perspective on the Austronesian diaspora: The switch from cereal agriculture to maritime foraging in the colonisation of island Southeast Asia. *Australian Archaeology, 67*, 31–52.

Burkill, I. H. (1966). *Dictionary of the economic products of the Malay Peninsula*. Kuala Lumpur: Ministry of Agriculture and Co-operatives.

Burkill, H. M. (1997). *The useful plants of west tropical Africa. 2nd Edition, Volume 4. Families M–R*. London: Royal Botanic Gardens, Kew.

Burton-Page, J. (1969). The problem of the introduction of *Adansonia digitata* into Africa. In P. J. Ucko & G. W. Dimbleby (Eds.), *Domestication and exploitation of plants and animals* (pp. 331–335). London: Duckworth.

Cain, C. C. (1999). Results from zooarchaeological analysis at Axum, Ethiopia. *Archaeolzoologia, 10*, 27–45.

Cain, C. R. (2000). Animals at Axum: Initial zooarchaeological research into the later prehistory of the northern Ethiopian highlands. Unpublished PhD dissertation, Washington University in St Louis.

Canard, M. (1959). Le riz dans le Proche Orient aux premiers siècles de l'Islam. *Arabica, 6*, 113–131.

Cappers, R. (1999). Trade and subsistence at the Roman port of Berenike, Red Sea Coast, Egypt. In M. van der Veen (Ed.), *The exploitation of plant resources in ancient Africa* (pp. 185–197). New York: Kluwer/Plenum.

Cappers, R. (2006). *Roman foodprints at Berenike: Archaeobotanical evidence of subsistence and trade in the Eastern Desert of Egypt*. Los Angeles: Cotsen Institute of Archaeology.

Carney, J. A. (2003). African traditional plant knowledge in the circum-Caribbean region. *Journal of Ethnobiology, 23*(2), 167–185.

Carney, J. A., & Rosomoff, R. N. (2009). *In the shadow of slavery: Africa's botanical legacy in the Atlantic world*. Berkeley: University of California Press.

Carter, R. (2001). Saar and its external relations: New evidence for interaction between Bahrain and Gujarat during the second millennium BC. *Arabian Archaeology and Epigraphy, 12*, 183–210.

Casson, L. (1989). *The Periplus Maris Erythraei: Text with introduction, translation, and commentary.* Princeton: Princeton University Press.

Castillo, C., & Fuller, D. Q. (2010). Still too fragmentary and dependent upon chance? Advances in the study of early Southeast Asian archaeobotany. In B. Bellina, E. A. Bacus, O. Pryce, & J. Weissman Christie (Eds.), *Fifty years of archaeology in Southeast Asia: Essays in honour of Ian Glover* (pp. 91–111). Bangkok/London: River Books.

Chami, F. (1994). *The Tanzanian coast in the first millennium AD: An archaeology of the iron-working, farming communities. Studies in African Archaeology 7*. Uppsala: Societas Archaeologica Upsaliensis.

Chami, F. (2001). Chicken bones from a Neolithic limestone cave site, Zanzibar: Contact between East Africa and Asia. In F. Chami, P. Pwiti, & C. Radimilahy (Eds.), *People, contact(s) and the environment in the African past. Studies in the African Past 1* (pp. 81–97). Dar es Salaam: Dar es Salaam University Press.

Chami, F. (2007). Diffusion in the studies of the African past: Reflections from new archaeological findings. *African Archaeological Review, 24*, 1–14.
Chaudhuri, K. N. (1985). *Trade and civilisation in the Indian Ocean: An economic history from the rise of Islam to 1750*. Cambridge: Cambridge University Press.
Chittick, H. N. (1984). *Manda: Excavations at an island port on the Kenya coast*. Nairobi: British Institute in Eastern Africa.
Clapham, A. J., & Rowley-Conwy, P. (2007). New discoveries at Qasr Ibrim, Lower Nubia. In R. Cappers (Ed.), *Fields of change. Progress in African archaeobotany* (pp. 157–164). Groningen: Groningen Institute of Archaeology.
Clutton-Brock, J. (1993). The spread of domestic animals in Africa. In T. Shaw, P. J. Sinclair, B. Andah, & A. Okpoko (Eds.), *The archaeology of Africa: Food, metals and towns* (pp. 61–70). London: Routledge.
Coltherd, J. B. (1966). The domestic fowl in ancient Egypt. *Ibis, 108*, 217–223.
Cook, I., & Crang, P. (1996). The world on a plate: Culinary culture, displacement and geographical knowledges. *Journal of Material Culture, 1*(2), 131–153.
Counihan, C., & Van Esterik, P. (Eds.). (2012). *Food and culture: A reader*. London: Routledge.
Coupaye, L. (2009). Ways of enchanting: Chaînes opératoires and yam cultivation in Nyamikum Village, Maprik, Papua New Guinea. *Journal of Material Culture, 14*, 433–458.
Crosby, A. (2004). *Ecological imperialism: The biological expansion of Europe, 900–1900*. Cambridge: Cambridge University Press.
Crowther, A., Fuller, D. Q., & Austin, P. (forthcoming). Archaeobotanical remains. In A. Crowther, M. Horton & N. Boivin (Eds.), *Zanzibar's Ancient Indian Ocean Trade and Contacts: Studies at Unguja Ukuu and Fukuchani*. Oxford: University of Oxford School of Archaeology Monograph Series.
Crowther, A., Horton, M. C., Kotarba-Morley, A., Prendergast, M., Quintana Morales, E., Wood, M., Shipton, C., Fuller, D. Q., Tibesasa, R., Mills, W., & Boivin, N. (2014). Iron Age agriculture, fishing and trade in the Mafia Archipelago, Tanzania: New evidence from Ukunju Cave. *Azania: Archaeological Research in Africa, 49*, 21–44.
Curtin, P. D. (1984). *Cross-cultural trade in world history*. Cambridge: Cambridge University Press.
D'Andrea, A. C. (2008). T'ef (*Eragrostis tef*) in ancient agricultural systems of highland Ethiopia. *Economic Botany, 62*(4), 547–566.
D'Andrea, A. C., Klee, M., & Casey, J. (2001). Archaeobotanical evidence for pearl millet (*Pennisetum glaucum*) in sub-Saharan West Africa. *Antiquity, 75*, 341–348.
D'Andrea, A. C., Kahlheber, S., Logan, A., & Watson, D. (2007). Early domesticated cowpea (*Vigna unguiculata*) from Central Ghana. *Antiquity, 81*, 686–698.
D'Andrea, A. C., Richards, M. P., Pavlish, L. A., Wood, S., Manzo, A., & Wolde-Kiros, H. S. (2011). Stable isotopic analysis of human and animal diets from two pre-Aksumite/Proto-Aksumite archaeological sites in northern Ethiopia. *Journal of Archaeological Science, 38*, 367–374.
Dahl, O. C. (1991). *Migration from Kalimantan to Madagascar*. Oslo: Norwegian University Press.
Darby, W. J., Ghalioungui, P., & Grivetti, L. (1977). *Food: The gift of Osiris (Vol. 1)*. London: Academic.
De Langhe, E. (2007). The establishment of traditional plantain cultivation in the African rain forest: A working hypothesis. In T. Denham, J. Iriarte, & L. Vrydaghs (Eds.), *Rethinking agriculture: Archaeological and ethnoarchaeological perspectives* (pp. 361–370). Walnut Creek: Left Coast.
De Langhe, E., Swennen, R., & Vuylsteke, D. (1994–1995). Plantain in the early Bantu world. *Azania: Archaeological Research in Africa*, *29–30*, 147–60.
Denbow, J., & Wilmsen, E. (1986). Advent and course of pastoralism in the Kalahari. *Science, 234*, 1509–1515.
Denham, T. (2010). From domestication histories to regional prehistory: Using plants to re-evaluate early and mid-Holocene interaction between New Guinea and Southeast Asia. *Food and History, 8*, 3–22.
Denham, T., & Donohue, M. (2009). Pre-Austronesian dispersal of banana cultivars West from New Guinea: Linguistic relics from Eastern Indonesia. *Archaeology in Oceania, 44*, 18–28.
Douglas, M. (2013). *Purity and danger: An analysis of concepts of pollution and taboo*. London: Routledge.
Dueppen, S. A. (2011). Early evidence for chickens at Iron Age Kirikongo (c. AD 100–1450), Burkina Faso. *Antiquity, 85*, 142–157.
Dunham, D. (1955). *The Royal Cemeteries of Kush II, Nuri*. Boston: Museum of Fine Arts.
Ehret, C. (2011). A linguistics history of cultivation and herding in Northeastern Africa. In A. G. Fahmy, S. Kahlheber, & A. C. D'Andrea (Eds.), *Windows on the African past: Current approaches to African archaeobotany* (pp. 185–208). Frankfurt: Africa Magna.
Epstein, H. (1971). *The origins of domestic animals in Africa*. New York: Africana.
Fahmy, A. G., Kahlheber, S., & D'Andrea, A. C. (Eds.). (2011). *Windows on the African past: Current approaches to African archaeobotany*. Frankfurt: Africa Magna.
Farb, P., & Armelagos, G. (1980). *Consuming passions, the anthropology of eating*. Houghton Mifflin.

Fleisher, J. B. (2003). Viewing stonetowns from the countryside: An archaeological approach to Swahili regional systems, A.D. 800–1500. Ph.D. dissertation, University of Virginia.
Fleisher, J. B. (2010). Rituals of consumption and the politics of feasting on the eastern African coast, AD 700–1500. *Journal of World Prehistory, 23*, 195–217.
Foster, K. P. (1998). Gardens of Eden: Exotic flora and fauna in the ancient Near East. In J. Coppock & J. A. Miller (Eds.), *Transformation of Middle Eastern natural environments: Legacies and lessons* (pp. 320–329). Bulletin Series, No. 102, Yale School of Forestry and Environmental Studies.
Fowler, K. D., & Greenfield, H. J. (2009). Unravelling settlement history at Ndondondwane, South Africa: A micro-chronological analysis. *Southern African Humanities, 21*, 345–393.
Freeman-Grenville, G. P. S. (1975). *The East African coast: Select documents from the first to the earlier nineteenth century.* London: Rex Collings.
Fuller, D. Q. (2000). The botanical remains. In T. Insoll (Ed.), *Urbanism, archaeology and trade: Further observations on the Gao region (Mali). The 1996 fieldseason results. BAR International Series 829* (pp. 28–35). Oxford: Archaeopress.
Fuller, D. Q. (2003). African crops in prehistoric South Asia: A critical review. In K. Neumann, A. Butler, & S. Kahlheber (Eds.), *Food, fuel and fields. Progress in African archaeobotany* (pp. 239–271). Cologne: Heinrich-Barth-Institut.
Fuller, D. Q. (2005). Ceramics, seeds and culinary change in prehistoric India. *Antiquity, 79*(306), 761–777.
Fuller, D. Q. (2006). Agricultural origins and frontiers in South Asia: A working synthesis. *Journal of World Prehistory, 20*, 1–86.
Fuller, D. Q. (2008). Archaeological science in field training. In P. Ucko, L. Qin, & J. Hubert (Eds.), *From concepts of the past to practical strategies: The teaching of archaeological field techniques* (pp. 183–205). London: Saffron.
Fuller, D. Q. (2014). Agricultural innovation and state collapse in Meroitic Nubia: The impact of the savannah package. In C. J. Stevens, S. Nixon, M. A. Murray, & D. Q. Fuller (Eds.), *Archaeology of African plant use* (pp. 165–178). Walnut Creek: Left Coast.
Fuller, D. Q., & Boivin, N. (2009). Crops, cattle and commensals across the Indian Ocean: Current and potential archaeobiological evidence. *Etudes Océan Indien, 42–43*, 13–46.
Fuller, D. Q., & Edwards, D. N. (2001). Medieval plant economy in Middle Nubia: Preliminary archaeobotanical evidence from Nauri. *Sudan and Nubia Bulletin, 5*, 97–103.
Fuller, D. Q., & Hildebrand, L. (2013). Domesticating plants in Africa. In P. Mitchell & P. Lane (Eds.), *The Oxford handbook of African archaeology* (pp. 507–525). Oxford: Oxford University Press.
Fuller, D. Q., & Madella, M. (2001). Issues in Harappan archaeobotany: Retrospect and prospect. In S. Settar & R. Korisettar (Eds.), *Indian archaeology in retrospect* (Protohistory, Vol. II, pp. 317–390). New Delhi: Manohar.
Fuller, D. Q., & Qin, L. (2009). Water management and labor in the origins and dispersal of Asian rice. *World Archaeology, 41*(1), 88–111.
Fuller, D. Q., Boivin, N., Hoogervorst, T., & Allaby, R. (2011). Across the Indian Ocean: The prehistoric movement of plants and animals. *Antiquity, 85*, 544–558.
Fuller, D. Q., Stevens, C. J., Nixon, S., & Murray, M. A. (2014). African archaeobotany expanding: An editorial. In C. J. Stevens, S. Nixon, M. A. Murray, & D. Q. Fuller (Eds.), *Archaeology of African plant use* (pp. 17–24). Walnut Creek: Left Coast.
Geertz, C. (1973). Deep play: Notes on the Balinese cockfight. In C. Geertz (Ed.), *The interpretation of cultures* (pp. 412–453). New York: Basic Books.
Gifford-Gonzalez, D., & Hanotte, O. (2011). Domesticating animals in Africa: Implications of genetic and archaeological findings. *Journal of World Prehistory, 24*, 1–23.
Goodman, D., & Watts, M. (Eds.). (1997). *Globalising food: Agrarian questions and global restructuring.* New York: Psychology Press.
Goody, J. (1982). *Cooking, cuisine, and class: A study in comparative sociology.* Cambridge: Cambridge University Press.
Grigson, C. (1991). An African origin for African cattle: Some archaeological evidence. *African Archaeological Review, 9*, 119–144.
Grimaldi, I. M. (2013). Food for thought: Genetic, historical and ethnobotanical studies of taro (*Colocasia esculenta* (L.) Schott) in Africa. Unpublished Ph.D. thesis, University of Oxford.
Guèye, E. F. (1998). Village egg and fowl meat production in Africa. *World's Poultry Science Journal, 54*, 73–86.
Gupta, A. (2012). A different history of the present: The movement of crops, cuisines, and globalization. In K. Ray & T. Srinivas (Eds.), *Curried cultures. Globalization, food, and South Asia* (pp. 29–45). Berkeley: University of California Press.
Haaland, R. (1999). The puzzle of the late emergence of domesticated sorghum in the Nile Valley. In C. Gosden & J. Hather (Eds.), *The prehistory of food: Appetites for change* (pp. 397–418). London: Routledge.

Hamdun, S., & King, N. (1998). *Ibn Battuta in black Africa*. Princeton: Markus Wiener.
Hamilton-Dyer, S. (2001). The faunal remains. In V. A. Maxfield & D. P. S. Peacock (Eds.), *Mons Claudianus: Survey and excavation II: Excavations 1* (pp. 251–312). Cairo: IFAO.
Hamilton-Dyer, S. (2007). Faunal remains. In D. P. S. Peacock & V. A. Maxfield (Eds.), *The Roman imperial quarries: Survey and excavation at Mons Porphyrites 1994–1998, Volume II: The excavations* (pp. 143–175). London: Egypt Exploration Society.
Hamilton-Dyer, S. (2011). The faunal remains. In D. P. S. Peacock & L. Blue (Eds.), *Myos Hormos–Quseir al-Qadim: Roman and Islamic ports on the Red Sea 2: Finds from the 1999–2003 seasons. BAR International Series 2286* (pp. 245–288). Oxford: Archaeopress.
Hamilton-Dyer, S. (1997). The domestic fowl and other birds from the Roman site of Mons Claudianus, Egypt. *International Journal of Osteoarchaeology, 7*(4), 326–329.
Hamon, S., & van Sloten, D. H. (1995). Okra. In J. Smartt & N. W. Simmonds (Eds.), *Evolution of crop plants* (2nd ed., pp. 350–357). London: Longman.
Helm, R. M., & Mudida, N. (2000). Patterns of subsistence: The faunal evidence. In R. M. Helm (Ed.), Conflicting histories: The archaeology of the iron-working, farming communities in the central and southern coast region of Kenya (pp. 253–273). Unpublished Ph.D. thesis, University of Bristol.
Helm, R., Crowther, A., Shipton, C., Tengeza, A., Fuller, D. Q., & Boivin, N. (2012). Exploring agriculture, interaction and trade on the eastern African littoral: Preliminary results from Kenya. *Azania: Archaeological Research in Africa, 41*(1), 39–63.
Helms, M. W. (1993). *Craft and the kingly ideal: Art, trade, and power*. Austin: University of Texas Press.
Hoffmann, R. C. (2001). Frontier foods for Late Medieval consumers: Culture, economy, ecology. *Environment and History, 7*(2), 131–167.
Holtzman, J. D. (2006). Food and memory. *Annual Review of Anthropology, 35*, 361–378.
Horton, M., & Mudida, N. (1993). Exploitation of marine resources: Evidence for the origin of the Swahili communities of East Africa. In T. Shaw, P. J. Sinclair, B. Andah, & A. Okpoko (Eds.), *The archaeology of Africa: Food, metals and towns* (pp. 673–693). London: Routledge.
Horton, M., & Mudida, N. (1996). Subsistence at Shanga: The faunal record. In M. Horton (Ed.), *Shanga: The archaeology of a Muslim trading community on the coast of East Africa* (pp. 378–393). Nairobi: British Institute in Eastern Africa.
Houlihan, P. F., & Goodman, S. M. (1986). *The birds of ancient Egypt*. Warminster: Aris and Phillips.
Hughes, J. D. (2003). Europe as a consumer of exotic biodiversity: Greek and Roman times. *Landscape Research, 28*(1), 21–31.
Hutchinson, J. B. (1976). India: Local and introduced crops. *Philosophical Transactions of the Royal Society, London B, 275*, 129–141.
Inglis, D., & Gimlin, D. (Eds.). (2009). *The globalization of food*. London: Bloomsbury.
Iwu, M. M. (2014). *Handbook of African medicinal plants* (2nd ed.). Boca Raton: CRC.
Jansen, P. C. M. (1981). *Spices, condiments and medicinal plants in Ethiopia, their taxonomy and agricultural significance*. Wageningen: PUDOC.
Jones, M. K., Hunt, H. V., Lightfoot, E., Lister, D. L., Liu, X., & Motuzaite-Matuzeviciute, G. (2011). Food globalization in prehistory. *World Archaeology, 43*, 665–675.
Juma, A. (2004). *Unguja Ukuu on Zanzibar: An archaeological study of early urbanism*. Uppsala: Uppsala University Department of Archaeology and Ancient History.
Kahlheber, S., Höhn, A., & Neumann, K. (2014). Plant and land use in southern Cameroon 400 B.C.E.–400 C.E. In C. J. Stevens, S. Nixon, M. A. Murray, & D. Q. Fuller (Eds.), *Archaeology of African plant use* (pp. 113–128). Walnut Creek: Left Coast.
Kennedy, J. (2009). Bananas and people in the homeland of genus *Musa*: Not just pretty fruit. *Ethnobotany Research and Applications, 7*, 179–197.
Kiple, K. F. (2007). *A movable feast: Ten millennia of food globalization*. Cambridge: Cambridge University Press.
Kirch, P. V. (1997). *The Lapita peoples: Ancestors of the Oceanic world*. Cambridge: Blackwell.
Koji, T. (1997). Malayan cultivated rice and its expansion. *Agricultural Archaeology, 1*, 73–78.
Kondombo, S. R., Nianogo, A. J., Kwakkel, R. P., Udo, H. M. Y., & Slingerland, M. (2003). Comparative analysis of village chicken production in two farming systems in Burkina Faso. *Tropical Animal Health and Production, 35*, 563–574.
Kouwenhoven, A., & Raharison, T. (1999). *Madagascar: The Red Island*. Leiden: WINCO Publishing.
Lejju, B. J., Robertshaw, P., & Taylor, D. (2006). Africa's earliest bananas? *Journal of Archaeological Science, 33*, 102–113.

Linseele, V. (2007). *Archaeofaunal remains from the past 4000 years in Sahelian West Africa: Domestic livestock, subsistence strategies and environmental changes*. Cambridge Monographs in African Archaeology 70, BAR International Series 1658. Oxford: Archaeopress.

Linseele, V. (2010). Did specialized pastoralism develop differently in Africa than in the Near East? An example from the West African Sahel. *Journal of World Prehistory, 23*, 43–77.

Livarda, A. (2011). Spicing up life in northwestern Europe: Exotic food plant imports in the Roman and medieval world. *Vegetation History and Archaeobotany, 20*, 143–164.

Logan, A. L., & D'Andrea, A. C. (2012). Oil palm, arboriculture, and changing subsistence practices during Kintampo times (3600–3200 BP, Ghana). *Quaternary International, 249*, 63–71.

Lupton, D. (1996). *Food, the body and the self*. London: Sage.

MacDonald, K. C. (1992). The domestic chicken (*Gallus gallus*) in sub-Saharan Africa: A background to its introduction and its osteological differentiation from indigenous fowls (Numidinae and *Francolinus sp.*). *Journal of Archaeological Science, 19*, 303–318.

MacDonald, K. C. (1995). Why chicken? The centrality of the domestic fowl in West African ritual and magic. In K. Ryan & P. J. Crabtree (Eds.), *Animal symbolism and archaeology* (pp. 50–56). Philadelphia: MASCA/University of Pennsylvania Press.

MacDonald, K. C., & Edwards, D. N. (1993). Chicken in Africa: The importance of Qasr Ibrim. *Antiquity, 67*, 584–590.

Mack, J. (1986). *Madagascar: Island of the ancestors*. London: British Museum Publications.

Maggs, T. (1984). Ndondondwane: A preliminary report on an Early Iron Age site on the lower Tugela River. *Annals of the Natal Museum, 24*, 71–93.

Magnavita, C. (2006). Ancient humped cattle in Africa: A view from the Chad Basin. *African Archaeological Review, 23*, 55–84.

Manning, K., Pelling, R., Higham, T., Schwenniger, J.-L., & Fuller, D. Q. (2011). 4500-year-old domesticated pearl millet (*Pennisetum glaucum*) from the Tilemsi Valley, Mali: New insights into an alternative cereal domestication pathway. *Journal of Archaeological Science, 38*, 312–322.

Marshall, F. (1989). Rethinking the role of *Bos indicus* in sub-Saharan Africa. *Current Anthropology, 30*, 235–240.

Marshall, F. (2000). The origins and spread of domestic animals in East Africa. In R. Blench & K. C. MacDonald (Eds.), *Origins and development of African livestock: Archaeology, genetics, linguistics and ethnography* (pp. 191–221). London: UCL Press.

Marvin, G. (1984). The cockfight in Andalusia, Spain: Images of the truly male. *Anthropological Quarterly, 57*(2), 60–70.

Mbassa, G. C. K., & Assey, R. J. (2009). Analysis of bony remains from Kuumbi and Mwanampambe Caves, Zanzibar. In F. Chami (Ed.), *Zanzibar and the Swahili coast from c.30,000 years ago* (pp. 155–163). Dar es Salaam: E&D Vision.

Mbida, C., Van Neer, W., Doutrelepont, H., & Vrydaghs, L. (2000). Evidence for banana cultivation and animal husbandry during the first millennium BC in the forest of Southern Cameroon. *Journal of Archaeological Science, 27*, 151–162.

Mbida, C., Doutrelepont, H., Vrydaghs, L., Swennen, R. L., Swennen, R. J., Beeckman, H., De Langhe, E., & de Maret, P. (2001). First archaeological evidence of banana cultivation in central Africa during the third millennium before present. *Vegetation History and Archaeobotany, 10*, 1–6.

Mbida, C., Doutrelepont, H., Vrydaghs, L., Beeckman, H., Swennen, R. L., Swennen, R. J., De Langhe, E., & de Maret, P. (2004). Yes, there were bananas in Cameroon more than 2000 years ago. *InfoMusa, 13*, 40–42.

Mbida, C., Doutrelepont, H., Vrydaghs, L., Swennen, R. L., Swennen, R. J., Beeckman, H., De Langhe, E., & de Maret, P. (2005). The initial history of bananas in Africa. A reply to Jan Vansina, *Azania*, 2003. *Azania: Archaeological Research in Africa, 40*, 128–135.

Mbida, C., De Langhe, E., Vrydaghs, L., Doutrelepont, H., Swennen, R. O., Van Neer, W., & de Maret, P. (2006). Phytolith evidence for the early presence of domesticated banana (*Musa*) in Africa. In M. Zeder, D. G. Bradley, E. Emshwiller, & B. D. Smith (Eds.), *Documenting domestication: New genetic and archaeological paradigms* (pp. 68–81). Berkeley: University of California Press.

Miller, J. (1968). *The spice trade of the Roman Empire*. Oxford: Oxford University Press.

Mintz, S. W. (1985). *Sweetness and power: The place of sugar in modern history*. New York: Penguin.

Mintz, S. W., & DuBois, C. M. (2002). Anthropology of food and eating. *Annual Review of Anthropology, 31*, 99–119.

Motuzaite-Matuzeviciute, G., Staff, R. A., Hunt, H. V., Liu, X., & Jones, M. K. (2013). The early chronology of broomcorn millet (*Panicum miliaceum*) in Europe. *Antiquity, 87*, 1073–1085.

Mudida, N., & Horton, M. (2014). Subsistence and the faunal record. In M. Horton (Ed.), *Zanzibar and Pemba: The archaeology of an Indian Ocean archipelago. Memoirs of the British Institute in Eastern Africa* (pp. 220–238). London: British Institute in Eastern Africa and Ashgate Publishers. In Press.

Muigai, A. T., & Hanotte, O. (2013). The origin of African sheep: Archaeological and genetic perspectives. *African Archaeological Review, 30*(1), 39–50.

Mwacharo, J. M., Bjørnstad, G., Han, J. L., & Hanotte, O. (2013). The history of African village chickens: An archaeological and molecular perspective. *African Archaeological Review, 30*, 97–114.

Namdar, D., Gilboa, A., Neumann, R., Finkelstein, I., & Weiner, S. (2013). Cinnamaldehyde in Early Iron Age Phoenician flasks raises the possibility of Levantine trade with Southeast Asia. *Mediterranean Archaeology and Archaeometry, 13*, 1–19.

Neumann, K., & Hildebrand, E. (2009). Early bananas in Africa: The state of the art. *Ethnobotany Research and Applications, 7*, 353–362.

Neumann, K., Bostoen, K., Höhn, A., Kahlheber, S., Ngomanda, A., & Tchiengué, A. (2012). First farmers in the Central African rainforest: A view from southern Cameroon. *Quaternary International, 249*, 53–62.

Neuwinger, H. D. (1996). *African ethnobotany: Poisons and drugs: Chemistry, pharmacology, toxicology.* Weinheim: Chapman & Hall.

Ngomou, T. (2010). Urban food provisioning in Cameroon: Regional banana plantain networks linking Yaounde and the villages of Koumou and Oban. In D. C. Wood (Ed.), *Economic action in theory and practice: Anthropological investigations. Research in Economic Anthropology, Volume 30* (pp. 187–207). Bingley: Emerald Group.

Nixon, S., Murray, M. A., & Fuller, D. Q. (2011). Plant use at an early Islamic merchant town in the West African Sahel: The archaeobotany of Essouk-Tadmakka (Mali). *Vegetation History and Archaeobotany, 20*, 223–229.

Northrup, D. (2005). Globalization and the great convergence: Rethinking world history in the long term. *Journal of World History, 16*(3), 249–267.

Oliver-Bever, B. E. P. (1986). *Medicinal plants in tropical West Africa*. Cambridge: Cambridge University Press.

Onyeagba, R. A., Ugbogu, O. C., Okeke, C. U., & Iroakasi, O. (2005). Studies on the antimicrobial effects of garlic (*Allium sativum* Linn), ginger (*Zingiber officinale* Roscoe) and lime (*Citrus aurantifolia* Linn). *African Journal of Biotechnology, 3*(10), 552–554.

Oppenheimer, A. L. (1954). Seafaring merchants of Ur. *Journal of the American Oriental Society, 74*(1), 6–17.

Orijemie, E. A., & Sowumni, A. (2014). Humans and the mangrove in southern Nigeria. In C. J. Stevens, S. Nixon, M. A. Murray, & D. Q. Fuller (Eds.), *Archaeology of African plant use* (pp. 103–112). Walnut Creek: Left Coast.

Pawlowicz, M. (2011). Finding their place in the Swahili World: An archaeological exploration of southern Tanzania. Unpublished Ph.D. thesis, University of Virginia.

Payne, W. J. A. (1964). The origin of domestic cattle in Africa. *The Empire Journal of Experimental Agriculture, 32*, 97–113.

Pelling, R. (2005). Garamantian agriculture and its significance in a wider North African context: The evidence of the plant remains from the Fazzan project. *The Journal of North African Studies, 10*, 397–412.

Pereira, F., Queirós, S., Gusmaõ, L., Nijman, I. J., Cuppen, E., Lenstra, J. A., Econogene Consortium, Davis, S. J. M., Nejmeddine, F., & Amorim, A. (2009). Tracing the history of goat pastoralism: New clues from mitochondrial and Y chromosome DNA in North Africa. *Molecular Biology and Evolution, 26*, 2765–2773.

Perrier, X., Bakry, F., Carreel, F., Jenny, C., Horry, J., Lebot, V., & Hippolyte, I. (2009). Combining biological approaches to shed light on the evolution of edible bananas. *Ethnobotany Research and Applications, 7*, 199–216.

Perrier, X., De Langhe, E., Donohue, M., Lentfer, C., Vrydaghs, L., Bakry, F., Carreel, F., Hippolyte, I., Horry, J.-P., Jenny, C., Lebot, V., Risterucci, A.-M., Tomekpe, K., Doutrelepont, H., Ball, T., Manwaring, J., de Maret, P., & Denham, T. (2011). Multidisciplinary perspectives on banana (*Musa* spp.) domestication. *Proceedings of the National Academy of Sciences of the United States of America, 108*, 11311–11318.

Phillips, L. (2006). Food and globalization. *Annual Review of Anthropology, 35*, 37–57.

Plu, A. (1985). Bois et graines. In L. Balout & C. Roubet (Eds.), *La momie de Ramsès II. Contribution scientifique à l'égyptologie* (pp. 166–174). Paris: Éditions Recherches sur les Civilisations.

Plug, I. (1996). Seven centuries of Iron Age traditions at Bosutswe, Botswana: A faunal perspective. *South African Journal of Science, 92*, 91–97.

Pock Tsy, J.-M. L., Lumaret, R., Mayne, D., Vall, A. O. M., Abutaba, Y. I. M., Sagna, M., Raoseta, S. O. R., & Danthu, P. (2009). Chloroplast DNA phylogeography suggests a West African centre of origin for the baobab, *Adansonia digitata* L. (Bombacoideae, Malvaceae). *Molecular Ecology, 18*, 1707–1715.

Pollard, E. A. (2009). Pliny's *Natural History* and the Flavian *Templum Pacis*: Botanical imperialism in first-century C.E. Rome. *Journal of World History, 20*(3), 309–338.

Possehl, G. L. (1986). African millets in South Asian prehistory. In J. Jacobsen (Ed.), *Studies in the archaeology of India and Pakistan* (pp. 237–256). New Delhi: Oxford and IBH.

Possehl, G. L. (1996). Meluhha. In J. Reade (Ed.), *The Indian Ocean in Antiquity* (pp. 133–208). London: Keagan Paul.

Potts, D. T. (1994). South and Central Asian elements at Tell Abraq (Emirate of Umm al-Qaiwain, United Arab Emirates), c. 2200 BC–AD 400. In A. Parpola & P. Koshikallio (Eds.), *South Asian archaeology 1993: Proceedings of the Twelfth International Conference of the European Association of South Asian Archaeologists, Helsinki University 5–9 July 1993* (pp. 615–628). Helsinki: Suomalainen Tiedeakatemai.

Prakash, S. (2011). History, evolution, and domestication of Brassica crops. *Plant Breeding Reviews, 35*(1), 19–84.

Radimilahy, C. (1998). *Mahilaka: An archaeological investigation of an early town in northwestern Madagascar. Studies in African Archaeology 15*. Uppsala: Department of Archaeology and Ancient History.

Randhawa, M. S. (1958). *Agriculture and animal husbandry in India*. Delhi: Indian Council for Agricultural Research.

Rangan, H., Carney, J. A., & Denham, T. (2012). Environmental history of botanical exchanges in the Indian Ocean world. *Environment and History, 18*, 311–342.

Ratnagar, S. (2004). *Trading encounters: From the Euphrates to the Indus in the Bronze Age. Revised* (2nd ed.). New Delhi: Oxford University Press.

Ray, H. P. (1994). *The winds of change: Buddhism and the maritime links of early South Asia*. New Delhi: Oxford University Press.

Ricci, L. (1955–1958). Ritrovamenti archeologici in Eritrea, II. *Rassegna di Studi Etiopici, 15*, 48–68.

Robinson, K. R. (1958). Zimbabwe pottery. *Occasional Papers of the National Museum of Southern Rhodesia, 23*, 193–226.

Robinson, K. R. (1959). *Khami ruins*. Cambridge: Cambridge University Press.

Sala, A. V. (1994). *Indian medicinal plants. A compendium of 500 species*. Delhi: Orient Longman.

Samuel, D. (2001). Archaeobotanical evidence and analysis. In S. Berthier (Ed.), *Peuplement rural et aménagements hydroagricoles dans la moyenne vallée de l'Euphrate fin VII^e–XIX^e siècle* (pp. 343–481). Damascus: Institut Français d'Études Arabes de Damas.

Schiebinger, L., & Swan, C. (Eds.). (2007). *Colonial botany: Science, commerce, and politics in the early modern world*. University of Pennsylvania Press.

Schoenbrun, D. L. (1998). *A green place, a good place. Agrarian change, gender, and social identity in the Great Lakes region to the 15th Century*. Oxford: James Curry.

Shinni, P. L., & Kense, F. J. (1989). *Archaeology of Gonja, Ghana*. Calgary: University of Calgary Press.

Shipton, C., Helm, R., Boivin, N., Crowther, A., Austin, P., & Fuller, D. Q. (2013). Intersections, networks and the genesis of social complexity on the Nyali Coast of East Africa. *African Archaeological Review, 30*, 427–453.

Sidebotham, S. E. (2011). *Berenike and the ancient maritime spice route*. Berkeley: University of California Press.

Sinclair, P. (2007). What is the archaeological evidence for external trading contacts on the East African coast in the first millennium BC? In J. Starkey, P. Starkey, & T. Wilkinson (Eds.), *Natural resources and wider connections of the Red Sea. BAR International series S1661* (pp. 1–8). Oxford: Archaeopress.

Slesak, G., Mounlaphome, K., Inthalad, S., Phoutsavath, O., Mayxay, M., & Newton, P. N. (2011). Bowel obstruction from wild bananas: A neglected health problem in Laos. *Tropical Doctor, 41*(2), 85–90.

Smartt, J. (1990). *Grain legume*. Cambridge: Cambridge University Press.

Smith, A. B. (2000). Origins of the domesticated animals of southern Africa. In R. Blench & K. C. MacDonald (Eds.), *Origins and development of African livestock: Archaeology, genetics, linguistics and ethnography* (pp. 222–238). London: UCL Press.

Solheim, W. (2006). *Archaeology and culture in Southeast Asia: Unravelling the Nusantao*. Quezon City: University of the Philippines Press.

Sonaiya, E. G., Branckaert, R. D. S., Guèye, E. F. (1999). Research and development option for family poultry. In *First INFPD/FAO Electronic Conference on Family Poultry.* Resource document, Food and Agriculture Organization of the United Nations. http://www.fao.org/docrep/019/aq635e/aq635e.pdf. Accessed December 22, 2013.

Sorenson, J. L., & Johannessen, C. L. (2009). *World trade and biological exchanges before 1492*. Bloomington: iUniverse.

Sowunmi, M. A. (1999). The significance of the oil palm (*Elaeis guineensis* Jacq.) in the late Holocene environments of west and west central Africa: A further consideration. *Vegetation History and Archaeobotany, 8*(3), 199–210.

Spriggs, M., Reepmeyer, C., Anggraeni, Lape, P., Neri, L., Ronquillo, W. P., Simanjuntak, T., Summerhayes, G., Tanudirjo, D., & Tiauzon, A. (2011). Obsidian sources and distribution systems in Island Southeast Asia: A review of previous research. *Journal of Archaeological Science, 38*, 2873–2881.

Stearns, P. N. (2010). *Globalization in world history*. London: Routledge.

Stevens, C. J., Nixon, S., Murray, M. A., & Fuller, D. Q. (Eds.). (2014). *Archaeology of African plant use*. Walnut Creek: Left Coast Press.

Stump, D. (2006). The development and expansion of the field and irrigation systems at Engaruka, Tanzania. *Azania: Archaeological Research in Africa, 41*(1), 69–94.

Sutton, J. E. G. (2002). Research and interpretation in eastern African archaeology: A review of 'People, contact(s) and the environment in the African past'. *Journal of African History, 43*, 503–540.

Sykes, N. (2012). A social perspective on the introduction of exotic animals: The case of the chicken. *World Archaeology, 44*(1), 158–169.

Tengö, M., & von Heland, J. (2011). Trees and tree-planting in southern Madagascar: Sacredness and remembrance. In K. G. Tidball & M. E. Krasny (Eds.), *Greening in the Red Zone: Disaster, resilience and community greening*. New York: Springer.

Thomas, R. I. (2012). Port communities and the Erythraean Sea trade. *British Museum Studies in Ancient Egypt and Sudan, 18*, 169–199.

Tomber, R. (2008). *Indo-Roman trade: From pots to pepper*. London: Duckworth.

Turner, J. (2004). *Spice: The history of a temptation*. New York: Vintage Books.

Valamoti, S. M. (2013). Millet, the late comer: On the tracks of *Panicum miliaceum* in prehistoric Greece. *Archaeological and Anthropological Sciences*. doi:10.1007/s12520-013-0152-5.

van der Veen, M. (1996). The plant remains from Mons Claudianus, a Roman quarry settlement in the Eastern Desert of Egypt—an interim report. *Vegetation History and Archaeobotany, 5*(1–2), 137–141.

van der Veen, M. (1998). A life of luxury? The food and fodder supply to Mons Claudianus. *Journal of Roman Archaeology, 11*, 101–116.

van der Veen, M. (1999). The food and fodder supply to Roman quarry settlements in the Eastern Desert of Egypt. In M. van der Veen (Ed.), *The exploitation of plant resources in ancient Africa* (pp. 171–183). New York: Kluwer/Plenum.

van der Veen, M. (2003). Trade and diet at Roman and medieval Quseir al-Qadim, Egypt, a preliminary report. In K. Neumann, A. Butler, & S. Kahlheber (Eds.), *Food, fuel and fields: Progress in African archaeobotany* (pp. 207–212). Cologne: Heinrich Barth Institut.

van der Veen, M. (2004). The merchants' diet: Food remains from Roman and medieval Quseir al-Qadim, Egypt. In P. Lunde & A. Porter (Eds.), *Trade and travel in the Red Sea region. Proceedings of the Red Sea Project I. Society for Arabian Studies Monograph 2. British Archaeological Reports, International Series 1269* (pp. 123–130). Oxford: Archaeopress.

van der Veen, M. (2007). New evidence for the Roman spice trade and for diet in Egypt's Eastern Desert. *Journal of Roman Archaeology, 20*, 631–634.

van der Veen, M. (2011). *Consumption, trade and innovation: Exploring the botanical remains from the Roman and Islamic ports at Quseir al-Qadim, Egypt*. Frankfurt: Africa Magna.

van der Veen, M., Cox, A., & Morales, J. (2006). Plant remains—evidence for trade and cuisine. In D. Peacock & L. Blue (Eds.), *Myos Hormos–Quseir al-Qadim: Roman and Islamic ports on the Red Sea. Volume 1—Survey and excavations 1999–2003* (pp. 227–234). Oxford: Oxbow.

Van Neer, W. (1997). Archaeozoological data on the food provisioning of Roman settlements in the Eastern Desert of Egypt. *ArchaeoZoologia, 9*, 137–154.

Van Neer, W. (2000). Domestic animals from archaeological sites in Central and West-Central Africa. In R. Blench & K. C. MacDonald (Eds.), *Origins and development of African livestock: Archaeology, genetics, linguistics and ethnography* (pp. 163–190). London: UCL Press.

Van Neer, W., & Ervynck, A. (1998). The faunal remains. In S. Sidebotham & W. Wendrich (Eds.), *Berenike '96. Report of the excavations at Berenike (Egyptian Red Sea Coast) and the survey of the Eastern Desert* (pp. 349–388). Leiden: CNWS. Special Series 3.

Van Neer, W., & Ervynck, A. (1999). The faunal remains. In S. Sidebotham & W. Wendrich (Eds.), *Berenike '97. Report of the 1997 excavations at Berenike and the survey of the Egyptian Eastern Desert, including excavations at Shenshef* (pp. 325–348). Leiden: CNWS. Special Series 4.

Van Neer, W., & Lentacker, A. (1996). The faunal remains. In S. Sidebotham & W. Wendrich (Eds.), *Berenike '95. Preliminary report of the excavations at Berenike (Egyptian Red Sea Coast) and the survey of the Eastern Desert* (pp. 337–355). Leiden: CNWS. Special Series 2.

Vansina, J. (2003). Bananas in Cameroun c. 500 BCE? Not proven. *Azania: Archaeological Research in Africa, 38*, 174–176.

Voigt, E. A. (1983). *Mapungubwe: An archaeozoological interpretation of an Iron Age community*. Pretoria: Transvaal Museum, Monograph 1.

Voigt, E. A. (1986). Iron Age herding: Archaeological and ethnoarchaeological approaches to pastoral problems. *South African Archaeological Society Goodwin Series, 5*, 13–21.

Voigt, E. A., & Von den Driesch, A. (1984). Preliminary report on the faunal assemblage from Ndondondwane, Natal. *Annals of the Natal Museum, 26*(1), 95–104.

Waines, D. (2003). "Luxury foods" in medieval Islamic societies. *World Archaeology, 34*, 571–580.

Walsh, M. T. (2007). Island subsistence: Hunting, trapping and the translocation of wildlife in the western Indian Ocean. *Azania: Archaeological Research in Africa, 42*, 83–113.

Walshaw, S. C. (2005). Swahili urbanization, trade and food production: Botanical perspectives from Pemba Island, Tanzania, A.D. 600–1500. Unpublished PhD dissertation, Washington University in St Louis.

Walshaw, S. (2010). Converting to rice: Urbanization, Islamization and crops on Pemba Island, Tanzania, ad 700–1500. *World Archaeology, 42*, 137–154.

Walshaw, S. C., & Pistor, D. (2010). Flotation at Songo Mnara: First macrobotanical finds. Paper presented at the SAfA/PanAf Conference, Dakar, Senegal. http://www.songomnara.rice.edu/pdf/walshaw.pdf. Accessed 13 February 2012.

Watson, A. M. (1983). *Agricultural innovation in the early Islamic world: The diffusion of crops and farming techniques, 700–1100*. Cambridge: Cambridge University Press.

Wattenmaker, P. (1979). Fauna. In D. Whitcomb & J. Johnson (Eds.), *Quseir al-Quadim 1978: Preliminary report* (pp. 250–252). Princeton: American Research Center in Egypt.

Weber, S. A. (1991). *Plants and Harappan subsistence: An example of stability and change from Rojdi*. New Delhi: Oxford University Press and IBH Publishing Co.

Weber, S. A. (1998). Out of Africa: The impact of millets in South Asia. *Current Anthropology, 39*, 267–274.

Weisskopf, A., & Fuller, D. Q. (2014). Sesame: Origins and development. In C. Smith (Ed.), *Encyclopedia of Global Archaeology* (pp. 6578–6590). New York: Springer.

Wickens, G. E. (1982). The baobab: Africa's upside-down tree. *Kew Bulletin, 37*(2), 173–209.

Wild, A. (2004). *Black gold: The dark history of coffee*. London: Harper Perrenial.

Wilson, M. (1954). Nyakyusa ritual and symbolism. *American Anthropologist, 56*, 228–243.

Wilson, T. H., & Omar, A. L. (1997). Archaeological investigations at Pate. *Azania: Archaeological Research in Africa, 32*, 31–76.

Wolf, E. R. (1997). *Europe and the people without history*. Cambridge: Cambridge University Press.

Wright, H. T. (1984). Early seafarers of the Comoro islands: The Dembeni phase of the IXth–Xth centuries AD. *Azania: Archaeological Research in Africa, 19*, 13–59.

Wright, H. T. (1992). Early Islam, oceanic trade and town development on Nzwani: The Comorian archipelago in the XIth–XVth centuries AD. *Azania: Archaeological Research in Africa, 27*, 81–128.

Zach, B., & Klee, M. R. (2003). Four thousand years of plant exploitation in the Chad Basin of NE Nigeria II: Discussion on the morphology of caryopses of domesticated *Pennisetum* and complete catalogue of the fruits and seeds of Kursakata. *Vegetation History and Archaeobotany, 12*, 187–204.

Zaouali, L. (2007). *Medieval cuisine of the Islamic world*. Berkeley: University of California.