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Crops, cattle and commensals across the Indian Ocean

Current and Potential Archaeobiological Evidence

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Crops, cattle and commensals across the Indian Ocean

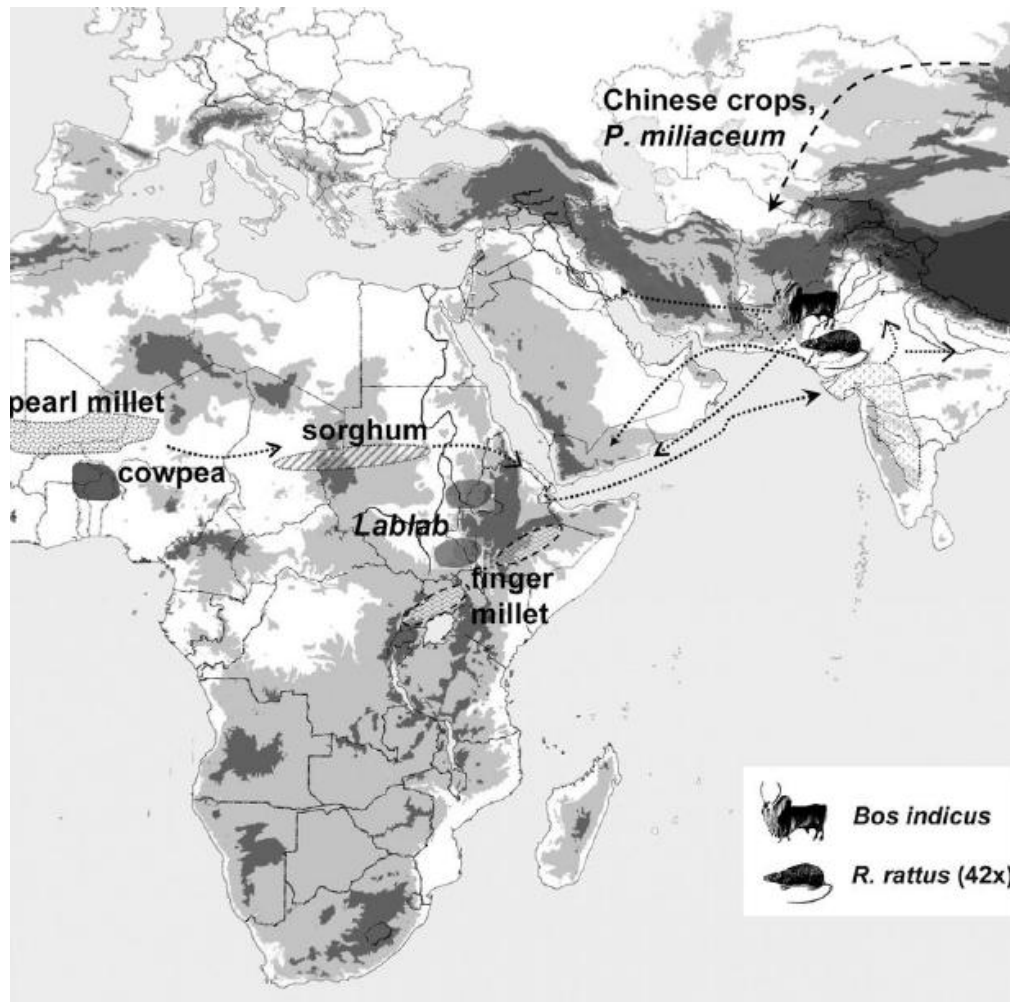
Current and Potential Archaeobiological Evidence

Pagination de l'édition papier : p. 13-46

Introduction

- 1 More than 50 years ago Sauer (1952: 36) characterized the coastal links between India, Arabia and East Africa as “a lost corridor of mankind.”
- 2 While he was thinking mainly in terms of Palaeolithic population dispersals, the same sentiment might apply to later periods like the Neolithic or Bronze Age, when livestock, crops and weeds were also being spread by people to new regions and continents. About twenty years ago Cleuziou and Tosi (1989: 15) referred to the prehistoric Arabian peninsula as a “conveyor belt between the two continents, channelling an early dispersal of domestic plants and animals.” The question of how precisely African crops reached India beginning around 2000 BCE has now attracted the attention of archaeologists and botanists for decades (e.g. Allchin 1969; Hutchinson 1976; Harlan and Stemler 1976; Possehl 1986; Weber 1998; Haaland 1999; Misra and Kajale 2003; Blench 2003; Fuller 2003a; Boivin and Fuller 2009). Less discussion has been devoted to domesticates that went the other way, such as Asian crops that were moved to Africa, although the presence of Asian zebu cattle in Africa has received attention (e.g. Marshall 1989; Grigson 1996; Magnavita 2006). In the present paper, we review the current state of archaeological evidence and discussions relating to the dispersal of domesticates in both directions. We will suggest that there are two broad phases and sets of processes in intercontinental transfers. First, there was an earlier circum-Arabia or Arabian Sea phase of the Middle Bronze Age (from 2000 BCE), in which domesticates were transferred between the northern African savannahs and the savannah zones of India (Figure 1). Then there was a later mid-Indian Ocean phase that may be regarded as generally Iron Age (late centuries BCE to early centuries CE), which began to draw South India, South-east Asia and East Africa into the wider remit of trade/contact, setting the stage for a genuinely Indian Ocean world. In addition, we would like to draw attention to the significance of transfers of commensal animals and weeds, a largely unstudied but potentially revealing body of evidence for early human contacts across the Arabian Sea and the Indian Ocean.

Figure 1. A schematic representation of some key Arabian Sea-Savannah zone biotic transfers of prehistory (the “Bronze Age horizon”).



Early African Crops in Asia

- 3 Agriculture in both Arabia and India includes major contributions from African domesticates. In the dry-cropping regions of India, sorghum (*Sorghum bicolor* (L.) Moench), pearl millet (*Pennisetum glaucum* (L.) R. Br.) and finger millet (*Eleusine coracana* (L.) Gaertn.) are traditionally the most productive grains, while numerous varieties of cowpea (*Vigna unguiculata* (L.) Walp.) and hyacinth bean (*Lablab purpureus* (L.) Sweet) are important pulses. All five of these species have their wild progenitors in different parts of sub-Saharan African and archaeological evidence places them in South Asia in prehistory. Due to concerns with dating, and with correct archaeobotanical identification of these species, caution is warranted in taking some reports, and much secondary literature at face value, but a critical assessment of the quality of data in reports from India and Pakistan has been provided by Fuller (2003a). Taking a very cautious view of dating evidence, as direct radiocarbon dates are few and associated dating evidence is often limited or has wide error margins, it is nevertheless clear that most of these species were present by the first few centuries of the Second Millennium BCE. Recently the authors had a series of direct Accelerator Mass Spectrometry (AMS) radiocarbon dates run on hyacinth bean from South India, confirming presence in the south at ca. 1600-1500 BCE (Fuller *et al.*, 2007a). The earliest occurrences in South Asia, however, appear to be on the eastern periphery of the Harappan civilization in Saurashtra and the Ganges-Yamuna region, with a number of clear finds by the Late Harappan period (2000-1700 BCE) (Fuller 2003a). A potentially earlier inland report of sorghum is from Kunal (Saraswat and Pokharia 2003), and nearby Banawali and Rohira, and there is the disputed identification of finger millet from Mature Harappan Rojdi (see Fuller 2003a, Fuller 2006: 37-38; cf. Weber 1991; 1998). These finds would move the arrival date some centuries

earlier, perhaps to ca. 2500 BCE, but further documentation or dating evidence is needed for all of these finds.

- 4 At present count, some 33 archaeological sites in South Asia dating from the Middle Bronze Age (ca. 2000 BCE) through the Iron Age (to ca. 300 BCE), with 5 more from the Early Historic period, have evidence for crops of African origin for which botanical identity is acceptable (Table 1; Figure 2). In almost all instances, these crops co-occur with native Indian millets and pulses, and as such can be seen as additions to an existing system of summer monsoon agriculture, as argued previously (Weber 1998: 342-344; Fuller and Madella 2001). Only in the case of Pirak was *Sorghum*, together with rice (plausibly *japonica* rice) and *Panicum miliaceum* L. (one of the Chinese millets), added to the established Indus repertoire of winter crops. This unique association in a traditional winter-cropping area might suggest a separate diffusion pathway from the wider African crop-package which was incorporated into Indian savannah farming. In general, the available evidence indicates that these taxa were not adopted on a large scale on individual sites nor are they consistently in evidence over particular regions.

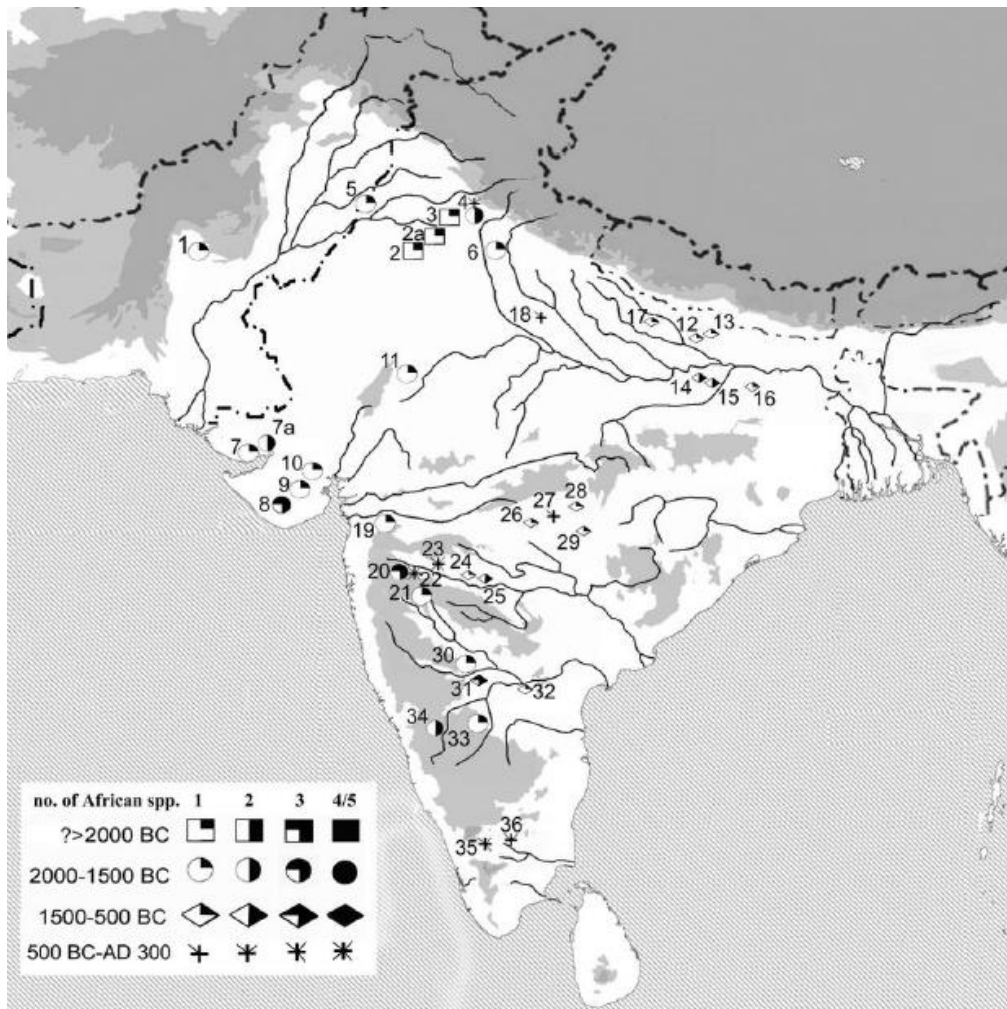
Table 1. Sites in South Asia with evidence for crops of African origin.

Site	Phase	<i>Triticum</i>	<i>Hordeum</i>	<i>Oryza</i>	<i>Panicum sumatrense</i>	<i>Setaria / Bracharia</i>	<i>Vigna radiata</i>	<i>Vigna mungo</i>	<i>Macrotyloma</i>	<i>Sorghum bicolor</i>	<i>Pennisetum glaucum</i>	<i>Eleusine coracana</i>	<i>Vigna unguiculata</i>	<i>Labiob purpureus</i>
Makran/Baluchistan/Sindh/Bannu														
Pirak	L.Har	X	X	X						X				
Hund	Mughal	X	X	X			X	X		X				
Eastern Harappan/Upper Ganges														
Kunal 1C	M.Har?	X	X	X			X		X	X				
Banawali	M.Har?	X	X	X			X		X	X				
Rohira	M.Har?	X	X			X			X	X				
Sanghol	L.Har	X	X			X			X	X				X
Harappa	L.Har	X	X	X	X	X	X		X	X				X
Hulas	L.Har	X	X	X			X		X	X				
Sanghol (Kushana)	E.Hist.	X	X	X			X	X	X	X		[]	X	
Saurashtra/Kutch/Rajasthan														
Shikarpur	L.Har	X			X	X					X			
Rajdi A/B	M.Har		X		X	X		X				?		
Rajdi C	L.Har			X	X	X	X		X	X	X	?		
Babor Kot	L.Har			X	X	X					X	?		
Oriyo Timbo	L.Har				X	X		X				?		
Rangpur III	L.Har			X							X			
Kanmer	L.Har		X	X		X	X		X	X	X			
Kanmer	E. Hist.	X	X	X		X	X		X	X	X			
Middle Ganges														
Narhan 1	Chal	X	X	X			X		X		X			
Senuwar 2	Chal	X	X	X			X		X	X		X		
Taradih, Bihar	Chal		X				X		X					X
Imlidih-Khurd, I	Chal		X	X		X	X			X	X			
Malhar 2	Iron Age	X	X	X			X		X	X		X		
Charda, I	Iron Age		X	X			X	X				[]	X	
Charda, IIA	Iron Age	X	X	X		X	X	X	X			[]	X	
Hulaskhera C/D	E. Hist.	X	X	X			X				X	[]		
Charda, IIB	E. Hist.											[]		
North Deccan														

Ojijana (Rajasthan)	E.Chal	X	X	X	X	X	X	X	X	X				
Daimabad Malwa	E.Chal	X	X		X			X			[]	X	X	
Inamgaon Malwa	E.Chal	X	X		X		?	X					X	
Kaothe	E.Chal				X		X			X				
Apegaon	L.Chal	X	X			X		X					X	
Daimabad Jorwe	L.Chal	X	X		X			X			[]	X	X	
Inamgaon Jorwe	L.Chal	X	X		X	X	?	X				X	X	
Tuljapur Garhi	L.Chal	X	X	X		X	X	X	X				X	
Adam IA (13-8)	Iron Age			X	X		X	X					X	
Bhagimohari (2-7)	Iron Age		X	X			X	X					X	
Bhokardan Ia/II	Iron Age	X		X				X					X	
Bhokardan Ib	Iron Age	X		X	X		X		X				X	
Inamgaon (L Jorwe)	Iron Age	X	X	X	X	X	?	X					X	
Adam EH (7-2)	E. Hist.	X	X	X		X	X						X	
Bhatkuli	E. Hist.								X					
Nevasa	E. Hist.	X	X	X		?	X	X	X	X	X	X	X	
Paithan I	E. Hist.		X	X	X	X	X		X	X	X		X	
Paithan II	E. Hist.	X	X	X	X	X	X	X	X	X			X	
Paithan III	Med.	X	X	X	X	X	X	X	X	X		X	X	
South Deccan														
Budihal	S.Neo.IIIA	X	X		X	X		X						X
Sanganakallu	S.Neo.IIIA	X	X		X	X	X		X					X
Hallur	S.Neo.IIIA	X		x?	X	X	X	X	X	X	X			X
Hallur	S.Neo.III B	X		x?	X	X	X	X	X	X				X
Sanganakallu	S.Neo.III B	X	X			X	X		X					X
Sanganakallu	S.Neo.IV	X	X		X	X	X		X					X
Piklihal	S.Neo.IV	X			X	X	X		X	X	X			
Hallur	S.Neo.IV			x?		X	X	X	X			X		X
Veerapruam	Iron Age		X	X				X	X					X
Veerapuram	E. Hist.			X					X					X
Perur	E. Hist.			X	X	X	X	X	X		X	X	X	
Kodumanal	E. Hist.			X	X	X	X	X	X				X	X
Piklihal	E. Hist.				X	X	X		X					X

Sites in South Asia with evidence for crops of African origin (shaded columns at right), with a selection of other recurrent crops species shown.?= identification/dating is problematic; []= reported but deemed a mis-identification. Abbreviations for periods: Har= Harappan, Chal= Chalcolithic, S.Neo=Southern Neolithic, Hist.=Historic, Med.= Medieval; E= Early, L= Late, M= Mature. Data augmented from Fuller 2003a; with Chanchala 2002, Cooke, Fuller, and Rajan 2005, Saraswat 2004, Saraswat 2005, Saraswat and Pokharia 2003.

- 5 Rather each of the African species appears to be locally important, or supplemental, to agricultural economies based primarily on other species. Linguistic evidence, for example from Dravidian languages, indicates that these African crops have less time depth (cognates across fewer branches of the language family) than native crops and native trees (Fuller 2003b; 2007; Southworth 2005). These African crops were important additions to existing agricultural systems in South Asia.

Figure 2. Map of archaeological sites with African crops in South Asia.

Map of archaeological sites with African crops in South Asia, indicating the number of African crops that co-occur. For further details, see Table 1. Sites numbered: 1. Pirak; 2. Kunal; 2a. Banawali; 3. Rohira; 4. Sanghol; 5. Harappa; 6. Hulas; 7. Shirkapur; 7a. Kanmer; 8. Rojdi; 9. Babor Kot; 10. Rangpur; 11. Ojijana; 12. Imlidh-Khurd; 13. Narhan; 14. Malhar; 15. Senuwar; 16. Taradih; 17. Charda; 18. Hulaskhera; 19. Kaothe; 20. Daimabad; 21. Inamgaon; 22. Nevasa; 23. Paithan; 24. Apegaon; 25. Bhokardan; 26. Tuljapur Garhi; 27. Bhatkuli; 28. Bhagimohari; 29. Adam; 30. Budihal; 31. Piklihal; 32. Veerapuram; 33. Sanganakallu; 34. Hallur; 35. Perur; 36. Kodumanal.

- 6 By contrast to the evidence from South Asia, evidence for African crops on Arabian prehistoric sites is largely non-existent. A few reports of sorghum exist from both Yemen and Oman, but in all cases identifications have been questioned by experts and appear dubious (see, e.g., Willcox 1992; Rowley-Conwy *et al.* 1997; Tengberg 2003; De Moulins *et al.* 2003; Fuller 2002: 281-2). There have been no reports for any of the other African crops that are known from prehistoric India (pearl millet, finger millet, hyacinth bean, cowpea). This tends to suggest that African agriculture impacted the Arabian peninsula cultures rather later, perhaps only from the Iron Age and later. It may be significant that this later period was when exchanges between Arabia, Asia, South-east Asia and the more southerly part of the East African coast began (see below). Amongst African crops, several were traditionally important on the Arabian peninsula, especially in Yemen (Mason, 1946; Varisco, 1994). These include cereals, such as *Sorghum bicolor* from the eastern savannas (perhaps from Chad or Darfur), pearl millet (*Pennisetum glaucum*) from West Africa, and finger millet (*Eleusine coracana*) from the Ethiopian uplands. In addition, both of the African pulses, as well as some species from India, are reported from traditional cultivation in Yemen (Varisco 1994) while in the mountains of Oman sorghum, pearl millet and *Lablab* are cultivated (Gebauer *et al.* 2007). Tef (*Eragrostis tef* (Zucc.) Trotter), a cereal from Ethiopia (D'Andrea 2008), is found otherwise only in Yemen, and appears to be present before the end of the first millennium BCE at Hajar Bin Humeid (Van Beek 1969).
- 7

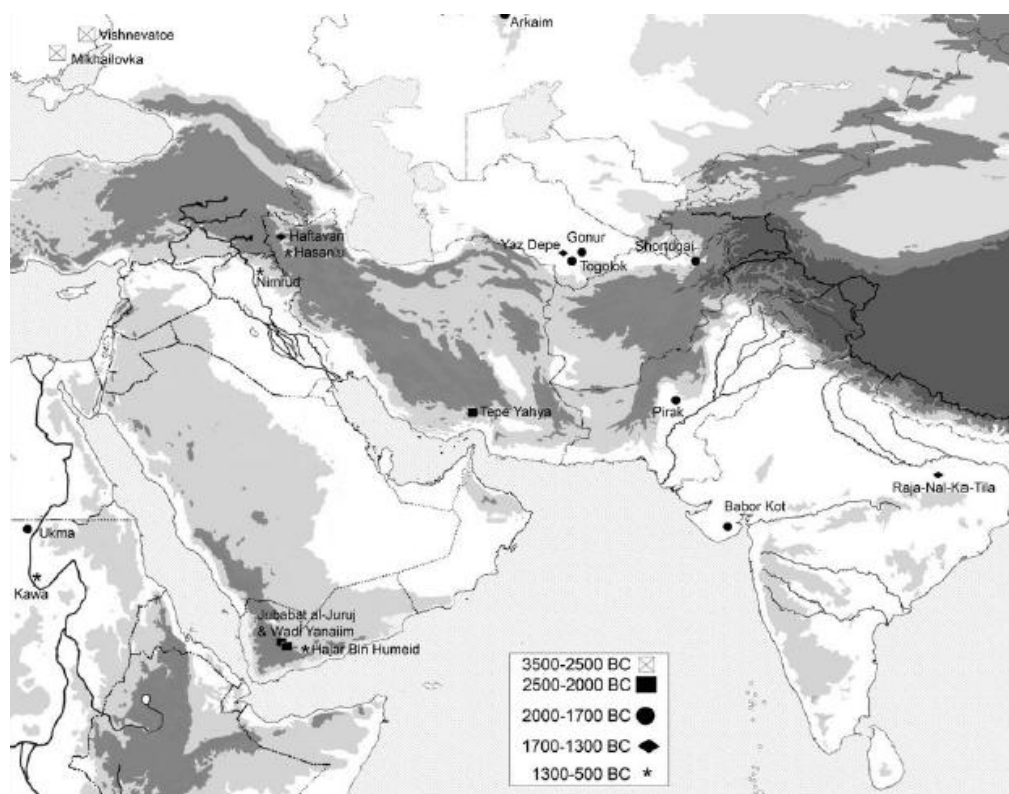
- 8 As in surrounding urban civilizations, the archaeobotanical record of Arabia is dominated by wheat and barley, but differences can be noted between the west (Yemen) and east (Persian Gulf). In the Gulf region, it is free-threshing wheats, and especially bread wheat (*Triticum aestivum* L.), that are most common amongst the wheats (Tengberg 2003). This is notable since this is the variety of wheat (certainly free-threshing wheat) that dominates the archaeobotany of South Asia, especially the Indus region (Fuller 2002; 2006). By contrast, in Yemen it is hulled emmer wheat (*Triticum dicoccon* Schrank ex Schübl.) that is most frequent (De Moulins *et al.* 2003). This is of note because emmer wheat was the dominant wheat in Egypt and Nubia until the later first millennium BCE (Murray 2000; Fuller 2004), and was a prevalent wheat in Ethiopia, in evidence from the first millennium BCE at Axum (Boardman 2000) and in Ona area sites in Eritrea (D'Andrea, Schmidt, and Curtis 2008; D'Andrea 2008). This could suggest some agricultural or culinary zones of influence along the Red Sea and the Gulf respectively, but on current evidence neither involved the transfer of tropical savannah crops from either Africa or India.
- 9 In addition to the “big five” African crops, discussed above, there are a number of more minor, and lesser known, crops that have moved from Africa to India. Many of these were reviewed by Blench (2003), and most lack any sort of record from archaeobotany. Future archaeobotanical research needs to keep an eye open for these. In some cases, some botanical caution is warranted, since species such as okra (*Abelmoschus esculentus* (L.) Moench) and common sesame (*Sesamum indicum* L.) were probably domesticated in South Asia rather than Africa, but the presence of wild congeneric relatives in Africa, which may have been brought separately into cultivation, make species-level archaeobotanical identifications essential.

East Asian Millet in Africa: The Case of *Panicum miliaceum*

- 10 Crops of central Asian, and ultimately Chinese, origin may have moved in a counterflow to sorghum, especially the common/broomcorn millet, *Panicum miliaceum*. This plant was domesticated in northern China certainly by 6000 BCE (Liu *et al.* 2009; Barton *et al.* 2009) and possibly as early as 8000 BCE (Lu *et al.* 2009). It occurs occasionally in Neolithic Europe by ca. 5000 BCE (Hunt *et al.* 2008), raising the possibility of an early dispersal through the northern temperate steppe (e.g. Jones 2004), or else a second domestication somewhere else, like in the Caucasus (Zohary and Hopf 2000: 83-86; but, cf. Hunt and Jones 2008). In either case, *Panicum miliaceum* did not occur further south in areas around the Indian Ocean before the later Third Millennium BCE (despite a few problematic early reports, cf. Hunt *et al.* 2008). Broomcorn millet appears at Shortugai in Afghanistan in the Late Harappan horizon from ca. 2000 BCE (Willcox 1991), and in the classic phase of Bactria-Margiana Archaeological Complex sites in the fabric of clay vessels from Gonur and Togolok-21 (Bakels 2003), i.e. 2000-1800 BCE (Anthony 2007: 428). Millet is absent, however, earlier from systematically sampled Neolithic to Early Bronze Age sites in Western Central Asia (Miller 1999). Of the same general time horizon, millet reached the Indus Valley in Late Harappan times, i.e., after 1950 BCE (Figure 3; see Fuller and Madella 2001), based on finds from Pirak in Baluchistan (Costantini 1979), and Babor Kot in Gujarat (Reddy 1994). It is reported from Raja-Nala-Ka-Tila (1600-1300 BCE) in the middle Ganges plain (Saraswat 2005). The arrival of this crop in the Indus region corresponds with a “Chinese horizon” in which several domesticates and some artefact types, of ultimate Chinese origin appear in a piecemeal fashion in northwestern South Asia. Other plausible Chinese imports include peach and apricot trees (Fuller and Madella 2001: 341; Hunt and Jones 2008: 60), marijuana (*Cannabis sativa* L.), Chinese style harvesting knives, and probable *japonica* rice (Fuller 2006: 36; Fuller and Qin 2009: 102).
- 11 Apparently earlier dates for *Panicum* occur on the Arabian peninsula in Yemen (from the later Third Millennium BCE) (Costantini 1990; Ekstrom and Edens 2003). A similarly early report from Tepe Yahya (certainly before 2200 BCE, but how much earlier requires clarification), in southern Iran (Costantini and Biasini 1985), suggests that the start of this line of contact was across the Persian Gulf from the Iranian plateau already in the later third millennium BCE and thence to Yemen. The continuation of this line of diffusion to Africa is indicated by evidence for *Panicum miliaceum* in Nubia at Ukma from the Kerma period (Van Zeist 1987),

2000-1600 BCE, with later evidence from Kawa, 800-400 BCE (Fuller 2004). Meanwhile this species remains absent from Egypt (Clapham and Rowley-Conwy 2007, de Vartavan and Asensi Amorós 1997, Murray 2000, Rowley-Conwy 1989) and most of the Near East (Nesbitt and Summer 1998; Miller 1991).

Figure 3. Map of early finds of *Panicum miliaceum* in South Asia, Arabia and Africa. For references, see text.



South Asian Cattle in Africa

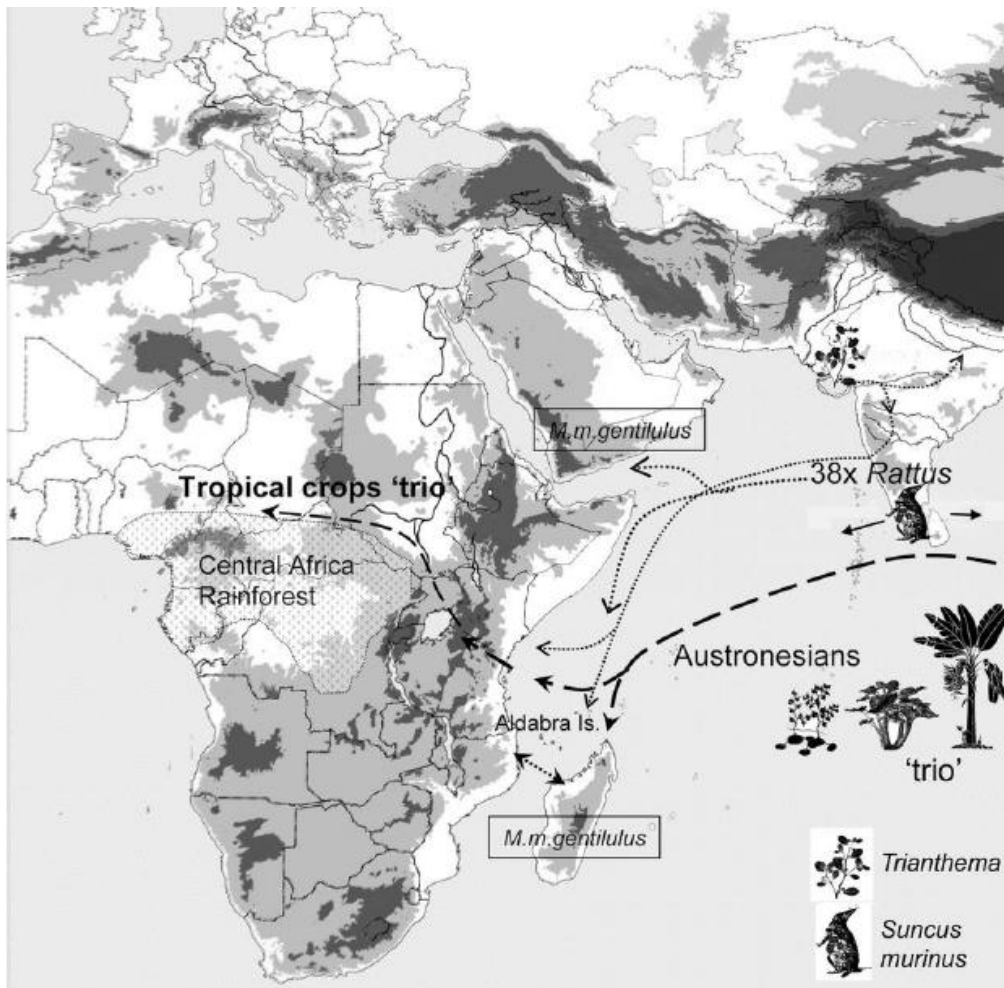
- 12 The other domesticate that moved between the Indian subcontinent and Africa, probably via Arabian maritime links, was the South Asia-derived zebu cow (*Bos indicus*). That zebu cattle spread from South Asia to Arabia and Africa is not in doubt, and a maritime route is suggested by genetic data. Marshall (1989) speculated that this could have occurred in the Second Millennium BCE as a counterflow to African crops that moved to Asia. Genetic data show a pattern of inter-regional introgression in which eastern and southern Africa, together with the Arabian peninsula near Africa, show a genetic cline, especially in Y-chromosome data, that indicates much higher zebu bull input than is the case for Mesopotamia and more northerly areas (Zeder 2006; Hanotte *et al.* 2002). Nevertheless, there was also clearly overland movement of zebu cattle from the Indus through Iran towards the Near East (Kumar *et al.* 2003). While it is possible that zebu then diffused south into Arabia overland, the genetic data suggests a separate direct line of diffusion. For dating this diffusion we must turn to archaeological evidence, but this remains very limited. Archaeozoological evidence for *Bos indicus* has been reported from Tell Abraq by the Wadi Suq period, 2000-1200 BCE, and possibly in the Umm an-Nar phase, 2500-2000 BCE (Uerpmann 2001).
- 13 The genetic data indicates that many southern and eastern African cattle are hybrids, to varying degrees, between taurines, on the female/mitochondrial side, and zebu, on the male/Y-chromosome side (Bradley *et al.* 1998; Hanotte *et al.* 2002; Frisch *et al.* 2003; Ibeagha-Awemu *et al.* 2004). As such they can draw on genetic advantages both of zebu, for adaptations to more arid climates and nutrient stress, as well as the potential of some indigenous African cattle for resistance to tsetse fly (see Marshall 1989). A recent review for Africa suggests no major influx of zebu, but rather occasional occurrences in Africa, based mainly on depictions rather than osteological evidence, and probably indicating rare imports, in Egypt by 2000-1500 BCE,

in Niger in the second millennium BCE and in the Chad Basin in the first millennium BCE (Magnavita 2006; but for a more cautious review, see Grigson 1996). As demonstrated by skull fragments, *Bos indicus* was present in Kenya by 200 BCE-CE 100 (Marshall 1989). While this could represent overland diffusion from the north, it is also possible that this relates to the later era of mid-Indian Ocean exchanges (see below). As Marshall (1989) notes, the many advantages of *Bos indicus* (or hybrids thereof) may have been important for the emergence of a more intensive and specialized pastoralism in East Africa at the time.

Mid-Indian Ocean Crop Transfers: Bananas and Tubers

- 14 This brings us to the evidence for species translocations from further south, which probably began from the Iron Age period (Figure 4). While this area, where preservation is poorer and archaeological evidence more limited, presents numerous challenges for tracing maritime species dispersals, other lines of evidence, particularly from biogeography, linguistics and to a lesser degree Classical sources, offer insights into what may have been some rather remarkable early trans-oceanic voyages. They suggest that the northern Indian Ocean zone that gradually enabled contacts between savannah-oriented agricultural systems in India and Africa was also twinned with a southern contact zone in which transfers between more tropical ecosystems were made possible.

Figure 4. A schematic representation of some Mid-Indian Ocean biotic transfers of later Prehistory (the “Iron Age horizon”).



- 15 Primary amongst the dispersing species in this zone are a trio of tropical crops, consisting of banana (*Musa x paradisiaca* L.), greater/water yam (*Dioscorea alata* L.) and taro (*Colocasia esculenta* (L.) Schott). These originated in Southeast Asia, and all three are now found across the African continent (Harris 1967: 100). Early interest in these distant transfers was demonstrated by Murdoch (1959: 222), who referred to them as the “tropical food kit”, and

suggested that they arrived in Africa via a coastal route of transmission. Their absence from intervening areas like northern India and Arabia makes this interpretation problematic. Equally likely, given the colonization history of Madagascar, whose language and population structure indicate a strong Southeast Asian contribution (e.g. Vérin and Wright 1999; Blench 2006: 169-171), is trans-oceanic transfer directly from Southeast Asia. Simmonds (1962: 144-145) favoured the hypothesis that bananas arrived in Africa via the peopling of Madagascar around the start of the First Millennium CE. However the date of such putative contacts remains controversial. Palaeoecological evidence suggests possible inhabitation of Madagascar by around the last centuries BCE (~200 BCE) and certainly by the start of the First Millennium CE (Burney *et al.* 2003; 2004).

- 16 The banana is perhaps the best studied of the tropical crop trio identified by Murdoch. All cultivated bananas, which include both sweet (or dessert) bananas and plantains (or cooking bananas), belong to the single species *Musa x paradisiaca* of hybrid (polyploidy) origin. While wild banana species have diploid genomes, cultivars are generally (though not always) triploid, combining two different ancestral genomes, usually termed A and B (Simmonds 1962). Most plantains are AAB, and most sweet bananas AAA. Interestingly, patterns of morphological variation, and linguistic and cultural embeddedness suggest that west rather than east Africa was the earliest centre for banana cultivation in the continent (De Langhe *et al.* 1994-95; De Langhe & de Maret 1999; De Langhe 2007; Blench 2006: 134; 2009). The region is dominated by AAB group plantains for which high numbers of cultivars and linguistic terms have been identified. In contrast, east Africa is dominated by the AAA type bananas, which are thought to have arrived into the continent at a later date. The hypothesis, derived from linguistic and botanical evidence, that plantains reached west Africa by 3000 BP (De Langhe *et al.* 1994-95; De Langhe 2007) has recently drawn support from discovery of banana phytoliths in Iron Age pits in Cameroon (Mbida *et al.* 2000; 2006); claims for earlier bananas in Uganda, at Munsa (Lejju *et al.* 2006), are more dubious, due to stratigraphic issues.
- 17 Some debate has arisen over the potential routes for dispersal of early plantains into western Africa. Watson (1983) suggests a late introduction to East Africa and even Madagascar through medieval Arab trade. Murdoch (1959) supposed a late prehistoric route through northern Somalia (Murdoch 1959), but De Langhe (2007) has made a fairly convincing case for a route from the East African coast, through the forest patches of Usambara and Pare and along the northern fringe of the equatorial rain forest, into west Africa, from where plantains are argued to have possibly “fueled” the Bantu expansion. Blench (2009) has meanwhile forwarded a more daring continental circumnavigation hypothesis, based on the lack of evidence for ancient plantain cultivation in East Africa, the problems of a dispersal route between the coast and central African rainforest, and the known sailing capabilities of the Austronesians. Further archaeobotanical work in Africa is desperately needed to clear up the controversy.
- 18 Another banana mystery concerns the wild, seeded *Musa acuminata* “Wete” populations on Pemba Island, off the Tanzanian coast. As described by Simmonds (1962: 22), this population of bananas resembles subsp. *malaccensis* in morphological characters. It has been successfully crossed with this subspecies, but seems even more genetically compatible with wild bananas from Java (*ibid.*: 57). This strongly suggests that a seeded, wild-type banana was taken by humans from Indonesia to eastern Africa (Pemba), although when this happened is unknown.
- 19 The other crops of the tropical trio, taro (or cocoyam) and Asian/greater yams are much more poorly known. The historian Watson (1983) argues for an introduction to Africa from Arabia, up the Nile and across to West Africa. He posits a similarly late diffusion down the East African coast. Others infer much greater antiquity, such as Martin (1976: 10) for *D. alata*, and Williamson (1993) for taro, and Blench (1997; 2009) for both.

Overlooked Passengers: Weeds and Rodents

- 20 People have done more than just move major economic species. While domesticated crops would have been carried and then propagated intentionally, many more species have been moved by mistake. The transportation of weeds, and creation of “invasive species,” is a well-known phenomenon (e.g. Ridley 1930: 628-659; Sauer 1988: 94-138). For parts of the

world where the flora is better-documented and paleobotanical evidence is available, e.g. in Britain (Godwin 1975), it is possible to infer which herbaceous species of the weedy flora were introduced in ancient times (archaeophytes), more recently (neophytes) or are truly native (apophytes). Archaeobotanical evidence of weed flora has the potential to provide a dataset for tracking the spread of agricultural systems and their impact on regional biodiversity (Coward *et al.* 2008). For many world regions, however, there is insufficient evidence for such studies, in part because not enough effort has been aimed at distinguishing species that are native, *i.e.* from pre-Neolithic times, from those that have been introduced through human agency. The archaeobotany of weed floras is an under-developed research discipline. While it has the potential to inform us about the ecology of early cropping systems, for example in Neolithic Europe (e.g. Bogaard 2004) or in Asia (Fuller and Qin 2009: 102-103), it may also record some of the geographical patterns in the history of crop dispersal. This represents a significant new direction for research on Indian Ocean connections. Somewhat better studied, but broadly similar, has been the transport of commensal animals, such as mice and rats. While a comprehensive review of weeds and commensals that might have been exchanged across the Indian Ocean is beyond the scope of the present contribution, we wish to highlight the potential of a few representative examples.

21 A comparison of the floristic inventories of East Africa (e.g. *Flora Zambesiaca*) and savannah India (Tadulingam and Venkatanarayana 1985: 143-5; Shetty and Singh 1987: 355; Singh 1998: 333; Singh *et al.* 2001: II, 89), reveals many shared species amongst the herbaceous flora of disturbed ground and agricultural fields. In many cases, these species are disjunct and absent from intervening areas, such as Egypt or Iraq. This raises the question as to whether these species are naturally disjunct, e.g. due to bird dispersal or separation resulting from climate change, or anthropochoric—transported by humans. Given the preference of these species for human-disturbed habitats, and agricultural fields, human-mediated transport seems likely. Many weeds persist as contaminants of harvested and stored grain, re-sown with the crop, and it therefore seems likely that weeds would have contaminated the grain stores of boats that carried people and traders across the Indian Ocean. Once transported, such weeds had the opportunity to become established on new continents.

22 As a few examples of weeds that probably moved from South Asia to East Africa, we will consider the horse purslanes, and buttonweeds. The horse purslanes (*Trianthema portulacastrum* L. and *T. triquetra* Willd.) are members of the carpetweeds family (Aizoaceae), and while they are reported as weeds in both tropical Africa and Asia, in Africa they appear to be limited mainly to anthropogenic habitats (Gonçalves 1978), whereas in the India they may be found in more plausibly naturally disturbed habitats, rocky areas and hillslopes (Tadulingam and Venkatanarayana 1985: 143-5; Shetty and Singh 1987: 355; Singh 1998: 333; Singh *et al.* 2001: II, 89). What is more, both species have archaeobotanical records in India. They are frequent weeds in Gujarat from Harappan and Late Harappan sites (Weber 1991; Reddy 1994). They are so far absent from South India Neolithic sites, although the related *Zaleya decandra* (L.) Burm. f. occurs (Fuller 1999), but they do occur by Early Historic times at Paithan on the Godavari river in Maharashtra (Fuller, unpublished). In addition, *T. portulacastrum*, is a new weed in the Ganges basin from the Chalcolithic period (after 1400 BCE), probably infesting dry rice fields (Fuller and Qin 2009: Table 2). Today this species is also found in dry rice fields in mainland Southeast Asia (Noda *et al.* 1985). Thus we can suggest some history of dispersal within South Asia and Southeast Asia from its earlier development as a weed in Gujarat. At some stage, as yet undated, both *Trianthema* species came to the millet and sorghum fields of the African savannahs, where they persist as weeds to the present day. In addition, *T. portulacastrum* is reported from the Aldabra Islands of the southwestern Seychelles (Robertson 1989:106), where human translocation can be inferred.

23 The buttonweeds (*Spermacoce ocymoides* Burm. f., *Spermacoce pusilla* Wall., *Spermacoce hispida* L.; family Rubiaceae) are tropical weeds of drycropping. *S. hispida* is a weed of Asia apparently introduced to East Africa only in the 20th century CE (Verdcourt 1976: 362). *S. pusilla* is plausibly native to India, occurring in open forest habitats of the Deccan and Western India (Shetty and Singh 1987: 370; Singh 1988: 341); in East Africa it is often a

weed, but may also be invasive in native grasslands (cf. Verdcourt 1976). It is also reported from Madagascar (Verdcourt 1976). A *Spermacoce* sp. (syn. *Borreria*) occurs on sites of the South Indian Neolithic (Fuller 1999), but is apparently absent from Gujarat (cf. Weber 1991; Reddy 1994). Further refining identification to species level is needed. This genus is absent from Mesopotamia [modern Iraq flora] (Ehrendorfer and Schönbeck-Temsey 1980) and Egypt (Täckholm 1974: 418), and thus transfer of these species between the tropics across the Indian Ocean is implied. These few species are probably just indications of what is likely a wealth of species being transported to Africa and to islands in the Indian Ocean. By contrast *S. ocymoides* is described from forest habitats in East Africa; it is thus plausibly native there (Verdcourt 1976), and since it is found only occasionally in nonarable habitats in India, it may represent a species that went the other way. Further archaeobotanical attention to weeds, including improved efforts at species level identifications, is needed.

24 Another candidate species for a weed that originated in the African savannahs is the witchweed, *Striga asiatica* (L.) Kuntze (syn. *S. lutea* Lour.). This is a parasitic weed, especially infecting sorghum, where it feeds off of the roots of the plant (Doggett 1970: 278). It can infect other grasses, including finger millet, sugarcane, and dry rice fields (Tadulingam and Venkatanarayana 1985: 226; Soerjani *et al.* 1987: 546), although it is plausible that it evolved in the African savannahs with wild sorghums. Today witchweed is widespread in Asia, and indeed the Americas – anywhere that sorghum is cultivated. Were these transported from Africa with sorghum? Did this occur when sorghum was first brought to South Asia in the Bronze Age, or was this a later migrant from southeastern Africa? More efforts to identify archaeological weed seeds in India, Africa, Arabia and from islands, may one day help to resolve these questions.

25 In addition to weeds, people also transported several small mammals. Whether these commensals rode on boats as overlooked stowaways or might have been more intentionally encouraged as potential protein snacks for long voyages is unknown. At the present time, genetic and archaeological studies that might shed light on the dispersal of these commensals in the Indian Ocean are rather limited. Nonetheless, it is clear from biogeographical data that three key types of commensals in particular have been extensively dispersed through human activity in the Indian Ocean.

26 Of these, probably the most well-known is the black rat, *Rattus rattus*, also known as the ship rat or house rat. This species is present at occupation sites in the Near East and Persian Gulf by the Third Millennium BCE (Cleuziou & Tosi 2000; Mosseri-Marlio 2000; Armitage 1994), where it is argued to have spread via maritime transport from Harappan centres in northwestern India. The black rat is also present on Roman period sites in Egypt and the Mediterranean (McCormick 2003; Armitage 1994), and the possibility of a separate wave of colonisation as a result of Graeco-Roman trade with India is suggested by the presence of the Oceanic *Rattus rattus* karyotype (38 chromosomes; currently found in south India) in northern Europe and the Mediterranean today, instead of the Asian karyotype (42 chromosomes) that would be expected if colonisation were via the Indus Valley and Near East (Armitage 1994). It is possible that modern karyotype distributions do not match ancient ones, but the more plausible explanation for the present-day karyotype distribution is that Asian type rats failed to permanently establish themselves in southwest Asia. This theory is supported by the notable absence of *R. rattus* remains from a rich small mammal faunal assemblage from the Early Iron Age site at Nichoria in southwest Greece (Armitage 1994: 234). An equally if not more complicating factor is the apparent presence of *R. rattus* remains at Natufian period sites in the Levant (Armitage 1994, Byrd 1994).

27 Genetic studies hold the potential to provide much information about the prehistoric dispersal of the black rat, but despite the recognized importance of this invasive species, these are at a relatively early stage (Hingston *et al.* 2005). Allozyme analysis of rats from Madagascar indicates that they are of the Oceanic form (Duplantier 2003) and preliminary mitochondrial DNA (mtDNA) study specifies an origin in the Indian subcontinent, though additional colonization via the East African coast is also likely (Hingston *et al.* 2005). Despite low genetic variability, it is suggested that the black rat may have arrived with the first settlers (Duplantier

2003; Hingston *et al.* 2005). Archaeological evidence for rats does not, however, appear until the 11th-14th centuries, from an Islamic site on the northwestern side of the island (Rakotozafy 1996; Duplantier 2003). *R. rattus* is probably one of the most damaging invasive species on islands worldwide, competing with and preying on local species, as well as transmitting diseases to both native animals and humans (Hingston *et al.* 2005) and its impact on Indian Ocean islands, particularly those with high proportions of endemic species, is likely to have been significant (Drake & Hunt 2008).

28 Another key Indian Ocean commensal is the house mouse, *Mus musculus*. This species originated in the Indian subcontinent from whence it radiated approximately 0.5 million years ago, giving rise to three distinct subspecies (which some authors consider proper species): *Mus musculus domesticus*, found in Western Europe, north Africa and the Near East, *M. m. musculus*, found from Central Europe and northern China, and *M. m. castaneus*, found in Southeast Asia (Duplantier *et al.* 2002). Two other taxa have also been proposed: *M. m. bactrianus*, from central Asia, and, more recently, *M. m. gentilulus*, found on the Arabian peninsula (Boursot *et al.* 1993; Duplantier *et al.* 2002). *M. m. domesticus* is found at archaeological sites dating back to the late Pleistocene in the Near East, and spreads into Europe, in part through maritime routes, in the Holocene (Cucchi *et al.* 2005; Boursot *et al.* 1993). Long-distance anthropogenic translocation is not restricted to *M. m. domesticus*, but is particularly notable with this species, due most likely to its association with Europeans, whose maritime exploits from the fifteenth century are argued to have spread the house mouse to America, tropical Africa and many Atlantic and Pacific islands, making this the most widespread species of house mouse (Boursot *et al.* 1993). Interesting, therefore, is the fact that mtDNA studies of modern-day mice on Madagascar indicate that they are phylogenetically closest to Yemeni mice of the *gentilulus* lineage (Duplantier *et al.* 2002). Furthermore, both low nucleotide diversity and a lack of subgroupings within the Malagasy mitochondrial lineage suggest a recent and probably unique origin for the house mouse on Madagascar; the species likely came from the Arabian peninsula, perhaps as a result of the Arab trade in the medieval period (*ibid.*). Earlier contact between Arabia and the East African coast, attested by Classical texts (which already by this time period indicate regular trade, African-Arab intermarriage, and Arab authority over at least the trading location of Rhapta; Casson 1989), may also have brought the house mouse to East Africa, from whence it later colonised Madagascar. Lack of data pertaining to East African *M. musculus* populations is, however, a problem in assessing the diverse possibilities. One question is whether such work will demonstrate the presence on any of the western Indian Ocean islands or East African coast of the *castaneus* lineage, which was not identified in any of the populations sampled in the Madagascar study (Duplantier *et al.* 2002).

29 The Asian house shrew (or wild musk shrew), *Suncus murinus*, is also a ship-borne invasive species (a Soricomorpha rather than a true rodent). Mitochondrial DNA studies suggest that the species originated in South Asia (Yamagata *et al.* 1995; Kurachi *et al.* 2007), from where already differentiated populations dispersed, probably as commensals of early human populations moving out of Asia (Kurachi *et al.* 2007). The main population groups are the Continental type (found on the South Asian mainland), the Island type (found in the islands of Southeast Asia) and the Malay type (found in the Malay Peninsula). The Island type of *S. murinus* is argued to have diverged from a South Indian/Sri Lankan population, from where it colonised island Southeast Asia by maritime routes (Kurachi *et al.* 2007); this may reflect the contact between south India and Southeast Asia that has been identified for the first millennium BCE (Bellina & Glover 2004) and that may even have more ancient roots in the late Second Millennium BCE contacts that putatively brought sandalwood to South India (Boivin *et al.* 2008: 190; Asouti and Fuller 2008: 117). The Asian house shrew has also reached Arabia, the East African coast and the islands of the Indian Ocean as a result of anthropogenic dispersal. Like the house mouse, this species is argued to have reached Madagascar via an East African route (Hutterer and Tranier 1990; Duplantier 2003). High morphological variability in shrew populations from the Arabian peninsula and from Africa (including Madagascar), suggest multiple importations from different origins (Hutterer and Tranier 1990). Thus, as

with the other small commensal mammals, we have a pattern which suggests the transport of house shrews in prehistory via Indian Ocean contacts, but still lack targeted zooarchaeological research to anchor this process to sites and dates.

Conclusion

30 Increasing lines of evidence from a range of disciplines suggest that the Indian Ocean was one of the world's earliest arenas for long-distance biological exchange on a significant scale. Some of the key species, discussed in this paper, are compiled in Table 2, but this is by no means a comprehensive list.

Table 2. Summary of taxa discussed in this paper, inferred to have been translocated across the Indian Ocean.

Scientific name	English	French	Inferred direction
Cereal crops			
<i>Sorghum bicolor</i>	sorghum, great millet	sorgho, gros mil	Africa to South Asia
<i>Pennisetum glaucum</i>	pearl millet	mil à chandelles, mil perle	Africa to South Asia
<i>Eleusine coracana</i>	finger millet	mil rouge	Africa to South Asia
<i>Panicum miliaceum</i>	broomcorn millet, common millet	mil commun	South Asia to Arabia to Africa (Nubia)
<i>Eragrostis tef</i>	tef	mil éthiopien	Ethiopia to Yemen
<i>Triticum aestivum</i>	bread wheat, common wheat	blé ordinaire	Land dispersal from Southwest Asia
<i>Triticum dicoccon</i>	emmer wheat	amidonier	Land dispersal from Southwest Asia; Yemen to Ethiopia (?)
Pulse crops			
<i>Vigna unguiculata</i>	cowpea	pois à vaches, haricot indigène, dolique oeil noir, dolique de Chine	Africa to South Asia
<i>Lablab purpureus</i>	hyacinth bean	dolique, dolique d'Egypte	Africa to South Asia
Tuber crops			
<i>Dioscorea alata</i>	greater yam, water yam	grande igname, igname ailée, igname de Chine	Asia to Africa
<i>Colocasia esculen</i>	taro, cocoyam	colocasie	Asia to Africa
Other crops			
<i>Abelmoschus esculentus</i>	okra, lady's fingers	gombo, gombeaud, bamie-okra, ketmie comestible	Modern crop of hybrid origin in India; Asia to Africa; native relatives in Africa
<i>Sesamum indicum</i>	sesame	sésame	South Asia to Africa; native relatives in Africa
<i>Cannabis sativa</i>	marijuana, hemp	chanvre	Land dispersal from China and Central Asia
<i>Musa acuminata</i>	wild banana	banane sauvage	Island Southeast Asia to Pemba Island
<i>Musa x paradisiaca</i>	banana, plantain	banane, bananier commun	Asia to Africa
Weeds			
<i>Trianthema portulacastrum</i>	horse purslane, desert horsepurslane, giant pigweed	pourpier courant, brède cacayanga	India to Southeast Asia & to Africa
<i>Trianthema triquetra</i>	black horse purslane, black pigweed	pourpier courant noir	India to Africa
<i>Spermacoce ocymoides</i>	purple-leaf buttonweed	...*	Africa to Asia
<i>Spermacoce pusilla</i>	small buttonweed	...*	South Asia to Africa
<i>Spermacoce hispida</i>	hairy buttonweed	...*	Asia to Africa (modern)
<i>Striga asiatica</i> (syn. <i>S. lutea</i>)	witchweed	goutte de sang	Africa to Asia

Domestic Animals			
<i>Bos indicus</i>	zebu cattle	zébu	South Asia to Arabia, to Africa
Commensal Animals			
<i>Rattus rattus</i>	black rat	rat noir	Asia to Africa
<i>Mus musculus gentilulus</i>	house mouse, subspecies of Arabia	souris grise (type Arabien)	Arabia to Madagascar
<i>Suncus murinus</i>	Asian house shrew, wild musk shrew	grande pachyure, musaraigne musquée, Pachyure musquée	Asia to Africa

* The authors have been unable to find a report of a *nom vernaculaire* in French (see, e.g. <http://malherbiologie.cirad.fr>)

31 Human activities, desires, choices and errors not only delivered species far beyond their natural ranges, but also worked to affect the degree to which they invaded and altered their new environments. The species which people moved across the seas can be divided along a spectrum from those that were intentional and required a specific effort, such as large livestock (e.g. cattle) or vegetatively propagated crops (taro, bananas), to those that might have been left-overs of food taken for voyages (the seeds of grain crops, perhaps small animals (chickens, possibly rats)), to those which were the unintentional stow-aways (weeds, mice, shrews). We have suggested that the routes and chronology of these translocations can be divided into two phases/zones. There was an earlier, broadly Bronze Age/Chalcolithic, horizon focused on the circum-Arabia/northern Indian Ocean, which moved domesticates between the savannahs of India and northeast Africa/Yemen. Then later, from sometime in the First Millennium BCE (and perhaps mainly in the later part of that millennium), we can outline the Iron Age network that included much more distant contacts and dispersal across the middle Indian Ocean, as well as increased north-south contacts along the East Africa coast, northwards to Arabia. This must certainly relate to a more intensive use of the monsoon and open-ocean voyaging. The Austronesian settlement of Madagascar can be placed within this second period of exchanges, although it may have been later than some of the initial mid-Indian Ocean contacts. While the vastness of the Indian Ocean may seem a formidable barrier, it is clear that this was not the case given the species moved across it, and the developments of maritime technology and capability in certain cultures on its margins.

32 One of the more intriguing aspects of early Indian Ocean crop and animal dispersals is that they appear to have occurred for the most part between relatively small-scale societies. By contrast to the better-known overland trade routes, such as those surrounding ancient Egypt and Mesopotamia, or the classical and medieval Silk Road, the players in the initial Indian Ocean movements were more frequently not well-developed urban states. Indeed, the emergence of circum-Arabian trade, involving Late Harappan Gujarat, corresponds to the period when urbanism declined in the greater Indus Valley (cf. Possehl 1997; Madella and Fuller 2006). The longer-term pattern of early trade in the Red Sea and Persian Gulf, as well as between continents, suggests a prominent role for small-scale coastal societies, developing initially amongst Neolithic shell-midden-making fisher-folk (“Ichthyophagi”) and their materially enriched Bronze Age descendants (Boivin and Fuller 2009). The period when mid-Indian Ocean transfers began to occur, in the first millennium BC, was in many of the relevant parts of the Indian Ocean a period of relatively dispersed agropastoralists, maritime-oriented fisher-sailers-traders, and intensive foragers probably engaged in cultivation and trade (cf. Phillipson 1993; Mitchell 2002). It was only later, after links across the seas were established, that large state-players appear to have become involved, such as the Romans, with their interest in Indian spices and textiles at the end of the First Millennium BCE, or the later Arabs focused on the African coast south of the Horn and eastwards towards Malaysia. Archaeologists have long been biased towards the monumental remains of urban centres and expansive states, and this has meant that the small-scale communities and traders who pioneered longdistance communication and transport have been under-studied. There is much that archaeologists need to do to shed more light on this “lost civilization” of the coasts and sea,

and this paper hopefully demonstrates the critical role that the archaeological sciences will undoubtedly play in meeting this challenge.

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Droits d'auteur

Résumés

Les plantes cultivées, les mauvaises herbes, les bovins et les animaux commensaux ont tous été transportés par l'action de l'homme à travers l'océan Indien depuis les temps préhistoriques. Dans cet article, nous examinons les preuves, principalement issues de l'archéobotanique et de l'archéozoologie, mais aussi de la génétique, de ces échanges. Ces derniers peuvent être divisés en deux grandes sous-régions d'interactions : l'une plus ancienne et dans le Nord, et l'autre plus tardive et au milieu de l'océan Indien. Le premier et le plus ancien ensemble d'échanges a eu lieu dans tout le nord-ouest de l'océan Indien, près de l'Arabie il y a environ 2 000 ans av. J.-C. Cette période a vu le transfert de plusieurs plantes cultivées, d'Afrique à l'Inde, notamment *Sorghum bicolor*, *Pennisetum glaucum*, *Eleusine coracana*, *Labiata purpureus*, et *Vigna unguiculata*. Les données actuelles favorisent l'hypothèse d'un transfert direct par mer plutôt que par la péninsule Arabique. Les transferts de l'Asie à l'Afrique incluent notamment le mil *Panicum miliaceum*, le zébu, même si tous deux ont dû voyager jusqu'à l'Afrique via la péninsule Arabique. La seconde époque d'échanges a eu lieu probablement après 1 000 av. J.-C., mais la date est sujette à caution. Ces échanges ont porté principalement sur les transferts de l'Asie à la côte et aux îles de l'Afrique de l'Est, bien que quelques espèces aient été transférées à des parties de l'Asie à ce moment ou plus tard. Les contributions importantes d'Asie tropicale à l'agriculture tropicale africaine ont été *Musa sapientum*, *Colocasia esculenta* et *Dioscorea alata*, même si les preuves archéologiques sont limitées à la banane. En outre, des mauvaises herbes, telles que *Trianthema spp.* et *Spermacoce spp.*, et des animaux commensaux, *Rattus rattus*, *Mus musculus*, et *Suncus murinus*, ont été involontairement transportés de l'Asie à l'Afrique comme cela a été démontré par la biogéographie et la génétique. D'autres mauvaises herbes qui probablement comprennent *Striga asiatica* et *Spermacoce ocymoides* ont été déplacées de l'Afrique à l'Asie. Ces nombreux transferts préhistoriques d'organismes suggèrent que les petites sociétés de pêche côtière et maritime de la côte d'Afrique et d'Asie ont été des agents actifs d'échange et d'interaction, même si leurs vestiges sont moins visibles et moins étudiés par les archéologues que ceux des sociétés plus tardives de pêche et d'échanges maritimes sur les marges de l'Océan Indien.

Crops, weeds, cattle and commensal animals have all been moved by human agency across the Indian Ocean since prehistoric times. In this paper we review evidence, mainly from archaeobotany and archaeozoology but also from genetics, for these exchanges. They can be divided into two broad sub-regions of interaction: one earlier and northern, and the other later and across the middle of the Indian Ocean. The first and earlier set of exchanges took place across the northwestern Indian Ocean, near Arabia from about 2000 BCE. This period saw the transfer of several African crops to India, including *Sorghum bicolor*, *Pennisetum glaucum*, *Eleusine coracana*, *Labiata purpureus*, and *Vigna unguiculata*. Current evidence favours direct transfer by sea rather than across the Arabian peninsula. Transfers from Asia to Africa included the millet *Panicum miliaceum* and zebu cattle, although both may have moved via the Arabian peninsula to Africa. The second focus of exchange took place after 1000 BCE, although dating is poorly resolved. These exchanges were focused on transfers from Asia to the East African coast and islands, although a few species moved to parts of Asia at this time or later. Important Asian contributions to tropical African agriculture were *Musa x paradisiaca*, *Colocasia esculenta* and *Dioscorea alata*, although archaeological evidence is limited to bananas. In addition weeds, such as *Trianthema spp.* and *Spermacoce spp.*, and commensal animals, *Rattus rattus*, *Mus musculus*, and *Suncus murinus*, were brought unintentionally from Asia to Africa as inferred by biogeography and genetics. Other weeds moved from Africa to Asia, and probably included *Striga asiatica* and *Spermacoce ocymoides*. These numerous prehistoric transfers of organisms suggest that small-scale coastal and maritime societies of the African and Asian coasts were active agents of exchange and interaction even though

their remains have been less visible and less researched by archaeologists than those of later seafaring and trading societies around the Indian Ocean rim.

Entrées d'index

Mots-clés : agriculture, commerce maritime, cultures, échanges commerciaux, élevage, millets, plantes -- Afrique orientale, plantes -- océan Indien occidental, plantes et civilisation, plantes sauvages, sorghum

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