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ORIGINAL PAPER

Shell Middens, Ships and Seeds: Exploring Coastal Subsistence, Maritime Trade and the Dispersal of Domesticates in and Around the Ancient Arabian Peninsula

Nicole Boivin · Dorian Q. Fuller

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Abstract The Arabian Peninsula occupies a critical position at the intersect of several major Old World landmasses. Inland aridity and a major coastal perimeter have long made maritime activities critical to Arabia's cultural trajectory. A wealth of recent studies, not previously synthesised, suggest not only that the peninsular littoral offered a rich resource base for thousands of years of human occupation in the region, but also that Arabia witnessed some of the world's earliest seafaring and maritime exchange activities, and played a role in Bronze Age maritime trade that has often been underestimated. Maritime activities were closely linked to developments in agriculture, which not only fuelled trade and exchange, but were also impacted on by the dispersal of domesticates along early maritime corridors. While regional specialisation has to some degree prevented consideration of the maritime prehistory of the peninsula as a whole, it is clear that there are interesting parallels, as well as important differences, between cultural trajectories in different parts of the peninsula.

Keywords Persian Gulf · Red Sea · Oman · Yemen · Arabia · Livestock · Crops · Boats · Incense · Land of Punt

Introduction

The Arabian Peninsula occupies a key geographic junction, with the African landmass to the west, the Levant (and Europe beyond it) to the north, and the Asian continent to the east. Whether we see it as a cul-de-sac or a gateway depends much upon how we view the sea that comprises some 80% of its perimeter. If the sea is a barrier, Arabia is largely cut off from its neighbours, except via the narrow land bridge to Africa, and the northern territories linking the peninsula to the remainder of the Eurasian landmass. If it acts as a

N. Boivin (✉)
School of Archaeology, University of Oxford, Oxford, UK
e-mail: nicole.boivin@rlaha.ox.ac.uk

D. Q. Fuller
Institute of Archaeology, University College London, London, UK

bridge, however, the sea puts Arabia at the centre of a vast web of terrestrial and maritime routes of contact, exchange, trade and dispersal, in a position unique in the Old World. The advent of seafaring must thus be seen as a critical development for Arabia, eventually placing the peninsula at the heart of the international incense and spice trade routes that linked up lands as distant as Rome and Jakarta. Also crucial to Arabia was the arrival of domesticated species and the emergence of agriculture, as these provided fuel for the expanding maritime trade, and enabled the development of powerful coastal and oasis settlements capable of mobilizing still further resources for technological and trade developments.

In recent years, the once peripheral Arabian Peninsula has seen a wealth of new studies shedding light on the emergence of coastal subsistence, maritime trade and agriculture in the region. These have demonstrated not only that the peninsular littoral offered a rich resource base for thousands of years of human occupation in the region, but also that Arabia witnessed some of the world's earliest seafaring and maritime exchange activities. To date, these developments have been studied largely within a regional context, resulting in a quite separate consideration of activities in the east and west of Arabia, and also sometimes in inadequate examination of Arabia's context in the wider Arabian Sea. The regional specialisation that has to some degree prevented the construction of a broader picture is, of course, understandable in light of the detailed and intensive research still required in many regions of the unevenly studied Arabian Peninsula. Nonetheless, given the importance of maritime developments to Arabia's trajectory, and the increasing recognition that the Arabian Sea witnessed some very long distance species translocations in prehistory that remain inadequately explained (Blench 1996, 2003, 2006, 2009; Cleuziou and Tosi 1989; Fuller 2003a; Mbida et al. 2000; Possehl 1986, 1996, 1998; Sauer 1952; Walsh 2007), there may be utility in undertaking a broad overview and synthesis of maritime activity in the peninsula, with additional reference to species dispersals and agricultural developments. Such an enterprise is also part of a wider effort in archaeology and other disciplines to better appreciate the important and diverse roles of maritime activities and relationships in human societies (e.g. Bailey 2004; Braudel 1995; Cooney 2003; Erlandson 2001; Rainbird 2007).

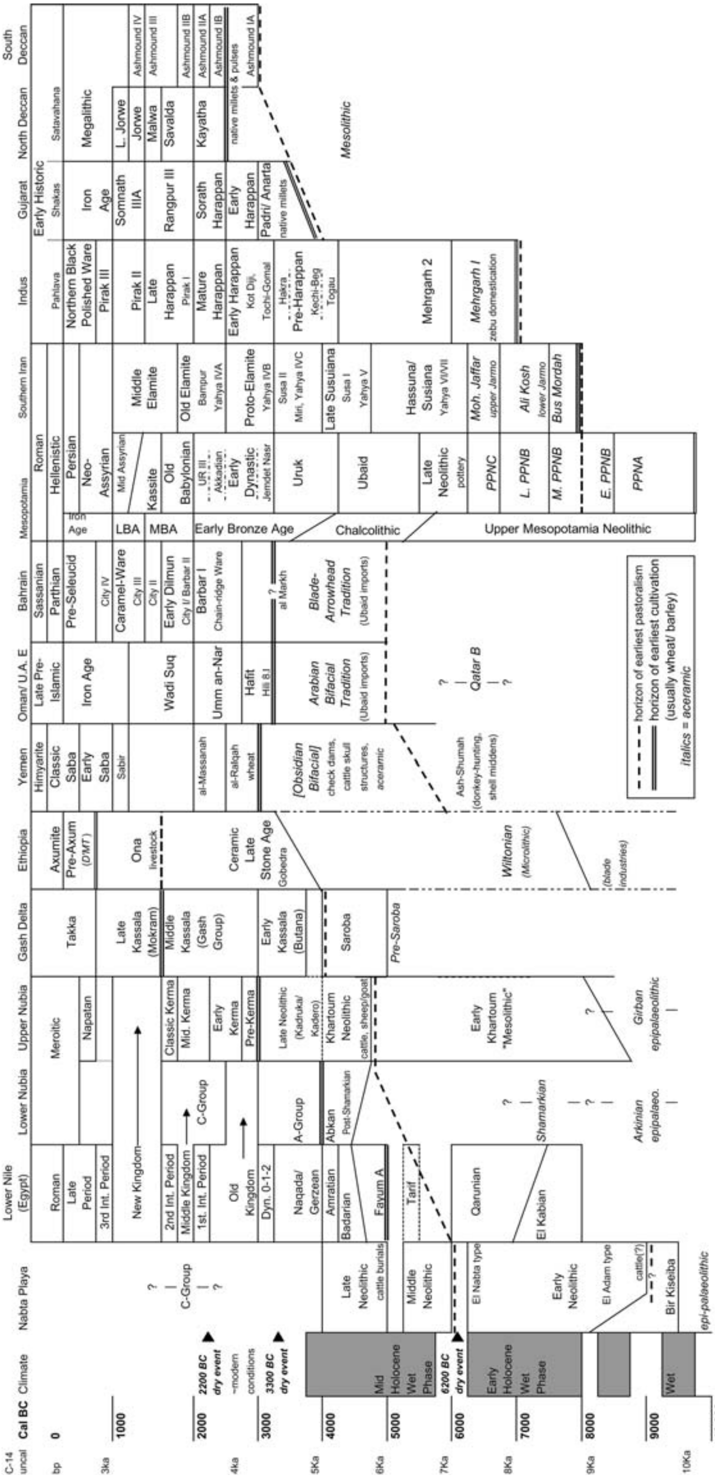
The present paper thus offers an examination of Arabia's maritime past from a general, inter-regional perspective. Our focus will be on Arabia's earliest records for maritime subsistence, seafaring activity and species translocations. In broad terms, we will argue that Arabia's maritime position grew through four major phases of maritime activities, beginning in the early/middle Holocene. In Phase I, during the early and middle Holocene, coastal-focused foragers were responsible for early boat use and the earliest contacts and maritime exchange along the coasts of parts of the Red Sea and the Persian Gulf/Gulf of Oman. In Phase II, from the fourth millennium BC, these two trading spheres on either side of the Arabian Peninsula were well-developed and included extensive maritime trade with the Early Bronze Age urban civilizations in Egypt, Mesopotamia and the Indus. This period also witnessed the development of clearly attested cultivation systems in southern Arabia. Perhaps towards the end of the third millennium, and certainly by the second millennium BC, evidence for crop transfers between eastern Africa and South Asia indicates links across the Indian Ocean, or perhaps along the southern coast of Arabia. Phase III, beginning around 2000 BC, saw transformations of regional trade patterns, with general continuity in maritime activity in some areas and eventual disruptions in others, all at a time of widespread political instability in the wider region at the beginning of the Middle Bronze Age. Finally, Phase IV saw major changes as transport and agricultural innovations ushered in a new era of Iron Age maritime activity that culminated in the

Indian Ocean spice trade in the Graeco-Roman period. We will focus our attention in particular on developments in the two early phases, when maritime activities first emerged.

In this review, we will draw attention to evidence not only for maritime subsistence, seafaring, and trade, but also for agricultural dispersal and production, for each of these phases. Agricultural systems are important to this theme in two ways. First, most domesticated plants and animals in Arabia did not originate there, and thus attention must be given to the likelihood of some of these introductions having occurred by sea, whether from Africa or South Asia, or from Mesopotamia and the Levant by routes that may have been at least partly coastal. Considerations of the spread of African crops to South Asia, for example, have played a significant role in scholarly thinking about early links between Arabia and the regions to either side (e.g. Blench 2003; Cleuziou and Costantini 1980; McCorriston 2006; Possehl 1996), and also the potential role of these contacts in the development of early Arabian societies. Secondly, agricultural systems must have underpinned trade in at least some parts of the region, providing the basic surpluses on which craft production, regular voyaging, and trade became possible, as well as in some cases the species (whether of incense, grain, cattle and so on) that were the object of trade.

Although changes in agricultural economy are tightly linked to the broader socioeconomic system, there has often been a separation in the scholarship on early agricultural systems in South Asia, eastern Africa, Mesopotamia and Arabia. Yet if we are to understand the connections between these regions (and the contexts in which domesticated plants and animals were transported) we need to consider how their cultural and subsistence histories compare. As a starting point, a general chronology of these diverse regions is given here (Fig. 1; we may note here that a generally accepted chronological framework remains to be achieved, as indicated by the absence of any chronological chart in reviews by Potts 1990, 1997); assessment of the radiometric evidence for the Arabian peninsula is beyond the scope of the present paper but, as noted by Cleuziou (2002), there are chronological discrepancies that derive from matching radiocarbon evidence with historical chronologies, and for the latter there are both short and long chronologies to contend with). In the sections that follow, we focus on the four chronological phases of maritime development in the Arabian Peninsula, with interspersed discussion of the evidence for agricultural developments.

Another key theme here is the role of small-scale societies both in the emergence of maritime contact and exchange, and in the later more systematic Bronze Age trade in the Red Sea, Persian Gulf and Arabian Sea. There has been, as Mark Horton has observed, both a tendency to focus on textual evidence for trade and a marked bias towards the trade activities of the larger, state-level societies in the Indian Ocean (Horton 1997). This is perhaps understandable in light of the broader variety of evidence from ancient states, including historical records, greater concentrations of goods, better preservation, depictions of maritime activities in art and iconography, and—at a methodological level—longer-term and larger-scale excavations. As we aim to show, however, there is increasing evidence for both local processes and indigenous communities in early maritime contact and exchange—including contact over long distances. As Horton has observed, with respect to the ancient Indian Ocean: ‘we only have to think of the maritime societies of the Pacific to realize that very complex exchange systems could have existed, and that the Harappans, Greeks or Achaemenids may have been *parvenus* on the scene’ (Horton 1997a, 748). The potentially critical role of small-scale societies in the early emergence and subsequent elaboration of maritime activities should not be underestimated. In an earlier review, Cleuziou and Tosi questioned the ‘Mesopotamocentric’ understanding of Persian Gulf history and pointed towards an alternative view of mutual ‘interference’ between


C-14 uncal bp
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Climate
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Lower Nubia
Upper Nubia
Gash Delta
Ethiopia
Yemen
Oman/ U.A. E
Bahrain
Mesopotamia
Southern Iran
Indus
Gujarat
North Deccan
South Deccan
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2200 BC dry event
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3300 BC dry event
6200 BC dry event
Mid Holocene Wet Phase
Early Holocene Wet Phase
Wet
C-Group
Late Neolithic
cattle burials
Middle Neolithic
El Nabta type
Early Neolithic
El Adam type
cattle(?)
Bir Kiseiba
epi-palaeolithic
Roman
Late Period
3rd Int. Period
New Kingdom
2nd Int. Period
Middle Kingdom
1st. Int. Period
Old Kingdom
Dyn. 0-1-2
Naqada/ Gerzean
Amratian
Badarian
Fayum A
Tarif
Qarunian
El Kabian
A-Group
Abkan
Post-Shamarkian
Shamarkian
Arkinian epipalaeo.
Meroitic
Napatan
Classic Kerma
Mid. Kerma
Early Kerma
Pre-Kerma
Late Neolithic (Kadruka/ Kadero)
Khartoum Neolithic
cattle, sheep/goat
Early Khartoum "Mesolithic"
Girban epipalaeolithic
Takka
Late Kassala (Mokram)
Middle Kassala (Gash Group)
Early Kassala (Butana)
Saroba
Pre-Saroba
Axumite
Pre-Axum (DMT)
Ona
livestock
Ceramic Late Stone Age
Gobedra
Wiltonian (Microlithic)
(blade industries)
Himyarite
Classic Saba
Early Saba
Sabir
al-Massanah
al-Raiqah wheat
[Obsidian Bifacial] check dams, cattle skull structures, aceramic
Ash-Shumah (donkey-hunting, shell middens)
Late Pre-Islamic
Iron Age
Wadi Suq
Umm an-Nar
Hafit
Hili 8.I
Arabian Bifacial Tradition (Ubaid imports)
Qatar B
Sassanian
Parthian
Pre-Seleucid
City IV
Caramel-Ware
City III
City II
Early Dilmun
City I/ Barbar II
Barbar I
Chain-ridge Ware
al Markh
Blade-Arrowhead Tradition (Ubaid imports)
Roman
Hellenistic
Persian
Neo-Assyrian
Mid Assyrian
Iron Age
LBA
MBA
Kassite
Old Babylonian
UR III
Akkadian
Early Dynastic
Jemdet Nasr
Early Bronze Age
Uruk
Chalcolithic
Ubaid
Late Neolithic pottery
PPNC
L. PPNB
M. PPNB
E. PPNB
PPNA
Upper Mesopotamia Neolithic
Middle Elamite
Old Elamite
Bampur
Yahya IVA
Proto-Elamite
Yahya IVB
Susa II
Miri, Yahya IVC
Late Susuiana
Susa I
Yahya V
Hassuna/ Susiana
Yahya VI/VII
Moh. Jaffar
upper Jarmo
Ali Kosh
lower Jarmo
Bus Mordah
Pahlava
Northern Black Polished Ware
Pirak III
Pirak II
Late Harappan
Pirak I
Mature Harappan
Early Harappan
Kot Diji, Tochi-Gomal
Hakra
Pre-Harappan
Kechi-Beg
Togau
Mehrgarh 2
Mehrgarh I
zebu domestication
Early Historic
Shakas
Iron Age
Somnath IIA
Rangpur III
Sorath Harappan
Early Harappan
Padri/ Anarta
native millets
Satavahana
Megalithic
L. Jorwe
Jorwe
Malwa
Savalda
Kayatha
native millets & pulses
Mesolithic
Ashmound IV
Ashmound III
Ashmound IIB
Ashmound IIA
Ashmound IB
Ashmound IA
horizon of earliest pastoralism
horizon of earliest cultivation (usually wheat/ barley)
italics = aceramic

◀ **Fig. 1** A general comparative chronology for the Arabian Peninsula and surrounding regions. Inferred horizon for the beginnings of pastoralism and plant cultivation is indicated. Divisions between phases and correlations are approximate, the precise chronology in many regions may be open for debate

cultures (Cleuziou and Tosi 1989, 15–17). In our paper we expand upon this viewpoint and give particular consideration to societies beyond the large states (or so-called 'cores') whose activities have so often dominated discussions of seafaring and maritime trade in and around the Arabian region. While the limitations of current evidence in many of the regions under consideration make this difficult, we have tried at minimum to outline the evidence that does exist for maritime communities and their activities. This at least provides an indication of the inevitably intensive local maritime socio-economic processes concurrent with the rise and reign of the great Bronze Age states.

Neither of the authors of this paper is an Arabia specialist. Our regional interests lie on either side of the peninsula, and our interest in Arabia stems from a need to understand its role in maritime developments within the wider Arabian Sea. Accordingly, the outline we present may be considered a preliminary sketch whose details—and in some cases broad outlines—will need further working out. Nonetheless, the synthesis presented here is, as far as we are aware, the first of its kind for Arabia (though previous somewhat more regional but nonetheless important syntheses by Potts 1990, and by Cleuziou and Tosi 1989, 2007, should not be overlooked). This synthesis enables us to construct an initial picture of maritime developments in the Arabian peninsula that will contribute eventually to better understanding of the prehistory of the Arabian Sea, and the earliest interactions between Africa, Arabia and South Asia, which eventually led to the emergence of the complex trade networks described in Classical sources like the first century AD *Periplus Maris Erythraei* (Miller 1968; Casson 1989; Ray 1998; Cappers 2006).

Geography

As Hourani outlined in his book *Arab Seafaring*, geography in certain general respects very much favoured the development of sailing from Arabian shores (Hourani 1995). The peninsula's long coastline—extending from the Gulf of Suez to the head of the Persian Gulf—and proximity to the region's most fertile zones encouraged engagement with the sea from an early date. With much of the interior of the Arabian peninsula bisected by mountain chains and deserts, communication and commerce by sea was often no less formidable—and indeed, once the appropriate technology had been developed, potentially easier—than parallel activities by land. The Red Sea and the Persian Gulf, supplemented by the great river systems of the Nile, the Euphrates and the Tigris, accordingly eventually enabled traffic between the spatially distant Mediterranean basin and Eastern Asia. As Hourani writes of the later societies of the Arabian Peninsula, 'the Arabs were astride two of the world's great trade routes' (Hourani 1995, 5). Nonetheless, the gradual and sometimes downright slow development of maritime contacts and exchange across these various bodies of water during the Holocene suggests that the geographical story is more complex, and indeed the specific articulation of land and sea features has helped shape the development and maritime engagement of regional societies in the Arabian Peninsula. On land, movements, dispersals and interactions have been shaped by the presence of hills, valleys, deserts, mountains, river systems, and coastal plains, while sea connections have been impacted by an equally complex topography of the sea, incorporating winds, currents, shoals, upwellings, and coral reefs. Resources have also played a critical role, including resources for the biota, like marine animals and shellfish, that humans rely on, as well as resources for humans themselves—food, materials for boat-building, trading, and creating objects for socially and economically important exchange activities. All these geographical factors have exerted a significant influence on an Arabian maritime prehistoric trajectory characterised by broad regional patterns with significant local variability. They have both provided and constrained maritime opportunities for individual groups inhabiting particular landscapes.

We may outline some of the key factors. One is river systems. William Facey has observed that the Red Sea, which bisects the globe's most extensive arid zone, the Saharo-Arabian, is not fed by any large river systems that might give direct access to riparian civilisations (Facey 2004, 7). This meant that, apart from Ethiopia/Eritrea and Yemen at its southern end, the Red Sea's shores were not lined with maritime, mercantile civilisations in direct contact with the sea. The civilisations in closest contact with the Red Sea, like for example Egypt, were generally separated from it by mountain and desert. In contrast, Arabia has had the opportunity for rather more direct contact with both the Mesopotamians and the Harappans, both coastally and along the major river systems that were a critical feature of both civilisations. These river systems have potentially also been important in enabling the spread of crops. Both their rich alluvial soils and function as conduits to the interior may help explain why so many crops moved from the Horn of Africa to India, and so few the other way (for a discussion of these translocations, see Blench 2003). The absence of such major river systems in Arabia may help to explain why it seems often to have been skipped over by eastwards-dispersing crops, at least until later time periods.

Another key factor in the maritime prehistory of Arabia and its surrounding regions is seasonal wind patterns. In the Red Sea, the wind pattern divides the sea into two main zones (see Fig. 2). This pattern, as Facey observes, makes it very easy to sail out of the Red Sea southwards for most of the year, and correspondingly difficult to sail northwards up it (Facey 2004). This is because in the northern zone, the prevailing wind blows from the north the whole year round. In the south, while the wind still blows from the north for much of the year, there is a period from October to March/April—the season of the northeast monsoon winds in the Arabian Sea—when a southerly wind blows. Sailing ships accordingly are then enabled to sail partway up the Red Sea. But because of these wind patterns, journeys north of the line roughly between modern-day Jiddah and Aydhab would have been both dangerous and tedious. Facey notes that it is due to this geographic scenario that we see a gradual southward creep of many Red Sea ports over time, and argues that the wind patterns help explain why the Ptolemies and the Romans developed the ports of Myos Hormos and Berenice, both quite a way down the coast (compared to Suez), and serviced by well-maintained overland routes from the Nile Valley (Facey 2004: 11).

Wind patterns, and currents, are of course critical to the issue of maritime contact and trade in the Arabian Sea. The seasonally changing winds known as the monsoon (from the Arabic *mausim*, meaning 'season') have long helped to bridge distant continents and people (Chaudhuri 1990; Das Gupta and Pearson 1987; Hall 1996; Pearson 2003; Vink 2007), no doubt well before their 'discovery' by the Greek navigator Hippalus (according to the Periplus). In general terms, the monsoon phenomenon is the result of the differential warming of air over land and sea (Mitchell 2005; Schott and McCreary 2001; Webster and Yang 1992). In the northern summer, from June to September, land warms faster than the ocean, causing Eurasian continental air masses to rise. This creates a low pressure that results in a steady wind blowing toward the land, bringing the moist near-surface air over the oceans with it. The Earth's axial rotation deflects this air such that it blows from the southwest. In the winter, the situation reverses, and the wind blows from the northeast

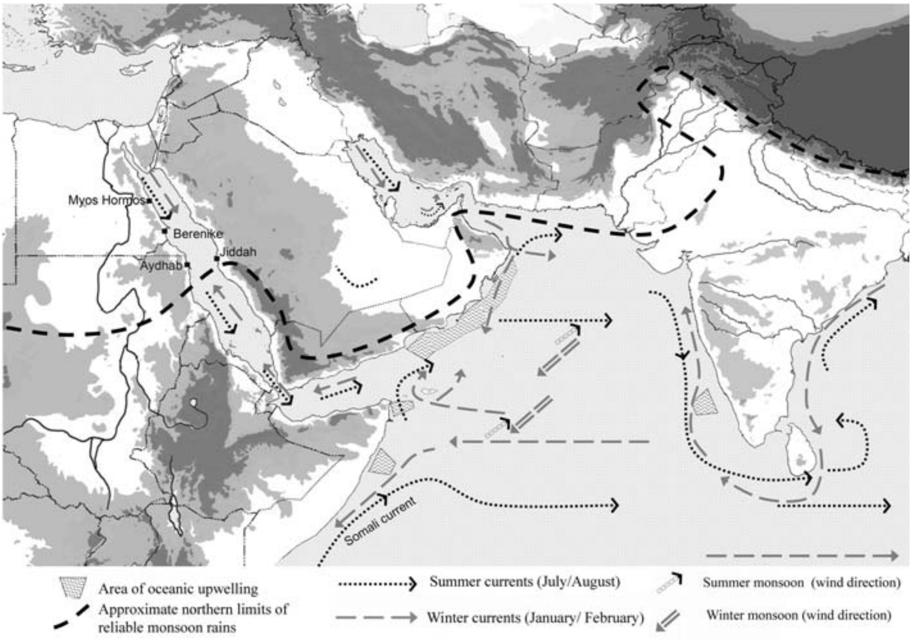

Fig. 2 Arabian Peninsula, wind patterns, and broad climatic division of monsoonal region. *Arrows* indicate the major current directions in the summer (*black dotted lines*) and winter (*grey long dashed lines*) (based on Facey 2004; Mitchell 2005; Schott and McCreary 2001). *Currents and wind directions* largely coincide, except in the middle of the Indian Ocean where winds cut across latitudinal currents. The main thrust of the monsoon in these areas is indicated separately. Major summer ocean upwelling regions indicated. Approximate northern limited of significant monsoon rainfall, in which some summer dry cropping is possible, indicated by *thick black dashed line*

(retreating monsoon). The result is that sailors aware of this consistent pattern could use the monsoon winds to propel their ships from the Red Sea straight to the Malabar coast in the summer, and then back again in the winter. Sea currents also played a role in the Arabian Sea (Mitchell 2005). Intimately connected to the monsoon is the Somali current, which carries water north and east along the Somali coast in summer, and reverses in the winter. In addition, as the Arabian Peninsula became part of ever wider interaction zones, the main east–west Indian Ocean currents that reversed direction every 6 months, and so enabled voyages between India and Africa (Mitchell 2005), would have become relevant as well. In general, surface water currents reflect those of wind direction, and the broad patterns are highlighted in Fig. 2.

Ocean winds and currents also have a role to play in the differential distribution of marine resources off the Arabian coasts. Monsoon currents cause regions of coastal ocean upwelling (Fig. 2), making certain coastal areas biotically rich. Such areas are found along the southern Somali coast, as well as near the tip of the Horn of Africa, and along the eastern Yemeni coast and the Omani coast (Schott and McCreary 2001, Fig. 8). The nutrients in these upwellings promote extensive and intense phytoplankton blooms (Tudhope et al. 1996), which in turn support high fish and bird populations. The upwelling off the southeastern coast of Oman stretches along some 1,000 km of coastline (Tudhope et al. 1996). The Oman coast is thus one of the richest fishing zones in the Middle East, and serves as a seasonal passage for a number of migrating species that are favoured by people, including tuna and sardines (Charpentier 1996). It has accordingly been a focus of fishing activity from a particularly early period. The monsoon-induced upwelling also occurs off the southwest coast of India (FAO 1997; Naidu 1996).

Seafaring activity was also impacted by the presence of coral reefs. In the Red Sea, these skirt both coasts, and are immense, in some places extending far out into the sea. Considerable knowledge and skill were required to avoid being wrecked on them (Hourani 1995, 5). While conditions were more favourable in the Persian Gulf, where on the western and southern shores at least, there are natural harbours with fresh water (McGrail 2004), it is worth noting that the peninsula as a whole has no navigable rivers and few first-class harbours (Hourani 1995, 5). Nonetheless, as sites like Ras al-Hadd at the conjunction of the Gulf of Oman and Arabian Sea demonstrate, natural harbours did exist elsewhere on the peninsula, and often became early foci of maritime trade and key conduits for the movement of goods inland (Cleuziou and Tosi 2007). Furthermore, the earlier claim that Arabia does not and never has produced wood suitable for building strong oceangoing ships (Hourani 1995, 5) has recently been challenged by findings from charcoal and pollen analysis, which indicate that *Rhizophora mucronata*, the red mangrove, an excellent wood for ship-building, was present along the coasts of the Arabian peninsula, and particularly in the Oman peninsula (Lézine et al. 2002; Tengberg 2005). Pollen evidence from Suwayh swamp near Ras al-Hadd indicates that *Rhizophora* was part of the local mangroves, together with black mangrove in the early-mid Holocene, showing a marked decline before c. 4000 BC and probably disappearing by 3000 BC (see Lézine et al. 2002). *R. mucronata* is predominantly from more southerly coastlines (e.g. East Africa, India), and is today absent from the mangroves of the Oman region (which are dominated by the black mangrove, *Avicennia marina*); the closest reported populations of *Rhizophora* today are in Yemen and the southern Red Sea (Torre and Gonçalves 1978) and the Las Bela region of the Indus Delta (Snead and Tasnif 1966; Ghafour 1984).

Agriculture in the Arabian Peninsula was meanwhile shaped by hydrological conditions. The Arabian Peninsula as a whole is desertic, and falls between two rainfall patterns: the winter rains of the Mediterranean system and the summer rains of the monsoon. Across much of the peninsula, including lowland and coastal areas, rainfall is insufficient to support agriculture directly. However, below-ground water reservoirs (aquifers), which are slowly topped up by rains, provide water at natural seepages, which form oases, and can be tapped by wells (Blau 1999; Edens 1993). Much traditional oasis agriculture is thus based on tapping these below ground sources, and advances in the methods for doing so have been important to the development of agriculture in the peninsula. Of particular importance was the development of *falaj* (or *qanat*) systems by the early Iron Age, with possibly earlier roots (Magee 2005; see discussion below). Oasis agriculture involves growing trees, especially the date palm (*Phoenix dactylifera*), in the protective shade of which cereals, pulses and vegetables can be grown. Winter crops, such as wheat and barley are grown in this way, but so too are summer crops, including sorghum and in some areas pearl millet (Mason 1946, 475).

In the mountain areas rainfall is higher and sufficient water for agriculture can be obtained from run-off of the limited rains derived from the summer monsoon (for the approximate limits of this, see Fig. 2). The hills of Oman receive an average of c. 700 mm of rainfall annually, which is sufficient to grow crops without irrigation, and this falls mainly in the winter. Thus the traditional crops in this region have primarily been the winter crops of Near Eastern origins, such as wheat and barley. In Yemen, the hills receive sufficient rainfall to support agriculture and the runoff allows rain-fed farming on the foothill slopes that approach the Tihama plain (Munro and Wilkinson 2007). Here the rainfall is monsoonal and falls in the summer, and thus traditional rainfed cultivation has been based on sorghum and millets, and a much greater diversity of summer crops is grown in this region (Mason 1946; Varisco 1994).

As Edens (1993) points out, the two regions, of aquifers and orographically derived runoff, define potential centers of agricultural population in eastern Arabia. In the Persian Gulf region, they were in fact the two focal areas of Bronze Age societies. They correspond to the civilisations of *Dilmun* (aquifers/oases) and *Magan* (run-off), known from cuneiform toponyms, and prominent in the history of Bronze Age maritime trade. In southwest Arabia, in the interior of the uplands, zones of these types were also important economic centres of the classic Sabean civilization (Robin 2002; Wilkinson 2002). One key difference between the eastern and western sides of the peninsula is that these zones of agricultural production were oriented towards the coast on the Persian Gulf side, but towards the desert in Yemen. This may help to account for the earlier and more extensive evidence for coastal trade in the Persian Gulf/ Gulf of Oman region.

Climate and Sea Level Change

Settlement, agriculture, and maritime activity in the Arabian Peninsula have also been shaped by climate, which has undergone important transformations over the course of the Holocene. Monsoon intensity has changed since the Pleistocene, altering summer insolation over Eurasia, linked to orbital precession (Kutzbach 1981; Ruddiman 2006). Useful datasets from which to infer climatic changes come from lakes and palaeolakes in Arabia and the Qunf Cave stalagamite in southwest Oman (Fleitman et al. 2003; Lézine et al. 1998, 2007; Parker et al. 2004, 2006a, b; Wilkinson 2005). These in turn can be correlated with the general patterns recorded in East African lakes (Gasse 2000), the Eastern Sahara (Hassan 1997), lakes in the Thar Desert in northwestern India, and Arabian Sea sediments that relate to the Indus river discharge (for a recent review of these and other South Asia datasets, see Madella and Fuller 2006). The correlations between a selection of these sources are shown in Fig. 3, and the location of the sites from which these samples were derived is plotted in Fig. 4. In broad terms, we see that, after the return to glacial-like conditions during the Younger Dryas, during which time deserts were drier, the Early and Middle Holocene period was characterised by higher water/rainfall levels from c. 9000 BC to 2500 BC, although this was punctuated by numerous dry episodes. The past 4,000–4,500 years have been characterized by near-modern conditions of aridity.

Within this broad wet phase, the impact of higher rainfall would have been most dramatic in the desert and semi-desert regions, like those in the Sahara and most of the Arabian Peninsula. In the Eastern Sahara, for example, increases in rainfall of 150–200 mm are inferred to link to northward shifts in latitudinal vegetation belts of as much as 600 km (Hassan 1997; Neumann 1989). This moved the transition from savannah to desert—the boundary of monsoon climate, as indicated in Fig. 2—from the central Sudan to southwestern Egypt, allowing colonization of the southern Sahara by groups of hunter-gatherer-fishers of the early ceramic horizon in Egypt/Sudan (e.g. Fuller 1998; Haaland 1992; Hassan 1997; Jesse 2003; Wendorf and Schild 1994). Mesolithic groups also encroached on the Thar Desert of India/Pakistan (Ajithprasad 2004; Biagi and Kazi 1995; Fuller 2006, 10). A similar pattern would have extended to the deserts of the Arabian Peninsula, with rainfall and savannah-like vegetation spreading as far north as an-Afud. In the mid-Holocene (from c. 6000/5900 BC) conditions were wetter than at present, though not as wet as in the early Holocene, and it has been suggested on the basis of data from

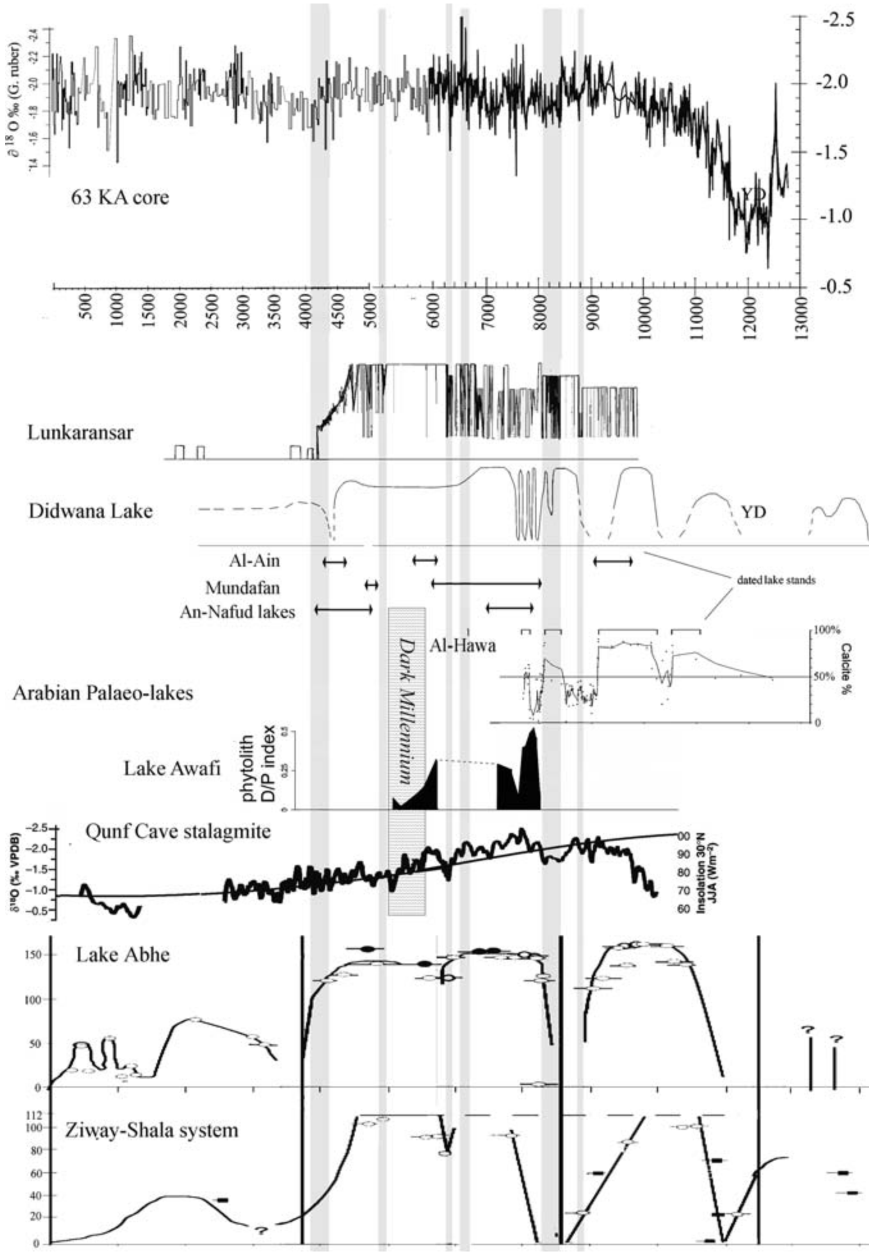

Fig. 3 Correlation of palaeoclimatic proxies for the Arabian peninsula, northwestern South Asia and East Africa. From *top* to *bottom*: O-18 isotopic variation from Pakistan continental margin, core 63 KA (after Staubwasser et al. 2002, 2003); lake level data from Lunkaransar (after Enzel et al. 1999); lake levels from Didwana lake (after Wasson et al. 1984); dated high lake stands from selected Arabian palaeolakes (after Lézine et al. 1998); lake level proxy calcite data from Al-Hawa palaeolake, Yemen (after Lézine et al. 2007); dicot-to-grass vegetation (phytoliths) index from Awafi Lake, United Arab Emirates (after Parker et al. 2004); O-18 isotopic record from the Qunf Cave stalagmite (after Fleitman et al. 2003); lake level data from Abhe and Ziway Shala in Ethiopia (after Gasse 2000)

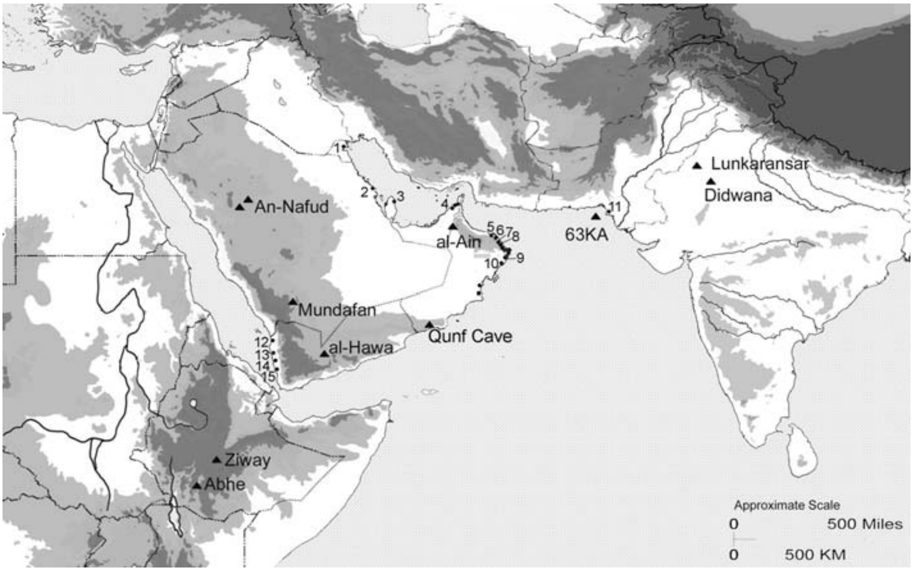

Fig. 4 Map showing the distribution of major palaeoclimatic datasets discussed in the text (indicated by *triangles*; see also Fig. 3, above), and the general distribution of Mid-Holocene shell midden sites (indicated by *circles*). Sites with chronometric evidence (see Fig. 5) are numbered: 1. H3, Kuwait; 2. Dosariyah, Saudi Arabia; 3. Khor D & Khor FB, Qatar; 4. ar-Ramlah 6 (RA 6), UAE; 5. Ras al-Hamrah sites and Saruq, Oman; 6. Wadi Wuttaya (WW), Oman; 7. Bandar Khayran, Oman; 8. Daghmar, Oman; 9. Suwayh (SWY-11), Oman; 10. SAQ-1, Oman; 11. Daun-1, Pakistan; 12. Jizan area shell middens; 13. Wadi Sardud; 14. Hodeidah area shell middens; 15. Ash-Shumah, Yemen

South Asia that the mid-Holocene conditions derived from higher levels of winter rainfall from the Mediterranean system, whereas early Holocene conditions were driven more by a stronger monsoon (reviewed in Madella and Fuller 2006; also Wilkinson 2005, 172). This appears to be reflected in the very latest palaeolake dates in Arabia from the northern region at An-Nafud (cf. Lézine et al. 1998).

The impact of dry episodes, both regional and local, would, however, have been particularly significant. The seventh millennium BC, for example, was punctuated by major dry episodes. The first was focused around 6800 BC, and is particularly marked in the Al-Hawa data from Yemen (see Fig. 3). This arid event appears merged with the later dry event of 6200–6000 BC in the East Africa datasets, but it is clear from the Thar and Arabian evidence that there was a recovery of rainfall in between. The major dry episode of 6200–6000 BC now appears to have been a more or less global climatic event, reflected also in the Greenland ice-cores, as well as East African and South Asian datasets (Alley and Ágústdóttir 2005; Alley et al. 1997; Gasse 2000; Kobashi et al. 2007; Madella and Fuller 2006). Recent study of the Greenland data suggests that the core event was only c. 150 years in duration, from c. 6175 BC to c. 6025 BC, although we can expect some lag time in local sequences. In the Al-Hawa data for example, lower lake levels are reached closer to 5900 BC, a time when Hassan (1997) infers a peak in aridity for the Egyptian desert. Potts' (2008b) assertion that Arabia was significantly more attractive to human populations than the Levant and Mesopotamia in the late seventh millennium BC may reflect a time lag in the arid phase reaching more southerly regions. This arid phase may nonetheless be expected to have had a major impact on the previously greener Sahara and

Arabian deserts. The cause of this event appears to have been a large outburst of freshwater into the north Atlantic, as glaciers completed their early Holocene thaw and melt, and released water from glacier-trapped lakes (Alley and Ágústdóttir 2005). We take this event to mark the transition from the early to mid-Holocene. During the subsequent mid-Holocene, there were additional dry episodes, and those focused at 4300 BC, perhaps 3300/3200 BC and the late third millennium (the 2200 BC event: see below) may be noted.

Of particular relevance to northern and eastern Arabia, however, is a more localized dry phase from 3800 BC. Evidence from northern Oman, United Arab Emirates and the An-Nafud region beginning around this time suggests a particularly marked period of aridity and decline in settlement evidence, which has been called the 'Dark Millennium' (Uerpmann 2003). This period was first postulated on the basis of the poor evidence for human occupation, except for a limited number of seasonal coastal sites, during this post-Ubaid period (Potts 1993; Uerpmann 2003). The recent paleoenvironmental reconstruction from the Awafi palaeolake in United Arab Emirates indicates two peaks in aridity, at c. 3900 BC and 3200 BC (Parker et al. 2006a, b). While these downward trends are evident in the Qunf speleothem (see Fig. 3), it is also clear that this period is not recorded as arid further afield in East Africa or South Asia, nor probably in southwest Arabia. The impact on vegetation in Eastern Arabia is suggested by first a sharp decline in woody vegetation followed by its near disappearance, as inferred from Awafi phytoliths ratios (Parker et al. 2004). The absence of palaeolake stands in An-Nafud at this time suggests aridity was particularly marked in northern and eastern Arabia. Subsequently a shallow lake refilled at Awafi by the early third millennium BC, and was present up until the 2200 BC dry event (Parker et al. 2006).

In addition to important climatic alterations, the early and mid-Holocene saw major coastline change, as sea levels rose with post-Pleistocene glacial melt. In the relatively shallow Persian Gulf, sea level rise had dramatic consequences (Lambeck 1996), reaching modern levels at 5400 BC, and its highest point at 5000 BC (see Fig. 5). It is no coincidence that the rise in sea levels occurs after the 6200 BC dry event; as indicated above, the latter appears causally linked to glacial melt and release of trapped fresh water lakes into the North Atlantic (Alley and Ágústdóttir 2005). The Persian Gulf, which became gradually filled after the last glacial, remained shallow, and did not really become something that could be called a sea until the mid-Holocene (Lambeck 1996). By contrast, the Red Sea is based on a much deeper rift (part of the African rift valley tectonic fault complex) and likely experienced much less dramatic change with early Holocene sea level rise. From the point of view of human populations in Arabia, the rising sea levels, which subsequently fell slightly over the mid-Holocene, together with the aridification of the inland deserts, meant that populations would have become increasingly restricted to a narrow coastal zone near the modern coastline.

Sea level rise can also be expected to have affected site visibility (Bailey 2004). It may explain why evidence is basically lacking for coastal occupation in the Pleistocene and Early Holocene prior to the dry event of c. 6200–6000 BC. As can be seen in Fig. 5, the earliest dates associated with Persian Gulf shell middens and coastal sites calibrate to c. 5800 BC (SWY). While putative coastal sites older than 6000 BC might be situated below current sea-level, coastal sedimentation (Chandramohan et al. 2001; Gaur and Sundaresh 2007; Sanil Kumar et al. 2006), especially in regions where inland rivers drain, as along the Makran, Indian and Yemeni coastlines, can also be expected to have buried many sites. Shell midden sites may have been particularly impacted. Other taphonomic factors active in these areas include river shift, late Holocene sea level fall, erosion, and tectonic activity (Mathur et al. 2004; Sanil Kumar et al. 2006; Shajan et al. 2008; Shroder 1993). Such

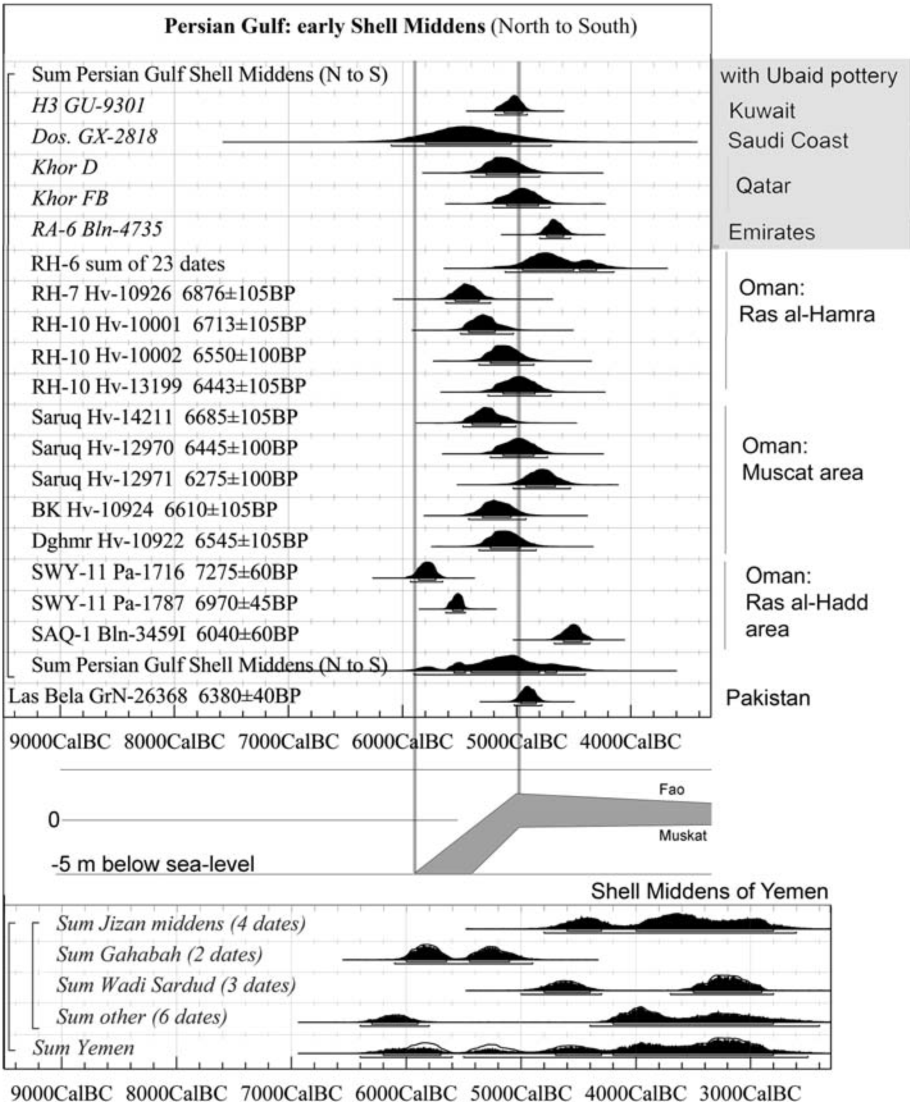

Fig. 5 The probability distribution of calendrical ages of representative early Arabian shell middens (>6,000 bp), compared with Persian Gulf sea level rise (after Lambeck 1996; converted to calibrated timescale: the *grey curve* indicates inferred variation in sea level rise between Fao and Muskat). As almost all dates were on shells, fishbones (and some charcoal may derive from mangrove), marine reservoir corrections were used, with ΔR derived from the Queens University Belfast database (http://intcal.qub.ac.uk/marine/). For Persian Gulf dates, $\Delta R = 230 \pm 65$, was derived from 3 datasets (map # 256, 581, 584), while for Red Sea dates, $\Delta R = 188 \pm 73$, was derived from 7 datasets (map #253, 582–3, 585–7). Calibrations were performed with OxCal 3.10 (Bronk Ramsey 2005). Dates for RH5 from Biagi and Nisbet (1992); other Persian Gulf dates from Biagi (1994, 2006). Data on Yemen shell middens from Edens and Wilkinson (1998) and Durrani (2005). For locations of sites see Fig. 4

factors, which can make even known historical sites with abundant artefacts difficult to locate (e.g. Shajan et al. 2008), may in part account for the more limited finds of shell midden sites along the South Asian coastlines.

Phase I: Early Ichthyophagi and the Emergence of Maritime Exchange from the Mid-Holocene

The question of coastal adaptations in Palaeolithic Arabia remains an open one (Bailey 2009), despite Sauer's early postulation of an Arabian 'lost corridor of mankind' (Sauer 1952, 36), and the current popularity of the not dissimilar Southern Dispersal Hypothesis in the archaeological and genetic literature (Forster and Matsumura 2005; Lahr and Foley 1994; Stringer 2000), perhaps in part for some of the taphonomic and/or climatic reasons outlined above. In contrast, there is clear evidence by the early to mid-Holocene for exploitation of coastal resources along the Red Sea, the Persian Gulf, and the Arabian Sea. The most obvious evidence for such activity is the ancient shell middens that are found along much of the coastal rim of the Arabian Peninsula, some of which date as far back as the late seventh millennium BC (Fig. 5; Biagi 1994, 2006; Biagi and Nisbet 2006). These and other finds suggest the exploitation of marine and mangrove swamp resources from an early date in the peninsula, and point to the prehistoric origins of the 'Ichthyophagi' or primitive fish-eaters of the East African, Arabian and Indian coasts described in Classical sources like the *Periplus of the Erythraean Sea* (Beech 2004; see also Biagi et al. 1984; Horton 1997b).

Along the eastern littoral of the Arabian Peninsula, much of the earliest evidence for a distinctive maritime adaptation can be traced to the eastern shores of Oman. This is to be found at shell midden and coastal sites like Suwayh (SWY-11) and Wati Wuttaya (WW), with dates going back to 5900 BC. The correlation to a dry episode may be meaningful, although we have also pointed out the potential impact of sea level change on earlier sites. These earliest shell midden and coastal sites are associated with the southerly part of the Gulf of Oman. During the sixth millennium BC, the number of shell middens increased, and the sites began to spread up towards Mesopotamia, with a peak in shell midden dates between 5400 and 5000 BC. Sites like Ras al-Hamra (RH-7) and Dosariyah, in Saudi Arabia, begin in the mid sixth millennium BC.

Changes in the number of sites over time likely relate in part to the rising sea levels, discussed in the previous section, from the seventh millennium cal. BC (see Fig. 5) It is interesting to note that sites with the earliest dates seem to be located near either inland topographic depressions in which swamp conditions could have developed in appropriate conditions (e.g. Dosariyah), or steep coasts (Suwayh, Wati Wuttaya, and Ras al-Hamra), both of which will have been minimally impacted by sea level rise (see Lambeck 1996 for definite shoreline reconstructions). As for subsequent periods, it is still not clear whether these sites reflect the activities of coastally adapted groups, or inland populations moving to the coast for the seasonal exploitation of maritime resources (for a discussion of this issue see Uerpmann et al. 2000).

When scholars first investigated the early coastal sites of Oman, it was assumed that they must date to the early Holocene, based on their aceramic, late Stone Age-type assemblages (Biagi et al. 1984). In fact, not only were they contemporary with the developing farm-based societies of Mesopotamia to the north, but they also had a significant food-producing component themselves, with evidence for both sheep/goat and cattle bones consistently found from the earliest strata (Biagi 2006; Biagi et al. 1984; Potts 2008b). These early indications of a pastoral element to the economy date back to the sixth millennium BC.

In terms of maritime activities, the most striking indication of definite seafaring activity in the Persian Gulf/Gulf of Oman region comes with the introduction, in the late sixth millennium BC, of Ubaid pottery from Mesopotamia onto Neolithic sites of the Arabian

Bifacial Tradition (Oates et al. 1977; Potts 1990; Roaf and Galbraith 1994). Ubaid pottery seems to arrive in the Persian Gulf perhaps as early as the late Ubaid 2 period, but to be focused on Ubaid 3 and 4, extending in places into the post-Ubaid-4 or Terminal Ubaid (Potts 1990; Rice 1994). Radiocarbon dates indicate a time range from the second half of the sixth millennium through to the end of the fifth millennium BC (Carter 2006; Matthews 2005; Potts 1990; Vogt 1994). Ubaid pottery has now been found at over 60 Arabian Neolithic sites (Carter 2006), mainly on the coast (but including a number of off-shore islands for example, Dalma and Bahrain), from Ras al-Sabiyah in the north to the approach to the Straits of Hormuz in the south (Phillips 2002; Fig. 6). While a number of earlier interpretations of the Ubaid pottery—which archaeometric analyses demonstrate was manufactured in Mesopotamia (Oates et al. 1977; Roaf and Galbraith 1994)—read it as an indication of Mesopotamian contact with Persian Gulf inhabitants, or even the remnants of Mesopotamian maritime expeditions (e.g. Lawler 2002; Oates et al. 1977; Potts 1990), increasing evidence suggests a potentially more active role for Arabian Neolithic peoples in moving the ceramics (Carter 2006; Cleuziou 2003; Kallweit 2002; Roaf and Galbraith 1994; Vogt 1994). Robert Carter has emphasised that the Ubaid pottery is an intrusive element on sites whose material culture is otherwise overwhelmingly Neolithic and Arabian (Carter 2006; see also Roaf and Galbraith 1994), and suggestive of mixed hunting-gathering, fishing and pastoral activities (Beech 2002, 2003a, b, c, 2004; Beech and al-Husaini 2005; Kallweit 2002). Burial patterns at the site of UAQ-2 on the UAE shoreline, where a cemetery with Ubaid ceramics appeared to be that of a local population (Phillips 2002), emphasise the indigenous flavour of Ubaid-related sites in the Persian Gulf (see also Vogt 1994). And while distribution is predominantly coastal, significant quantities of Ubaid ceramics are also found at sites up to 60–70 km inland, suggesting that it was circulated locally (Carter 2006; Kallweit 2002). Carter has drawn upon such evidence to suggest the operation of local exchange networks in which Ubaid ceramics featured as prestige goods, possibly exchanged in ceremonial contexts that played an important role in the negotiation of power and status within and between groups (Carter 2006). This seems a reasonable suggestion, especially in light of the focus on often delicate and thin-walled serving vessels, such as bowls and cups, in Persian Gulf Ubaid-related assemblages (Carter 2006, 59).

The prestige goods exchange model for Ubaid-related sites in the Persian Gulf would also explain the richer concentrations of Ubaid ceramics at selected centres, although predominantly in the northern Persian Gulf (Carter 2006; Phillips 2002; Spoor 1997). Archaeological studies of exchange systems suggest that both availability and distribution of goods decrease with increased distance from source, but social and economic forces may link key regional centres as foci of greater 'prestige' and more trade items (Carter 2006; Phillips 2002; Renfrew 1975). Whether Mesopotamians or Arabians initiated trade contacts is unclear, but the distribution of Ubaid ceramics across a range of site varieties, from large to small, and from coastal to inland (Carter 2006), does suggest the operation of local Arabian exchange networks (see also Kallweit 2002; Spoor 1997). The fact that imitations of Ubaid pottery were made in areas of lower circulation, further from the core regions of contact with Ubaid sources, underscores the desirability of Ubaid pottery for Neolithic Arabian populations and hence their potentially active role in acquiring it (Carter 2006). Also circulated and exchanged in the Persian Gulf's Neolithic maritime exchange economy were items like bitumen beads, stone and stone artefacts (especially flint and obsidian), and probably also pearls, shell and mother of pearl jewellery and beads, ochre and a wide range of perishable goods such as hides, fish (both fresh and dried), and livestock (including cattle) (Beech 2002, 2004; Beech and al-Husaini 2005; Carter 2006; Connan et al. 2005;

Flavin and Shepherd 1994; Phillips 2002). Textiles may also have been exchanged. A unique and difficult to explain find is that of remarkably early (fourth millennium BC) cotton thread embedded in plaster from the site of Dhuweila in the Arabian desert in Eastern Jordan (Betts et al. 1994). At this period, the only region likely to have been cultivating cotton and producing such textiles is Baluchistan, Pakistan (Fuller 2008; Fuller and Madella 2001, 337; Moulherat et al. 2002). It is unclear whether such textiles might have found their way through down-the-line trade over land or via the Persian Gulf. Such exotic types of textiles would presumably have been prized exchange items.

The idea that not just Mesopotamians, but also Neolithic Arabians were engaged in maritime trade in the Persian Gulf is strengthened by finds from the Kuwaiti site of H3 at As-Sabiyah (Beech and al-Husaini 2005; Carter 2006). Situated at the edge of a sheltered bay, now infilled, H3 has yielded Ubaid 2/3 ceramics and radiocarbon dates indicating occupation began between 5500 and 5000 BC. As at other Arabian Neolithic sites, the inhabitants appear to have had a broad economic base that included the management of domestic animals as well as fishing and hunting (Beech and al-Husaini 2005). Remarkably, excavations have also unearthed clear evidence of what may well be the world's earliest boat remains (Lawler 2002), consisting of over 50 pieces of bituminous amalgam, mostly with reed-impressions and/or barnacle encrustations, that are interpreted as fragments of the waterproof coating of sea-going reed-bundle boats (Carter 2006). These accompany a ceramic model of a reed-bundle boat and, especially notable, a painted disc depicting a sailing boat. The disc interpretation not only clearly demonstrates the use of boats at this time (since similar models at Eridu have also been interpreted as spinning bowls used by weavers: Strasser 1996), but also indicates employment of the sail by the Ubaid 3 period, pushing back its first known use (Stieglitz 1984) by a millennium. The fact that bitumen was obtained not from Mesopotamia but locally, from the Burgan Hill seeps 70 km away (Connan et al. 2005), suggests local boat-building or at least repair activities. Burgan Hill appears also to be the source of some of the flint at the site, and preliminary examinations suggest that the bitumen may also have been used to haft the flint implements made there (Connan et al. 2005). Analysis of the fish remains from the site indicates a focus on shallow water species, but also suggests that fishing occasionally extended into deeper waters (Beech and al-Husaini 2005). There is also evidence for some degree of craft specialisation in the production of shell and otolith beads, and possibly for year-round habitation of the site (Beech and al-Husaini 2005). While there has been suggestion of a mixed Mesopotamian and local population at H3 (Lawler 2002), overall the site looks more like an Arabian Neolithic habitation whose occupants were involved in more intensive trade due to the site's strategic location at the overlap between several key spheres of influence to the north and south (Beech and al-Husaini 2005).

Also noteworthy from this period of traded Ubaid ware are the surprisingly substantial Neolithic stone structures on the island of Marawah in the UAE (Anonymous 2004; Beech et al. 2005) and at H3 (Carter and Crawford 2003). These add to the impression that some coastal societies may have exhibited a degree of sedentism—for example, extended stays at the same localities year after year, as communities tracked seasonal resources (see also the substantial structures at sites like Dalma; Flavin and Shepherd 1994). The significant depth of Ubaid ceramic-bearing deposits found at a number of sites, like Dosariyah (3.5 m) and Abu Khamis (4 m) (Potts 1990), further reinforces this impression. There is also evidence for increasing uptake of activities like pearl-fishing, standardised jewellery production, deep-sea fishing, and intensive fish processing as early as the fifth/sixth millennia BC (Beech 2004; Beech and al-Husaini 2005; Carter 2005; Charpentier 1996; Popescu 2003). Deep sea fishing seems to have been more common in the southern Persian

Gulf and Gulf of Oman, however, where bigger fish were caught (Beech 2002, 2003, 2004). Late spring and early summer were probably the best times for fishing (Beech 2004). Although the spring–summer fishing season is at odds with the hypothesis of pastoral transhumance to inland areas during the summer rains (as per Potts 1997, 37; Uerpmann et al. 2000; Cleuziou and Tosi 2007; see Beech 2004, 213–214), it may be that social groups sub-divided, with some segments focusing on herds and others on fishing. It may also be that the higher summer rains and some winter rains were sufficient for persistence of vegetation, especially of perennial and woody species, in interior areas, and that these served as grazing areas in the autumn to early winter. As reviewed above, the lake level data from northern Arabia, and evidence from the Thar Desert in India, suggest that the mid-Holocene wet period was characterized by high winter rainfall as well as monsoons. The phytoliths and pollen data from Awafi (Parker et al. 2004) imply peak levels in woody plants between 6000 and 4000 BC (see Fig. 3).

As discussed above, Eastern Arabia and the Oman Peninsula witnessed a local climatic deterioration around 4000 BC, with dramatic changes in settlement and subsistence in some parts of the region. This is particularly apparent at sites like Jebel Buhais 18 in the UAE, where increased aridity is argued to have led to termination of occupation around this time (Uerpmann 2003). But not all areas were equally impacted. Indeed, in Oman, this is the period at which we find large shell middens along the mountainous coast from Ras al-Hamra to Ras al Hadd and beyond (Charpentier 1996; Uerpmann 2003). Evidence here suggests that occupants could still choose preferred over less preferred maritime resources, and that some domestic animals even increased in size (though cattle are smaller than at Jebel Buhais) (Uerpmann 2003). This difference may be linked in part to local geomorphological variation: the west coast of the Oman peninsula is flat, both below and above sea level, while the coast of the Omani Gulf is mostly steep, dropping from several meters above to more than 1,000 m below sea level over a short distance (Uerpmann 2003, 77). This bathometry, together with the wind-induced seasonal upwellings in the Gulf of Oman mentioned earlier, results in a much greater diversity of both marine and terrestrial habitats in the Gulf of Oman region (Charpentier 1996; Uerpmann 2003). In addition, the mountainous coast of Oman has numerous large wadis that maintained levels of fresh water, and it is around these that shell middens are concentrated (Uerpmann 2003). The inhabitants of Ras al-Hamra and neighbouring sites were thus able to pursue a mixed pastoral and maritime-oriented economy that enabled them to survive the 'Dark Millennium' (Uerpmann 2003). They used boats to fish large deep water species like tuna and jacks (Beech 2004; Biagi and Nisbet 2006), and appear to have led a less mobile existence—they were probably seasonally sedentary (Biagi and Nisbet 2006; Charpentier 1996, 2002; Uerpmann 2003). While sites in the interior and on the coast of the Persian Gulf decreased drastically in number in the fourth millennium BC, those on the Gulf of Oman coast continued through to the Early Bronze Age (Uerpmann 2003). The mid-millennium in Oman saw a transition from more individual to collective burials (Cleuziou and Tosi 1997) that probably reflected important changes in exchange relationships and an increase in social complexity (Cleuziou and Tosi 2001). Some coastal communities also engaged in the production of specific prestige and utilitarian goods, including polished stone earrings, different types of necklace beads, and marine shell fishhooks (Biagi and Nisbet 2006; Usai 2006).

Turning to the Red Sea, the picture of the earliest maritime activities is much less clear. One likely reason for this is the probability that high discharges of silt on the Tihama plain coastline of western Arabia have submerged settlement evidence beneath meters of sediment (Munro and Wilkinson 2007). Nonetheless, sites bearing Arabian Bifacial Tradition technology dating back to the late seventh millennium BC have been found on the Tihama plain, and are frequently associated with shell middens (see Fig. 5; Cattani and Bökönyi 2002; Durrani 2005; Edens and Wilkinson 1998; Khalidi 2007; Munro and Wilkinson 2007; Phillips 1998; Tosi 1985, 1986a). Few have been excavated, but it has been suggested that the decrease in bifacial elements in the lithic toolkit at these sites may mark a distinctive coastal adaptation (Uerpmann 1992). Sites are frequently 5–10 km inland, and associated with exploitation of mangrove environments. Finds of cowry and dentalia shells 400–500 km inland indicate that these coastal sites of the mid-Holocene were embedded in exchange networks that brought them into indirect contact with inland groups (transhumance between coasts and inland areas is also a possibility, although it would certainly not explain the significant distances travelled by some artefacts) (Edens and Wilkinson 1998). As on the eastern Arabian coast, the sense is of a variety of economic strategies, focused on shellfish gathering and fishing, but also incorporating hunting activities (at Ash Shumah, hunted wild donkeys make up around 90% of the faunal assemblage: Cattani and Bökönyi 2002). Also echoing the east coast is the presence of domesticates from an early date (the sixth and perhaps seventh millennia BC; see below), which indicate a mixed and by no means strictly hunting and gathering lifestyle. Shell midden dates continue up to the later fourth millennium BC, indicating a fairly stable economic system based on a mixture of hunting, herding and shellfish collection.

The main, and still poorly resolved, evidence for seafaring activity at this early period comes from source studies of obsidian artefacts (Francaviglia 1989; Khalidi 2009; Zarins 1990, 1996). Obsidian first appears on Tihama sites in the sixth millennium BC, and indicates direct or indirect contact with source traps in the central or southern highlands of

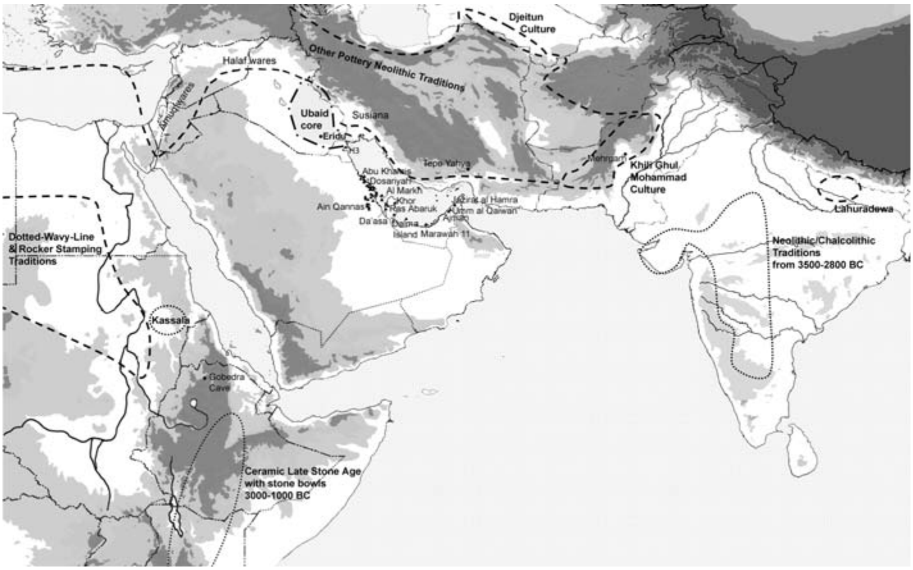

Fig. 6 Finds of Ubaid ceramics in the Persian Gulf (after Carter 2006; Crawford 1998), in relation to the core range of Ubaid pottery in Mesopotamia and other early ceramic traditions. The *dashed line* indicates the extent of early ceramic traditions of c. 6000 BC prior to the development of Ubaid. *Dotted areas* indicate important regional developments where ceramics were later, beginning between 3500 and 2500 BC (East African stone bowl traditions: Barnett 1999; South Asian traditions: Fuller 2006; Sahara-Sudan traditions: Jesse 2003; Kasalla: Sadr 1991)

Yemen, and/or the Horn of Africa, although preliminary source studies suggest that much of the Tihama obsidian may have come from the Eritrean/Ethiopian highlands (Zarins 1990, 1996). The impression of a maritime origin is strengthened by recent coastal survey indicating that obsidian densities are highest at sites right on the coastline and decrease at sites along the river deltas leading to the coastal interior (Durrani 2005; Khalidi 2007, 2009). While more studies are needed, particularly of the African sources, it is certainly not inconceivable that travel and exchange across the Red Sea took place at this early date. We have seen that extensive trade networks developed in the Persian Gulf by the sixth millennium BC, and recent excavations have revealed evidence for boats on the Nile by the early seventh millennium BC. This includes, in particular, a granite pebble painted with a boat motif, found at the 16-D-5 mound at El Salha in central Sudan, from deposits dating to the Mesolithic period (Usai and Salvatori 2007), as well as similarly dated finds of open water species from sites in both the Upper Nile (Peters 1991; Van Neer 1989) and Lower Nile (Hendricks and Vermeer 2000).

Subsequent evidence of maritime activity in the Red Sea is perhaps most marked in Egypt, where evidence for trade in obsidian is present from an early period. Zarins argues that Egyptian participation in the obsidian trade dates back to the Predynastic period (5000–3100 BC), when silver, lapis lazuli, turquoise, galena, malachite, svenite, specular iron (specularite) and 'resins'—and, undoubtedly, perishable items—were also traded, possibly via Red Sea routes (Zarins 1989, 1996). Maritime trade appears to date back to at least the Naqada I period (c. 4000–3500 BC), and to have become well established by the Naqada II period (3500–3200). Obsidian objects are initially small—simple blades and flakes, or beads, for example—and unlikely to have been the focus of trade. The Egyptians travelled to the Red Sea via the Wadi Hammamat, a desert corridor where rock engravings depicting ships (probably dating from the prehistoric period to the New Kingdom) have been identified (Fuchs 1989). The boats—perhaps made of papyrus or reed, but according to Ward (2006) probably already wooden sewn types—were dismantled and dragged overland to the coast. Based on the evidence outlined for obsidian trade networks in the southern Red Sea, it is likely that the Egyptians were simply tapping into an existing exchange network (Zarins 1996) and that trade over long distances was still indirect (see below; Kitchen 2002). It is also probable that the Egyptians were already importing incense products (frankincense and/or myrrh; see below), as these were well-embedded in Egyptian religious practice from the start of the Early Dynastic period and probably earlier (Neilson 1986; Wengrow 2006).

Overall, it is clear that intensive exploitation of coastal and marine resources goes back to the late seventh millennium BC in the Arabian Peninsula, and appears more or less simultaneously in the Red Sea and the Gulf of Oman. This may have more to do with sea level rise than synchronous processes across the Arabian Peninsula, but at any rate indicates a maritime focus from the early Holocene. Interestingly, the earliest evidence for seafaring activity in the peninsula also appears roughly simultaneously in the Persian Gulf and Red Sea, some 1,000 years later, in the sixth millennium BC. Evidence for maritime exchange is better for the Persian Gulf than the Red Sea, and may indicate more active exchange networks in this geographically more favourable arena (although patterns of archaeological focus are also certainly relevant). It seems that right from the start, these early seafaring communities sometimes stayed for significant periods in particular coastal habitations, and also produced craft goods for exchange. Certain coastal environments, like the rich southeastern Oman coast, were perhaps particularly conducive to sedentarisation and the emergence of more socially complex societies. The trade in exotic goods, some imported from Mesopotamia and Africa, may have played a role in the emergence of social competition and incipient hierarchies. Robert Carter's observation that Ubaid vessels imported by Neolithic societies in the Persian Gulf were generally serving vessels is important in this regard: it suggests the possible existence of ceremonial and feasting contexts for social display and aggrandizement.

We should bear in mind that there was probably significant variability in the degree of maritime orientation of the diverse coastal groups along the Arabian littoral. As a point of comparison, at the time of European colonisation, there were roughly 60 cultural groups living along the North American Pacific coast, and only some of them regularly used large ocean-going boats (Arnold 1995). Such variability may help explain the diversity of site types in particular coastal areas of the peninsula. For those societies that were particularly oriented towards the sea, ethnographic and ethnohistorical data from traditional maritime societies suggest that the sea and boats are likely to have been both symbolically and socially important. Most of these early boats were probably built of reeds, though the largest would have enabled the crossing of sometimes substantial distances, and the carrying of significant loads (e.g. 6.5 tonnes of cargo, as estimated by Vosmer (2003) for one reconstructed model of a Bronze Age reed built boat). Experimental reconstructions and cuneiform records suggest that construction of larger reed-built boats would have required an organised and specialised workforce (Vosmer 2003). This requirement, and the advantages that would have accrued to boat owners, may have contributed to the emergence of social elites in some coastal communities. Arnold has demonstrated the links that have frequently been found ethnographically between coastal sedentism, intensive trade and exchange, ocean-going boats and social stratification (Arnold 1995). Such factors may well have come together in the fifth and fourth millennia BC in certain societies along the Arabian peninsular littoral.

Origins of Arabia's Earliest Domesticates

Archaeozoological and archaeobotanical evidence for the arrival of domesticates from outside Arabia, and their prehistoric role in Arabian societies, can also provide information about the emergence of maritime activities in the region. Given the rich biomass in coastal waters, and evidence for its increasingly intensive exploitation in the early to mid-Holocene, it seems unlikely that the first regular trade activities had to await the creation of agricultural surpluses. More probable is a scenario in which initial maritime exploitation and trade activities played a role in stimulating agricultural food production. This could have occurred as intensive maritime resource use led to increased residential stability and thus prepared the way for a subsistence strategy dominated by domestic species. Early domesticated fauna may have entered the economy as supplements, or perhaps socially valued foods, along the lines of Hayden's competitive feasting model (Hayden 1990, 1995), or the scheduled availability model for early domesticates in Africa (Marshall and Hildebrand 2002). Trade itself may have developed as a subsistence strategy by moving foodstuffs between areas with differing degrees of scarcity and abundance. Such a model may be at odds with the current fashion for Neolithic migrations from the Levantine PPNB (e.g. Pinhasi et al. 2005; Drechsler 2007; Potts 2008b), but the absence of evidence for any of the Near Eastern crops at this early date, or for full dependence on livestock (over hunting and fishing) suggests an important role for local traditions of adaptation in Arabia. This is not to deny a role for some immigrant Levantine populations, which has been suggested on the basis of lithic tool-kit parallels between Qatar and the Levant (Potts

2008b); rather, the overall, long-term pattern suggests a mixture of processes which included local adoptions.

Whatever the specific scenario, it is clear that most domesticated plants and animals in the peninsula originated outside Arabia (Figs. 7, 8), and they therefore provide information about contacts, both terrestrial and maritime, between Arabia and her neighbours. On present evidence it appears that livestock in Arabia spread in the absence of plant-based agriculture, much as was the case in Saharan and east Sudanic Africa (Garcea 2004; Marshall and Hildebrand 2002), as well as parts of savannah India (Fuller 2006, 58). Over the course of the mid to late Holocene, an increasing range of domesticated animals, and subsequently plants, came to be relied upon in Arabia.

Amongst the first domesticates in Arabia were cattle. Domesticated cattle have been argued to go back to the seventh millennium BC in a few cases in southwestern Arabia (for a review of the evidence, see Edens and Wilkinson 1998; McCorriston and Martin 2009). The more secure early finds date to the sixth millennium BC in highland Yemen (McCorriston and Martin 2009), the early fourth millennium BC in the Tihama Plain (Edens and Wilkinson 1998), and the fifth millennium BC in eastern Arabia (Uerpmann and Uerpmann 2000). Reports of early Holocene wild cattle are available for Yemen and Oman, and biogeographically, as a continuation of the East African floral province, the presence of African wild cattle in Arabia seems reasonable. Secure finds of domesticated cattle generally coincide with the arrival of sheep and goat, and occur at roughly the same time in eastern and western Arabia, making it likely that domesticated cattle were ultimately introduced from the Near East rather than Africa. The African data accords with

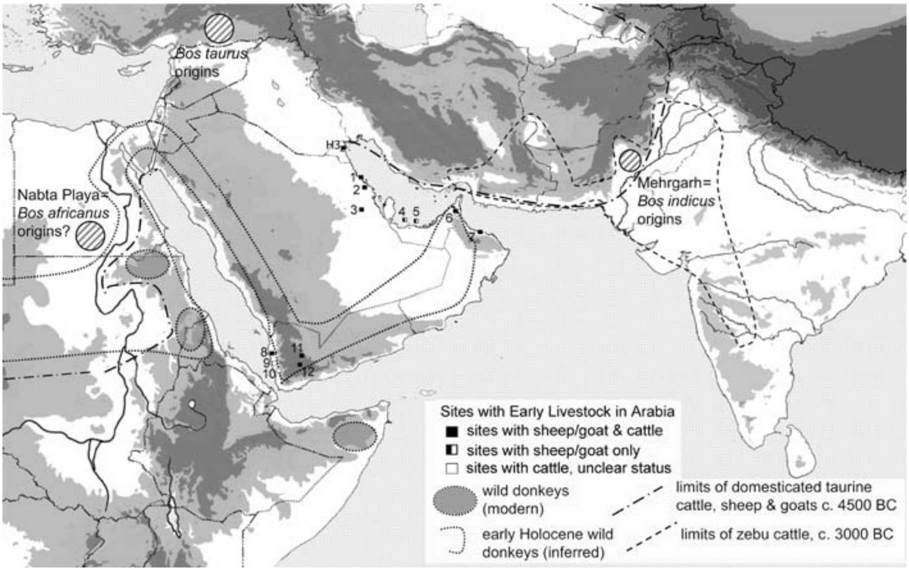

Fig. 7 Early distribution of livestock species in the areas around Arabia. Indicated is the distribution c. 4500 BC of taurine cattle (*Bos taurus* and/or *B. africanus*) together with sheep and goats, the distribution c. 3000 BC of zebu cattle (*Bos indicus*), and three potential foci of cattle domestication in the Eastern Sahara, the Fertile Crescent and Baluchistan. Extensions of the taurine/sheep–goat line are indicated for both sides of the Arabian Peninsula, and a few important sites for early zooarchaeological evidence are indicated. Also shown is the modern relict distribution of wild donkeys and the potential early Holocene distribution from Sudan through Egypt to Ash-Shumah in Yemen

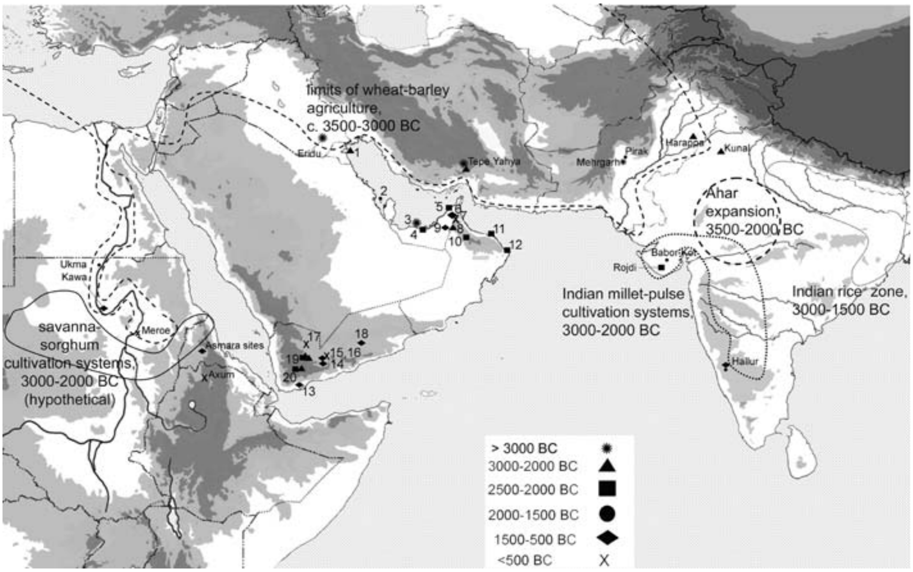

Fig. 8 Early distribution of cultivation systems. Shown is the spread of Near Eastern winter crops (wheat, barley, etc.) at c. 3000 BC, early distribution of local millet-pulse cultivation in peninsular India (after 3000 BC), the early rice zone of the Ganges (after 3000 BC) and a *hypothetical* savanna-sorghum cultivation zone in eastern Sudanic Africa. Sites with archaeobotanical evidence from the Arabian Peninsula indicated, together with selected sites from elsewhere mentioned in the text. *Symbols* represent broad time horizons based on earliest evidence, numbered as follows: 1. Failaka; 2. Saar; 3. Dalma; 4. Umm an-Nar; 5. Tell Abraq; 6. Muweilah; 7. Mleiha; 8. Hili; 9. Rumeilah; 10. Bat; 11. Ras al-Hamra; 12. Ras al-Jinz; 13. Sabir; 14. Hajar Bin Humeid; 15. Hajar al-Tamrah; 16. Haja al-Rayhani; 17. Baraqish; 18. Raybun; 19. Khawlan sites: al-Raqlah, Jubabat al-Juruf, Wadi Yanaiim; 20. Dhamar sites: Hayt al-Suad, al-Massanah. Also indicated are some sites from other regions mentioned in the discussion of archaeobotanical evidence

such a hypothesis, since the earliest domesticated cattle in Ethiopia or the Horn of Africa may be as late as 2000–1500 BC (Marshall 2000; Lesur 2007; cf. Fattovich 2005, 9). In addition, reports of cattle from Upper Nubia start from c. 4500 BC and extend no earlier than 5000 BC (Caneva and Gautier 1994; Marks 1991; Marshall 2000). Given the roughly simultaneous appearance of the sheep/goat/cattle triad in Egypt and western Arabia, it is not unlikely that they arrived via parallel processes, moving from the Levant through the Sinai region. This suggests a hunter-forager-herder economy, as in the Sahara, but with possible precursors in the Pre-Pottery Neolithic C period of the desert margins of eastern Jordan (Martin 2000; Wengrow 2006, 25).

Another important animal domesticate of northeast Africa, especially when considering prehistoric trade, was the donkey (*Equus asinus asinus*). Based on modern genetic data, donkeys appear to have been domesticated twice, each domestication relating to one of the disjunct wild populations—the Nubian and Somali subspecies of the donkey (*Equus africanus africanus* and *Equus africanus somaliensis*, respectively) (Vila et al. 2006). Historical linguistics also suggests more than one origin (Blench 2000). Early bone finds of hunted donkeys are known from Sudan, but not from Nabta Playa or Wadi Kubbaniya, or the Egyptian desert more generally (Van Neer and Uerpmann 1989: 320; cf. Gauthier and Van Neer 1989; Gauthier 2001), suggesting a more Sahelian, southern origin. However, wild donkey probably also extended along the fringes of the Nile Valley and the Red Sea hills. The presence of wild donkeys in the Levant remains controversial. Legge and

Rowley-Conwy (2000) identified early equid remains at Abu Hureyra as a local subspecies of onager (or Asiatic wild ass: *Equus hemionus*), and also noted the presence of another now extinct equid (*E. hydruntinus*), known from Pleistocene to mid-Holocene sites in southeastern Europe and the Middle East (Legge and Rowley-Conwy 2000, 426–429; Orlando et al. 2006). Donkey hunting at Ash-Shumah in Yemen, and finds in Oman indicate that wild donkeys extended to parts of Arabia in the early Holocene (Edens and Wilkinson 1998, 67; Cattani and Bökönyi 2002; Uerpmann and Uerpmann 2000). This implies that donkeys were present in the intervening area up the west side of the Peninsula, through the Sinai and into Egypt, as well as eastwards through southern Arabia (Fig. 7). Nevertheless, the earliest archaeozoological evidence for donkeys that were probably domesticated comes from the Late Neolithic and Predynastic of Egypt, from sites such as Maadi (c. 4500 BC) and Hieronkopolis (c. 3500 BC). Figurines indicate that donkeys were by this time used as pack animals and were presumably important in trade between urban Mesopotamia and the emerging Egyptian state (Wengrow 2006). Donkey burials associated with the First Dynasty royal cemetery at Abydos indicate that morphological changes from the wild form were gradual but clearly underway by 3000 BC (Rossel et al. 2008). Donkey trade was clearly important between Egypt and the Levant in the fourth millennium BC, especially during the latter half, and can be inferred to have shifted southwards as well, moving closer to sources of incense (Wengrow 2006). This presumably would have supplied a method for the movement of much Red Sea obsidian to Egypt, regardless of which side of the Red Sea this movement took place (or whether it occurred on both sides). The donkey was also clearly important in the Arabian Peninsula itself by the third millennium BC, particularly in regional trade, including the trade between inland areas and the coast (Cleuziou and Tosi 2007).

The one potential plant cultivar from this early period in Arabia is the date palm (*Phoenix dactylifera*). The date palm is of particular significance because it is central to traditional land-use patterns in the region. It is a shade-making canopy species, providing a micro-environment for oasis cultivation, which is based on below-ground water (aquifers), and usually wells (Cleuziou and Costantini 1982; Mason 1946). The true wild distribution of the date is unknown (Tengberg 2003b; Zohary and Hopf 2000), and the difficulties this introduces are compounded by the absence of clear morphological indicators of domestication in this species. Nevertheless, the date palm is probably native to semi-arid or oasis areas, and the fact that its sister species is the Indian *Phoenix sylvestris* argues for an easterly origin. Indeed, the early history of dates in South Asia is complicated by the presence of *P. sylvestris*, which is also often cultivated (Fuller 2007a, 403, 424). Wild populations are reported from the gorges of the southernmost Zagros and Khuzestan in Iran (Zohary and Hopf 2000; Zohary and Spiegel-Roy 1975), and possibly eastwards to Baluchistan (Tengberg 1999), and were perhaps also formerly present in the Southern Levant, judging from recent archaeological finds (Kislev et al. 2004). However, the existence of wild populations in parts of Arabia, in the western/southern region of the Persian Gulf, under Late Pleistocene or Holocene conditions, is plausible (Tengberg 2003b).

Archaeobotanical finds point to an Arabian origin for the date palm. The earliest secure finds of archaeological date stones come from the Persian Gulf at c. 5000 BC or a little earlier, including direct AMS dates at Dalma Island and early stones from H3 Sabiyah, Kuwait (Beech 2003a, b; Beech and Shepherd 2001). Reported date stones from Mehrgarh of similar age (Costantini 1983) remain problematic, as they are uncharred and unexpectedly large for that age. Nevertheless, this data fits with an early distribution on both sides of the Persian Gulf. The earliest find in Iran, from Tepe Gaz Tavila (Beech 2003a, 27; Costantini 1985), is early fifth millennium BC, as is that from Tell Oueili (Neef 1991). At Eridu dates are present from the end of the fifth millennium BC (Safar et al. 1981, 31). By 3000 BC, date cultivation seems well-embedded in the economy of eastern Arabia (Potts 2003; Tengberg 2003b), in contrast to Baluchistan and the Indus, which may argue for earlier cultivation on the west side of the Persian Gulf. As Tengberg (2003b) notes, it was the combination of date palm with introduced winter cereals that made oasis cultivation such a productive economic system, able to support the emergence of greater social complexity.

By the early third millennium BC, dates had spread to western Arabia (based on evidence for their presence at Al-Ralqah: Costantini 1990), but it was more than a millennium before they occurred on the west side of the Red Sea: in Egypt and Nubia, early date finds date to the Middle Kingdom and Kerma period (2000–1700 BC) (Murray 2000). As such, date palms were for some millennia restricted to Eastern Arabia, Iran and probably Baluchistan before they spread westwards. Further west, the earliest dates occur in southwest Libya just before 1000 BC, probably associated with the earliest local agriculture, also based probably on well irrigation (Pelling 2005). The origins of the important adaptive system of annual crop cultivation within planted date palm oases probably lie in Eastern Arabia, but further research is warranted.

Phase II: Early Bronze Age Trading Spheres and the Intensification of Maritime Contact (3500–2000 BC)

Beginning in the mid-fourth millennium BC, we see the emergence, in a number of the key regions bordering the Arabian Peninsula, of the first major state-level civilisations of the Old World. This urbanisation process took place in southern Mesopotamia, in Egypt, and in the Indus Valley, and was associated with the arrival of the earliest historical records, as well as new economic, social and political configurations. In Arabia, we may also track the emergence of more intensive agricultural production and new modes of social organisation at this time. Linked to this are signs of both increasingly intensive, and increasingly far-reaching maritime trade activities. While the urbanised states were clearly major players in this trade, there are also intriguing indications that coastal communities and local merchants played an important role. In addition, date palm-focused oasis settlements, together with donkeys for transport, probably supported movement through the interior, and to and from the coast.

The literacy and record-keeping traditions that developed during the Early Bronze Age in the regions immediately adjacent to the Arabian Peninsula add a new dimension to our understanding of trade contacts and relationships. Both the textual records and the detailed graphic representations that emerge shed light on increasingly encompassing trade networks and more developed seafaring activities. Nonetheless, use of textual and iconographic sources is not without caveats: they require careful interpretation (Cleuziou and Méry 2002). They often offer a biased view, which comparison with the archaeological record is able partially to redress. In Mesopotamia, for example, texts provide a very narrow view of trade, being few in number and disparate in type (e.g. palace and temple administrative accounts, private contracts and letters, royal inscriptions, etc., reflecting the activities of Mesopotamian but not foreign enterprises: Edens 1992). In addition, meanings of words and symbols may change over the significant lengths of time examined in an analysis like the present one. For example, the same term (e.g. *Dilmun*, *Meluhha*) may have been used to describe different places in different time periods (see also Keay 2006). Thus the location of *Dilmun* shifted between the Arabian mainland, and the islands of Bahrain and Failaka (Howard-Carter 1987), and *Meluhha* has referred sometimes to a place in the region of the Indus River, and (much later) to somewhere in Africa (Stieglitz 1984).

Similarly, the ancient Egyptians' *Punt* need not always have referred to the same locale or ethnic group. Indeed, disputes amongst Egyptologists over interpreting references to and locating the land of *Punt* (Meeks 2003; see further discussion below) provide a good illustration of the issues that can arise in relation to ancient textual sources. Nonetheless, textual and graphic sources undoubtedly begin at this time to significantly enrich our understanding of maritime activities in the seas around the Arabian Peninsula, and often corroborate or complement archaeological sources of evidence.

We have seen that Predynastic Egypt was active in the Red Sea by the fourth millennium BC. In the Archaic period, importation of exotica from the Red Sea region was greatly accelerated (Zarins 1996), and this may be attributed in part to advances in maritime technology. The middle of the fourth millennium BC probably saw a shift from reed or papyrus to wooden boats, as well as the introduction of a form of the sail by the Late Predynastic period, c. 3100 BC (Fabre 2005, 89)—probably, if depictions on Gerzean (Naqada II) pottery are an indication, a square one (Stieglitz 1984; Ward 2006). Egyptian rulers continued to promote long-distance trade for prestige and political purposes (Zarins 1996), and large watercraft appear to have played a key role in social competition. Spectacular wooden boat burials are found in Egyptian funerary contexts from the First Dynasty (c. 3000 BC), and their prestige value probably derived from the resources, technical skill and craft specialists necessary to build them, and their important role in acquiring exotic goods and controlling regional exchange networks (Arnold 1995; Ward 2006). During Old Kingdom times (from 2700 BC), the wood supplies (Cedar of Lebanon) for larger boats were imported from the Lebanese region, thus ensuring that boat-making continued to be an expensive undertaking and a royal prerogative. This source of long planks, as well as new building techniques allowed for larger boats to be constructed, such as that associated with Khufu's great pyramid at Giza. Advances in sail-rigging, in evidence by at least the Fifth Dynasty (c. 2500 BC) would have led to boats more suitable to the open sea, which texts indicate were used for Red Sea voyages (Faulkner 1941; Fabre 2005, 89–92). It is probably no coincidence that it is in this period, during the reign of Sahure, that the first sea voyage to *Punt* (or *Pwenet*) is recorded (Faulkner 1941; Harvey 2003; Kitchen 1993).

The Location of Punt and Incense Sources

The location of *Punt* has long been a source of debate, and is directly relevant to discerning patterns of maritime trade and exchange in the Red Sea region. Most scholars are agreed that *Punt* lay south of Egypt and was reached via the Red Sea. The Egyptians referred to *Punt* as a 'mining region' and they imported a variety of products from it, including electrum (an alloy of gold and silver) and staves (wood, perhaps ebony); pygmies arrived also from here, along with slaves in general, as well as exotic animals and leopard skins. Amongst the most prized imports from *Punt*, however, was a tree resin used as incense, called by the ancient Egyptians '*ntyw*, and thought to have been a form of either frankincense or myrrh, although it is likely the term extended to cover both. Frankincense and myrrh are resins from related trees of the *Burseraceae* family; both genera have several species from which fragrant resins can be collected, and these were prominent products obtained from or via the Southern Red Sea area (see below, and Fig. 9). Their importance in the region and beyond is well-recorded historically from the Classical period, and they were also associated with the Sabeans and the Old Testament's Queen of Sheba. Archaeological evidence indicates their use by the third millennium: resin finds in Egypt

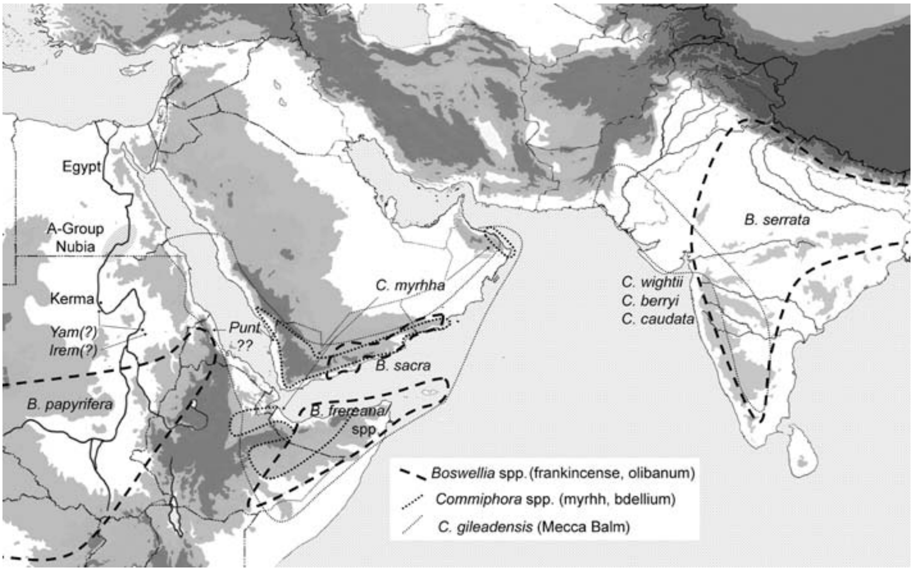

Fig. 9 Areas of main economic frankincense and myrrh species, together with archaeobotanical reports. *Boswellia* spp. indicated by *dashed lines*, *Commiphora* spp. indicated with *dotted lines*. Also indicated is the A-Group (3300–3100 BC) culture area with finds of incense burners in Nubia; the Bronze Age city of Kerma, and candidate regions that ancient Egyptian sources refer to as *Yam*, *Irem*, and *Punt*

attributed to myrrh and/or frankincense have been reported dating back to the 11th Dynasty at Deir el Bahri (c. 2000 BC), while Lucas identified a lump of incense material from Tutankhamen's tomb as frankincense (1325 BC). Myrrh has also been identified chemically as a constituent of ancient Egyptian perfumes (Lucas 1930). Indirect evidence traces the use of these substances back even earlier; for incense, such evidence goes back to the later fourth millennium BC in both Egypt and Nubia. The elite/royal graves in A-Group Nubia are famous for their decorated incense burners, some of which contained residues of a burnt substance. Despite the lack of chemical analyses, there is no reason to doubt that they were used in this way, and that Lower Nubia, like contemporary and later Egypt, was an importer of incense from the southern Red Sea lands (cf. Wengrow 2006). It was perhaps broadly speaking the area that was to become *Punt* that was already supplying incense to these regions through down-the-line trade mechanisms by the late Predynastic period and the Nubian A-Group (cf. Wengrow 2006).

The botany and geography of incense sources are relevant to understanding Egypt's Red Sea trade and the location of *Punt* (Fig. 9). Arabian frankincense is obtained from the small *Boswellia* tree that is native to the Dhofar and Hadhramaut coastal regions, and is regarded as the highest quality frankincense. Several other species of *Boswellia*, however, are harvested for lesser incenses, including the Indian olibanum (*B. serrata*), and *B. papyrifera*, Ethiopian frankincense, which is native to northern and western Ethiopia, Eritrea and an area westwards through Sudan to West Africa. Additional species of African frankincense occur in Somalia, including higher quality coastal *B. frereana*, and inferior *B. carteri* and *B. rivae* in the interior (Hepper 1969; Vollesen 1989). Several additional species of frankincense are native to the island of Socotra. *Commiphora* is the genus of myrrh and includes a number of species in addition to eponymous *C. myrrha*. The northernmost of these, which is native to the Red Sea coastal scrub of Gebel Ebla (Egypt), Sudan and

Eritrea, Eastern Ethiopia and Somalia as well as the Arabian peninsula, is *C. gileadensis* (syn. *C. opobasamum*), source of the so-called Balm of Gilead or Mecca Balm (Andrews 1952; Vollesen 1989). This species is unique in that its aromatic compound remains liquid, and can be recovered from the bark, wood or fruits. Fruits of this species were found in quantity at Roman era Berenike (Cappers 2006), and at the city of Meroe (Shinnie and Anderson 2004). *C. myrrha* is native to southern and eastern Ethiopia and adjacent Somalia, and also occurs in Yemen and southwest Saudi Arabia, and the coastal plains of Oman. In addition, at least ten other species of African *Commiphora* provide varieties of myrrh (Vollesen 1989), and Socotra has four species of its own (Radcliffe-Smith 1992). In India, three peninsular species are reported to have fragrant gum, although *C. wightii* (syn. *C. mukul*), the Indian bdellium tree, is the most important in commerce; it is distributed through the dry scrub of peninsular India, Gujarat and parts of Sindh and Baluchistan (Gamble 1922; Watt 1889–1893). The northern limits of the better frankincense and myrrh species delimit the plausible northernmost region for locating ancient *Punt* on either side of the Red Sea, either near modern Eritrea, or in the southwest Saudi/Yemeni borderlands.

It should be noted that these are not the only sources of aromatic gums/resins that were used in incense. Other species, including the genera *Pistacia* and *Cassia*, are known to have been used, and in many cases would have been available closer to Egypt. Ancient Egyptian *sntr* incense, for example, is identified as *Pistacia terebinthus* (Nielson 1986, 14). In Mesopotamia, where incense was equally central to religious practice, a long list of aromatics was in use, including many available from the hilly hinterland of the region (Nielson 1986, 27). Nevertheless, frankincense and myrrh were the most highly sought after aromatics. This is apparent by the time we have clear historical sources in the first millennium BC, including amongst Greek and Roman authors and in the Old Testament. The centrality of incense use, which presumably included one or both of these varieties, to early religious rites in both Egypt and Mesopotamia, led Frankfort (1951) to infer that these riverine civilizations were in contact with Southern Arabia or the Somali coast.

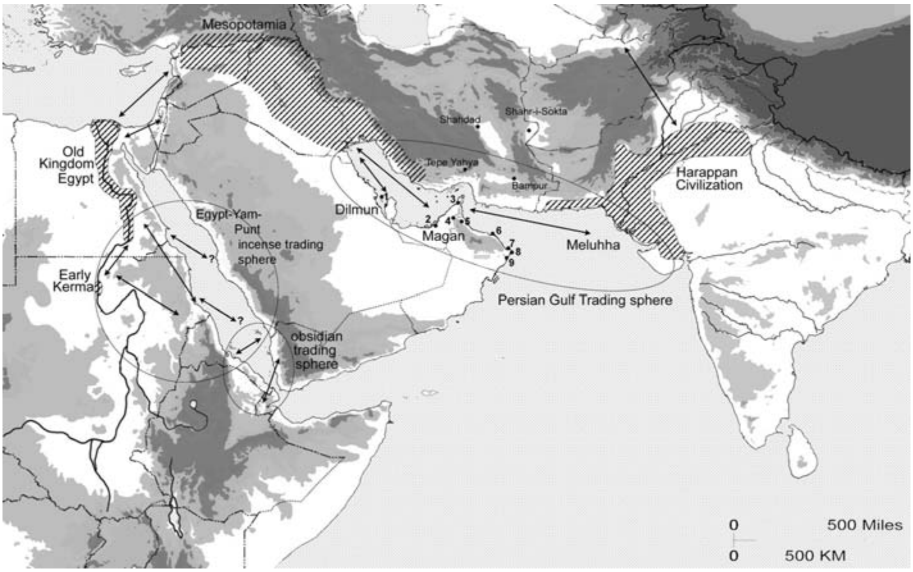

Fig. 10 Third Millennium trading spheres map with selected sites indicated: 1. Barbar; 2. Umm-an-Nar; 3. Tall Abraq; 4. Hili; 5. Wadi Suq; 6. Ras al-Hamra; 7. Ras al-Hadd; 8. Ras al-Jinz; 9. as-Suwayh

Current Egyptological orthodoxy places *Punt* in eastern Sudan and northern Eritrea, as argued for example by Kitchen (1993), although some earlier scholars argued for a location further south in the Horn of Africa, where superior incenses are available (e.g. Dixon 1969). One of the most heavily relied upon sources of evidence for locating *Punt* is the mortuary temple of Queen Hatshepsut (c. 1480 BC, at Deir el-Bahri), where frescoes depicting *Punt* are found with accompanying text discussing Hapshepsut's expedition to *Punt* to bring back not just products but living incense trees (see, e.g. Fabre 2005, 79, 81; Kitchen 1993, 592–597; Smith and Simpson 1981, 239–244). In the temple relief frescos of *Punt*, the presence of animals like the giraffe and the rhinoceros has been taken to indicate an African location. The use of modern ethnographic parallels, for example, for the huts on stilts depicted in *Punt*, has also played a role in arguments locating *Punt* in Africa.

Nonetheless, an alternative identification of *Punt* as situated along the eastern side of the Red Sea, including Yemen, requires careful consideration. Meeks (2003) argues this case strongly, based on some of the contradictions between Egyptian sources regarding *Punt.* In some cases, *Punt* is listed with southern lands, such as those of Nubia (*Kush*, *Yam*, etc.), but in other cases (including an example from Soleb in Nubia) it is listed with eastern Asiatic lands, such as *Pehal*, *Shosou* and *Kadesh*, which lie in the Levant. Egyptians often classify Puntite places names as ethnically Asiatic, and depict Puntites as Asiatics (by associated face/hair/beard style), in contrast to the clear African classification of Nubian place names and people. It is also noteworthy that one Egyptian source differentiates the incense of *Punt* from that of Nubia, considering *Punt* incense superior (Meeks 2003, 67). This would make sense if *Punt* supplied the best grades of *Commiphora* and *Boswellia.* These were available in Yemen and the Horn of Africa, while Nubia had access mainly to species such as *B. papyrifera* and *C. gileadensis* from nearby overland regions. Meeks (2003) contends that exotic fauna were themselves imported to *Punt*, as the giraffe and rhinoceros mingle with domestic fauna, and the rhinoceros appears to be single-horned, a trait of the Asiatic rhinoceros. This can be contrasted with a 19th Dynasty depiction of a two-horned Nubian rhinoceros (Houlihan 1996). An intriguing, if still speculative, implication would be that the techniques for transporting large fauna by boat from South Asia were already established by the early second millennium BC. Such means would have been important for the transport of Indian zebu bulls, a few of which had probably reached the African savannas by this time. One can imagine that exotic bulls might have been especially prized items for exchange amongst the cattle-focused groups of the savannas. An archaeological context for emerging social complexity in the region that Meeks proposes for Punt can be inferred from recent archaeological work in Yemen tracing the precursors of the Sabean civilization back to the later fourth and early third millennia BC (Edens and Wilkinson 1998), including evidence of field systems in the interior highlands (discussed below). Subsequently, during the later Bronze Age, walled towns appeared along the desert edge probably by the end of the second millennium BC.

Additional evidence for sea contact with *Punt* comes from the Nubian site of Kerma. Here, recent work has documented the preserved fragmentary painting of a royal tomb chapel of c. 1700 BC (Bonnett and Valbelle 2000). Fragments include evidence for various boats, including one sailed vessel suggestive of an ocean-going boat, raising the possibility that at this period, the King of Kush also engaged in long-distance trade via the Red Sea. Also suggestive is a partial depiction of two stilted huts entered by ladders, like those that the Egyptians would later depict for *Punt*, with a bare-breasted animal skin-wearing woman. The intriguing possibility is that Kush was also reaching *Punt* by sea, which would make less sense if the Eritrean location were accepted.

Social Evolution and Trade in the Early Bronze Age

While many have seen textual records of contact with *Punt*, and archaeological finds of exotica, as an indication that Egypt itself was an active maritime player in the Red Sea, it is also possible that Egypt's role has been overemphasised relative to that of the smaller scale communities in the Red Sea region. Kitchen has argued very convincingly that in fact Egypt may have undertaken relatively limited forays on the Red Sea, with local trade networks responsible for much of the movement of goods seen in the archaeological record (Kitchen 2002). Indeed, depictions like that of two 18th Dynasty Theban officials, which show Egyptians meeting laden boats from the Land of *Punt* somewhere in a desert, probably in the Sinai, suggest that peoples living along the southern Red Sea were regularly involved in moving commodities (Meeks 2003, 61–63). Depiction of the Puntite boats appears to represent vessels made from animal skin floats, decked with planks and mounted with simple triangular sails, which are known to have been used on both sides of the Red Sea (Bradbury 1996; Mitchell 2005, 79). While, as discussed above, significantly sized watercraft are clearly present and important in Egypt from the beginning of the Dynastic period, boats also appear to have been highly symbolic and valued items in Egyptian society (Fabre 2005; Ward 2006), which may indicate both their control by elites and the relative expense and rarity of expeditions such as those indicated in the relief frescoes at the temple of Deir el-Bahri at Thebes.

This scenario of indirect trade is perhaps supported by archaeological evidence for more intensive exchange across the Red Sea, between small-scale societies, beginning in the 3rd millennium BC (Fig. 10). Not only do densities of obsidian start to increase on the Tihama coastal plain, but similar lithic technologies also emerge on opposing coasts of the Red Sea (Khalidi 2007, 2009). Documentation of technological *chaînes opératoires* by Remi Crassard suggests that shared technological repertoires were responsible for the production of obsidian geometric microliths and *pièces esquillées* at contemporaneous sites in the Tihama plain and Horn of Africa (Crassard 2008). In addition, analysis of obsidian samples from Tihama points to an African origin for the Arabian artefacts (Khalidi 2009). It seems likely, as Kitchen has suggested, that coastal communities played an active role in Red Sea trade (Kitchen 2002), with existing exchange networks perhaps intensifying in response to new economic and social pressures in the region. Supplying the increasingly powerful elites of Egypt with goods and materials for social competition and conspicuous consumption would have been one important aspect of this activity, but transformations in Arabia itself probably also played a role. Coastal as well as inland communities in the Arabian Peninsula probably had their own incipient elites, and other transformations were clearly under way in this region. Phillips has argued, on the basis of findings from the site of SRD1 on the Wadi Surdud in particular, for an important economic transformation, from hunting to herding, in the Tihamah region during the mid-Holocene (Phillips 1998). In the hilly interior of Yemen, the building of terrace systems from the second half of the fourth millennium BC suggests the beginnings of plant cultivation, and organized efforts at mobilizing labour to irrigate fields (Harrower 2006, 2008a, b; Wilkinson 2005 [for a date as early as 4000 BC]), although the earliest archaeobotanical evidence (for wheat and barley) does not date until c. 3000 BC (see Table 2). From the third millennium BC, geoarchaeological evidence suggests increased soil erosion in the hilly interior (Wilkinson 2005). Increasing social hierarchy might be suggested by the emergence of megalithic burial structures from shortly before 3000 BC (Edens and Wilkinson 1998, 85), although there is limited evidence yet concerning details of social structure, and many such cairns date to subsequent millennia.

Turning our attention now to the eastern Arabian maritime orbit, there is similarly evidence for the beginnings of agricultural settlements and artificial irrigation, together with increasing trade and social complexity. Remnants of channels probably linked to wells have been dated to the third millennium BC in interior Oman (Cleuziou and Tosi 2007; Frifelt 2002). It is plausible that these represent precursors to the more complex subterranean channel systems of the *falaj* (*qanat*), although the latter are generally believed to have been invented closer to 1000 BC (see discussion below). By the start of the third millennium BC, settlements, apparently on the later oasis pattern, and burial monuments (so-called 'beehive tombs') were widespread in Oman (Cleuziou and Tosi 2007).

Evidence for maritime contact and trade in eastern Arabia becomes overwhelming during the course of the Early Bronze Age. The accentuated maritime activity seen in the Persian Gulf in the mid-Holocene relative to the Red Sea clearly intensified further during this period, and extensive, regular and long-distance trade networks can now be identified with certainty in the region. In the early Bronze Age, these networks linked southern Mesopotamia, the eastern littoral and islands of the upper and central Persian Gulf (Bahrain and Failaka), the Oman peninsula, eastern Iran and the Western littoral of the Indian subcontinent (Fig. 10), and were complemented by riverine and overland routes that connected the coastal sites and ports to a rich array of both nearby and distant inland sites (evidence for trade connections is found as far away as the eastern Mediterranean and central Asia: Cleuziou and Tosi 1989; Lamberg-Karlovsky 1972; Lamberg-Karlovsky and Tosi 1973; Méry 2000; Potts 2008a; Wright 2002).

The maritime component of the expansive trade and interaction network that Possehl refers to as the Middle Asian Interaction Sphere (Possehl 1996, 2002, 2007) has been the focus of much discussion and debate for over a century (Cleuziou and Tosi 2007; Edens 1993; Lamberg-Karlovsky 1972; Oppenheim 1954; Parpola 1977; Possehl 1996; Potts 2008b; Ray 2003; Ratnagar 2001, 2004; Wright 2002). Early archaeological discoveries, demonstrating the existence of the Indus Valley civilisation, and revealing the presence of its artefacts at Mesopotamian sites, and of Mesopotamian material culture in Pakistan, were subsequently attended by seminal textual studies that provided glimpses of the players and processes involved (e.g. Gadd 1932; Mackay 1931, 1948; Marshall 1931; Oppenheim 1954). In particular, the textually identified regions of *Dilmun*, *Magan* (*Makkan*) and *Meluhha* were linked through descriptions and archaeological finds to the real regions of present-day Bahrain (and/or variously Falaika and the eastern Arabian littoral), the Oman peninsula, and the Indus Valley and Gujarat, respectively. It is only in more recent decades, however, that archaeological research in southeastern Arabia has clarified Arabia's role in this trade, and demonstrated the significant contacts that existed in the Bronze Age between Arabia and her maritime neighbours (Edens 1993). Still not clear, but likely to emerge through continued investigations, is the picture of what kinds of societies, and precisely who, was involved in seafaring and trading activities. Nonetheless, we will draw upon the limited evidence to make some suggestions here.

The early Bronze Age period witnessed important transformations in maritime activity and trade in eastern Arabia, as well as more inter-relations with neighbouring regions (whose chronologies are thus drawn on for discussing many Arabian finds). In the Uruk period, however, there is still remarkably little evidence for Mesopotamian cultural artefacts in the Persian Gulf, which consist of just a few identified sherds (Potts 1990; Ratnagar 2004). Uruk sites do bear artefacts of exotic materials that certainly reach the region from diverse neighbouring areas, however, and possible Uruk colonies appear in southwestern Iran and the northern Euphrates (Ratnagar 2004). These suggest a counterintuitive contrast between the earlier Ubaid trade through the Persian Gulf, and the reduced signs of trade from the urbanized centres of the Uruk 'expansion'. Some of the explanation is perhaps to be found in the contrast explored by Wengrow (2008) between the exchange systems of a 'bazaar' economy, based more on kinship networks (even if symbolically extended), and the centralized and controlled production of labour-added commodities in the 'brand' economy of early urbanism. As Uruk era cities expanded, the focus appears to have been on exchange with the inland periphery rather than with the Persian Gulf.

The situation subsequently changed, however, and the Jemdet Nasr and Early Dynastic periods display more evidence for maritime trade. Pottery and small finds of these periods now turn up in graves and on settlements in southeastern Arabia and the central Persian Gulf (During Caspers 1971; Edens 1992; Potts 1993; Vogt 1996). In the same time period, shell-made lamps and cups—manufactured from a variety of conch shell types, none of which are found in the Persian Gulf and one of which comes only from India—are a common find in both burials and settlement sites in Mesopotamia (Edens 1992). There are a few Harappan small finds in Early Dynastic Mesopotamian contexts, including etched carnelian beads (Kenoyer 2007; Ratnagar 2004). In addition, archaic texts from Uruk make mention of Dilmunite copper, implying that by this period, copper is already moving from *Magan* to Mesopotamia via *Dilmun* (Cleuziou and Méry 2002; Edens 1992). Mesopotamian texts also indicate the importation of tropical hardwoods from India, probably mainly from Gujarat, although precise botanical identification for the archaic terms remains uncertain (Asouti and Fuller 2008, 98, 107–108; Ratnagar 2004, 129–131). There are also unconfirmed, and perhaps botanically dubious, claims for a few long distance spice finds in Bronze Age Mesopotamia, such as cardamom, which originates in the Western Ghats (Keay 2006), and cloves at Terqa, originating in Indonesia (Buccellati and Buccellati 1983; Turner 2004, xxviii). In both cases, expert confirmation of botanical attributions is needed.

Archaeological research in southeastern Arabia demonstrates that by this time (c. 3000 BC) well-developed oasis settlements—for example at the site of Hili—were engaged in the production and exchange of copper (Cleuziou 1996). Meanwhile, on the coasts—at Ras al-Jinz, Ras al-Hadd, and Ras Shiyah, for example—already complex and relatively sedentary fishing communities also began to import and use copper, as well, apparently, as sesame oil and minor quantities of exotic Mesopotamian pottery (Cleuziou 1996; Potts 1993). They also began to catch more deep-water species of fish (Beech 2004), possibly indicating greater maritime proficiency. Cleuziou hypothesises that the fish that they continued to process in various ways (for example, complicated drying, smoking and perhaps salting processes; see also Charpentier 1996) now began to see production for larger scale export (Cleuziou 1996). Such communities also produced a range of raw materials (like shell and fertilizer, the latter vital to palm-grove cultivation) and goods (jewellery, beads, fish hooks, kohl containers, etc.) that were traded both locally and further afield (Charpentier 1996, 2002). Interaction with southeastern Iran is hinted at by ceramic and copper production parallels that indicate technological borrowings (Cleuziou 1996; Cleuziou and Méry 2002), though pottery remained poorly integrated into daily life and craft activities (Cleuziou and Méry 2002). There is also evidence for South Asian materials on Omani sites (Ratnagar 2004). Both coastal and inland communities buried their dead in communal cairns, together with Mesopotamian pottery (that was never copied, and not used in other contexts), and their political structure was probably kinship-based (Cleuziou 1996; Cleuziou and Méry 2002; Cleuziou and Tosi 2001).

The central Persian Gulf region, on the other hand, now moved towards urbanism and statehood (Cleuziou 1996). The place identified by the cuneiform toponym *Dilmun* was at this time most probably located on the coastal littoral rather than the island of Bahrain (Howard-Carter 1987). Early Dynastic texts indicate trade with Dilmun, while finds of imported ceramics from Eastern Arabia and particularly the coastal island of Tarut reveal contact with Mesopotamia, Iran and Oman (Cleuziou 1996; Howard-Carter 1987). Overall, however, as Edens has outlined, trade in the southeastern Arabian peninsular region in the first half of the third millennium BC was relatively small in bulk and centred on a variety of luxuries (Edens 1992). Nonetheless, imported shell and other materials reinforce the impression, garnered from textual sources, that maritime trade with the still emergent Indus Valley civilisation began at an earlier date than we currently have good archaeological evidence for (Cleuziou 1992; During Caspers 1979; Howard-Carter 1987; Parpola 1977; Ratnagar 2004), suggesting already by this date the expansion of networks beyond the Arabian peninsular region. The distribution of Sumerian-inspired cylinder seals and sealing amulets in South Asia—they are found only at northern inland sites like Mohenjo-daro and Harappan rather than southern, coastal ones—also suggests an overland trade connection between the Indus and Mesopotamia (During Caspers 1984; Warburton 2007). It may be that disruption of this overland trade in the mid-third millennium served as a further catalyst to sea-borne economic interaction between South and Southwest Asia (During Caspers 1984).

The second half of the third millennium saw many important changes to trade and its socio-political context, following the emergence, by 2750 BC, of the Umm an-Nar cultural entity in Oman (Cleuziou 1996; Cleuziou and Méry 2002; Tosi 1986b) and the Mature Harappan in the Indus valley (Possehl 2002). After a gradual intensification of trade (Edens 1992; Vogt 1996), with *Dilmun* continuing to act as an intermediary, we see evidence for the emergence of direct contacts between the main trade participants (Edens 1992). This is subsequently reflected in Sargon of Akkad's (2334–2270 BC) boast that he had moored in his harbour ships from or destined for *Meluhha*, *Makkan* and *Dilmun* (Oppenheim 1954). A lesser known late Sargonic tablet (datable to c. 2200 BC) also mentions a man with an Akkadian name entitled 'the holder of a *Meluhha* ship', while an Akkadian cylinder seal bears the inscription 'Su-ilisu, *Meluhha* interpreter' (Parpola 1977). Indus seals begin to appear in the Mesopotamian archaeological record at this time (Parpola 1977; Possehl 2002). Ratnagar notes the paucity of material evidence for any Mesopotamian presence in Oman at the time, however, despite the military incursions by Akkadian kings (Ratnagar 2004). Mesopotamian pottery is evidently no longer desired by Oman communities for use in burial contexts after around 2600 BC, and the subsequent use of Mesopotamian jars at coastal settlements only continues until the beginning of the Akkadian period (Cleuziou and Méry 2002).

Coastal societies in Oman were nonetheless heavily dependent on trade in the second half of the third millennium BC, and like inland communities, began to build more substantial dwellings, of stone or mud-bricks at this time (Cleuziou 1996; Cleuziou and Tosi 1994, 1997). They exhibit ties to regions north and east (Cleuziou and Tosi 1989; Potts 1993). During the Umm an-Nar period, Oman seems to have been very strongly linked to southeastern Iran and to the Indus Valley (Cleuziou and Méry 2002; Cleuziou and Tosi 1989; Edens 1993; Potts 1994c; Vogt 1996). The earliest find of imported wood in eastern Arabia (Sissoo) probably comes from the Indo-Iranian borderland region, for example (though a source in India or even locally cannot be discounted: (Edens 1993; Tengburg 2002). Items of supposed Harappan provenience or inspiration, meanwhile, are found all over the peninsula, and cover a wide range, suggesting the import into *Magan* of both basic commodities and luxuries (Vogt 1996). Along with carnelian (some etched), combs, shell and shell objects, metal and metal objects, seals, and weights of more or less clear Harappan provenience (Edens 1993; Possehl 1996; Ratnagar 2004; Vogt 1996), there is a rich testimony of ceramic sherds, in particular of the widely distributed Indus black-slipped ware (Cleuziou 1992; Cleuziou and Méry 2002; Potts 1993, 1994; Vogt 1996). The potsherds of this ware belong to a highly standardized category of large-volumed vessels that appear to be storage jars.

Whether they were traded as storage items (since Oman lacked the technology for making large storage jars at this time) or for their contents (cheese is one suggestion) is still very unclear. The black-slipped jars are more common on the coast than the interior, and particularly on the coast of Oman rather than the Persian Gulf (Cleuziou and Méry 2002). Their mineralogy supports an Indus origin (Cleuziou and Méry 2002).

Trade in the final centuries of the third millennium BC saw an important shift from the predominantly luxury-oriented system that probably extended back several millennia, to a mixed trade that began to include necessities (Edens 1992). Trade also became less direct, with significantly less evidence for first-hand interaction between Mesopotamia and India. Parpola argues, from Ur III textual sources, for the presence at this time in Mesopotamia of acculturated Meluhhans (Indians), who no longer have contact with their homeland (Parpola 1977), though his argument for a Meluhhan village seems to us to be pushing the evidence. Ur III documents from the site of Ur also record the activities of seafaring merchants who took textiles, wool, leather, sesame oil and barley to *Magan*, which seemed to develop as a primary trading centre (Oppenheim 1954). Mesopotamian ceramics and other artefacts are found in Oman from this time period, though primarily on the coast (Vogt 1996). The focus of Mesopotamian merchants seems to have been on obtaining copper, which came to be used for increasingly utilitarian purposes during the Akkadian period and after (Edens 1992). While Mesopotamian coppersmiths in the first half of the third millennium BC focused on producing a wide variety of *objets d'art*, vessels, personal objects and tools, most productive equipment was made of stone, and it was not until the latter part of the millennium that copper became deeply embedded in the Mesopotamian political economy (Edens 1992). Cereals also underwent a similar 'category shift' (as Edens describes it), changing from luxury to necessity status. Grain movements through the Persian Gulf, particularly of barley, increased in the later part of the third millennium BC, and may have funded Mesopotamian copper import (During Caspers 1989; Edens 1992; though see Potts 1993).

Available evidence suggests that Oman's interaction and trade with the Harappan civilisation increased in the last few centuries of the third millennium BC (Vogt 1996). At this period, the evidence for direct contact with the Harappan culture is better than in the subsequent period, and is focused on coastal sites (Edens 1993). Sites in the interior tend to have more 'borrowings' from the Harappan culture (Edens 1993). Charpentier has argued that coastal communities played an intermediary role between inland and Indus civilisation populations, acquiring and supplying goods to both parties (Charpentier 1996). Palaeoanthropological analysis of skeletons from a late third millennium BC grave at Tell Abraq suggest the entombment of a biologically heterogeneous population, which may have included individuals from Bactria and/or the Indus Valley (Potts 1994c).

The Arrival of Crops in the Arabian Bronze Age

Archaeobotanical evidence from the Arabian Peninsula is still limited but suggests the basis of early subsistence in the region. More extensive evidence is available from many surrounding regions, including Egypt (see de Vartavan and Asensi Amorós 1997; Murray 2000); the Levant and Mesopotamia (Miller 1991; Riehl and Nesbitt 2003; Smith 2005; Zohary and Hopf 2000); and South Asia (see Fuller 2002, 2006). Eastern Africa and much of the Iranian Plateau are poorly known. Recent overviews of Arabian archaeobotany include McCorriston (2006), de Moulins et al. (2003), Tengberg (2003), and Ekstrom and Edens (2003), all expanding on the dataset available to the classic review by Potts (1994b).

Potts (1994a) also reviewed the limited evidence for agricultural tools, such as hoes and ards. Data for a selected core of species is summarized here in Tables 1 and 2. Apart from the early Dalma date stone find (c. 5000 BC), most evidence dates from the early third millennium BC onwards. There is therefore no evidence against the previous inference that crop cultivation was adopted from external influences around 3000 BC, at least in Eastern Arabia (Cleuziou and Tosi 1989; Potts 1994b). In the case of Yemen, however, the presence of irrigation systems in parts of the highlands, established before 3200 BC, may suggest a slightly earlier adoption of crops in Western Arabia (e.g. Harrower 2008a).

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 Persian Gulf region, the most common of the wheats are free-threshing and, especially, bread wheat (*Triticum aestivum*). 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 hulled emmer wheat (*Triticum dicoccum*) is most frequent. This is of note because emmer wheat was the dominant wheat in Egypt and Nubia until the later first millennium BC (Murray 2000; Fuller 2004), and was a prevalent wheat in Ethiopia, in evidence from the first millennium BC at Axum (Boardman 2000) and in Ona area sites of Eritrea (D'Andrea 2008; D'Andrea et al. 2008b). Both varieties of wheat are equally prevalent (at a site level) in the third millennium BC in Mesopotamia and the Levant, although emmer may also be more frequent (see, e.g. Charles 1993; Deckers and Riehl 2007; Miller 1991). This could suggest some agricultural or culinary zones of influence along the Red Sea and the Persian Gulf, respectively.

Numerous other crops and livestock varieties had their origins in Africa. Amongst African crops, several were traditionally important on the Arabian Peninsula, especially in Yemen (Table 1). These include cereals, such as *Sorghum bicolor* from the eastern savannas (perhaps from Chad or Darfur) and finger millet (*Eleusine coracana*) from the Ethiopian uplands. Tef (*Eragrostis tef*), 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 BC at Hajar Bin Humeid (Van Beek 1969). Evidence for the initial cultivation of most African cereals and their domestication is still, however, lacking in their region of origin (Fuller 2005; Neumann 2005), and the earliest secure archaeobotanical finds come from South Asia, where these species had been introduced by c. 2000 BC or shortly thereafter (Fuller 2003a). In addition, India provides the earliest evidence for two pulses of African origin, hyacinth bean and cowpea. Pearl millet (*Pennisetum glaucum*) may also demonstrate a similar pattern. Pearl millet originated far to the west in the Sahel zone of Mauritania and Mali, where firm evidence of domesticates is present by 1700 BC (Fuller 2007b; Fuller et al. 2007b; MacDonald et al. 2003), along with evidence for the spread of domestic millet southwards beyond its wild range (D'Andrea et al. 2001). Recently, direct dates on domesticated *Pennisetum* put this back to c. 2500 BC in northeast Mali (Finucane et al. 2008; Manning 2008), although domestication status remains unconfirmed. As with the other domesticates, pearl millet appears to be present in India by the Late Harappan horizon, 2000–1700 BC, with a number of finds from Gujarat. Finds of African crops in the interior of South India appear consistently later than those in Gujarat, focused on 1600–1500 BC (Fuller et al. 2007a), which tends to argue for an introduction via Gujarat at around the start of the Middle Bronze Age and the Late Harappan transition. A potentially earlier inland report of sorghum from Kunal (Saraswat and Pokharia 2003) and the disputed identification of finger millet from Mature Harappan Rojdi (see Fuller 2003a; Fuller 2006) would move this date some centuries earlier, perhaps to c. 2500 BC, but further documentation or dating evidence is needed.

Table 1 Selected crops of African, South Asian and East Asian origin cultivated in Arabia

Crop, with common names in English and Arabic	Region of origin and earliest evidence there	Cultivation in Arabia, historical evidence
Sorghum bicolor, Sorghum, *dhura;* in Socotra: *makedhīra*, for the grain: *habb*, *ta'am*	Eastern Sudanic savanna zone, by third millennium BC(?) (Fuller 2003a)	?Hili, Oman; ?Yemen finds, all botanically dubious; wild sorghum at Sabir, c. 900 BC; Medieval staple in Yemen with numerous varieties (Varisco 1994)
Pennisetum glaucum, Pearl millet, *dukhn* (but see also, *Panicum miliaceum*, *E. coracana*)	West Africa Sahel, by mid third millennium BC (Finucane et al. 2008; Fuller 2007b)	*Dukhn* cultivated in Medieval Yemen (Varisco 1994: 167)
Eleusine coracana, Finger millet, *keneb* sometimes *dukhn*	Ethiopia, by late second millennium BC(?) (Fuller 2003a)	Cultivated in present day in Arabia
Eragrostis tef, Tef, *tahaf*	Ethiopia and Eritrea, by later first millennium BC (Boardman 2000; D'Andrea et al. 2008b)	Hajar Bin Humeid, first millennium BC
Panicum miliaceum, Broomcorn millet, dukhn (sometimes), bakūr, siyal	China by c. 6000 BC (Crawford 2006)	Yemen by late third millennium BC
Foxtail millet, *msebeli* or *keneb* (but see also *Eleusine coracana*)	China by c. 6000 BC (Crawford 2006)	Cultivated in present day in Arabia
Vigna unguiculata, Cowpea, *lūbiyā'*, *dijr/dujr*	West Africa, Ghana by 1700 BC (D'Andrea et al. 2007); has also spread to India at this time (Fuller 2003a)	Medieval Yemen (Varisco 1994: 190)
Lablab purpureus, Hyacinth bean, *hurtimān*, *kishd*	East Africa, by early second millennium BC; in India by 1700 BC; south India by 1600 BC (Fuller 2003a; Fuller et al. 2007a)	Medieval Yemen (Varisco 1994: 189)
Vigna radiata, Mungbean, *qusheri*	India: northwest and south, by late third millennium BC (Fuller and Harvey 2006)	Cultivated in present day in Arabia
Vigna mungo, Urd bean, black gram, *māsh*, *dizur awad*	India: Gujarat/northern peninsula by 2500 BC (Fuller and Harvey 2006)	Medieval Yemen (Varisco 1994: 181)
Cajanus cajan, Pigeon pea, *qishta*, at Aden: *turai*	Eastern and Southern India, by 1400 BC (Fuller and Harvey 2006)	Cultivated in present day in Arabia
Sesamum indicum, Sesame, *simsim*, *juljul/jiljil*	Pakistan, by Harappan times (2500 BC) (Fuller 2003b)	First millennium BC Yemen (Sabir, Haja Bin Humeid); cultivated in Yemeni mountains in Medieval times (Varisco 1994, 195)
Gossypium arboreum, Tree cotton, *qutun*, *'otb*	Pakistan, by 5000 BC (Moulherat et al. 2002; Fuller 2008)	On Bahrain (*Tylos*) according to Theophrastus, c. 350 BC
Musa sapientum, bananas	New Guinea/Indonesia, by 4000 BC (De Langhe and De Maret 1999; Kennedy 2008); Indus Valley by 2000 BC (Fuller and Madella 2001).	Cultivated in Dhofar and foothills in Medieval times (Varisco 1994, 190)

Table 1 continued

Crop, with common names in English and Arabic	Region of origin and earliest evidence there	Cultivation in Arabia, historical evidence
Areca catechu, Betel-nut, areca-nut, *faufal*	Mainland/Island Southeast Asia, by 2000 BC(?)	Cultivated in Yemen and Batinah of Oman (Mason 1946, 594); *Piper betle* is also found cultivated occasionally
Cocos nucifera, Coconut, *jauz hindi* ('Indian walnut'), *jauz narjīl*	Island Southeast Asia	Cultivated in coastal gardens of Aden area (Mason 1946, 594)

Local Arabic names from Mason (1946) or Varisco (1994)

Boardman (2000), D'Andrea et al. (2007, 2008b), De Langhe and De Maret (1999), Finucane et al. (2008), Fuller (2003a, b, 2007a, 2008; Fuller et al. 2007a; Fuller and Harvey (2006), Fuller and Madella (2001), Kennedy (2008), Mason (1946), Moulherat et al. (2002) and Varisco (1994)

Also of note is the frequent occurrence of summer cereals or close wild relatives in Yemen rather than the Persian Gulf sites (*Panicum miliaceum*, *Eragrostis tef*, *Setaria*, and even *Sorghum*, although concerns over identification remain). This is in keeping with the higher monsoon rainfalls and the summer agriculture that is traditional in Yemen (Varisco 1994). While earliest evidence for cultivation dates from c. 3000 BC, we should probably assume that crops spread to the region during the previous 500–1,000 years, and interregional differences in wheat preference may suggest two distinct processes of crop diffusion along the Red Sea and Persian Gulf. Critically, as shown by the data summarised in Tables 1 and 2, it should be emphasised that the archaeobotanical record does not currently support adoption of African crops in Arabia prior to or at the time of their terminal third to second millennium BC introduction to South Asia (see below). Given that most of these crops *are* eventually grown in Arabia, it follows that the reasons for this pattern are probably cultural rather than environmental (that is, there is no evidence of a major environmental or climatic barrier to their dispersal, although, as we discuss above, geography could have slowed their dispersal).

From the northerly region originated the Neolithic 'founder crops'(Zohary 1996), such as barley and wheats (emmer and einkorn as well as developed free-threshing wheats), lentil, pea, chickpea, grasspea, broad bean and vetch, as well as flax. In addition it is probably from this region that domesticated figs and grapes were first introduced (Zohary and Hopf 2000). While numerous other crops, including several tropical pulses, small millets and rice, originated in South Asia, the earliest evidence for their domestication is much later, mainly from 2500 BC (Fuller 2006). Nevertheless, some of these species have spread to East Africa and Southwest Arabia, and have traditional importance in Yemen (Table 1). Available archaeobotanical evidence would suggest that these species spread west from India after the period considered here.

Phase III: Changing Trade Patterns in the Middle and Late Bronze Age (2000–c. 1200 BC)

The Early to Middle Bronze Age transition was a period of political instability and upheaval across much of the area under consideration here. This is seen first in Egypt, where the First Intermediate Period (2125–1975) ushers in a period of instability marked by disintegration into competing principalities (Baines and Malek 1980; Connah 2005). In Southwest Asia, the Ur III Empire collapses at the end of the third millennium, while the

Table 2 Archaeobotanical evidence from Arabian sites for a selected roster of species

			Hordeum vulgare	*Avena* sp.	*Triticum* sp.	*Triticum diococcum*	*Triticum durum*	*Tritucum aestivum*	*Sorghum bicolor* (cultivated)	*Sorghum arundinaceum* (wild)	*Eragrostis tef*	*Setaria* sp.	*Panicum miliaceum*	*Panicum* sp.	*Cicer arientinum*
Western Arabia															
al-Raqlah	Yemen	3000–2500 BC			x	x			[ ]	?					
Hayt al-Suad	Yemen	2800–2500 BC	x		x	?	?	?				x			
Jubabat al-Juruf	Yemen	3000–2200 BC	x		x							x	x	x	
al-Massanah	Yemen	2500–2000 BC	x		x	?		?							
Wadi Yana'im	Yemen	2250–2000 BC	x	x	x	?			[ ]	?			x		
Sabir	Yemen	ca. 900 BC								x		?		?	
Hajar Bin Humeid	Yemen	1000 BC–AD 500	x								x		x		
Hajar al-Tamrah	Yemen	1100–400 BC													
Hajar al-Rayhani	Yemen	500–200 BC	x												
Baraqish	Yemen	700–100 BC	x	x	x	x?	?	?				x			
Raybun	Yemen	900–100 BC			x	x									
Eastern Arabia															
Dalma	UAE	Late 6/ea. 5 M BC													

Table 2 continued

			Hordeum vulgare	*Avena* sp.	*Triticum* sp.	*Triticum diococcum*	*Triticum durum*	*Tritucum aestivum*	*Sorghum bicolor* (cultivated)	*Sorghum arundinaceum* (wild)	*Eragrostis tef*	*Setaria* sp.	*Panicum miliaceum*	*Panicum* sp.	*Cicer arientinum*
Ras al-Hamra 5	Oman	4500–3500 BC										x			
Ras al-Jinz 2	Oman	2500–2100 BC													
Hili 8	UAE	3000–2000 BC	x	x	x	x		x	[ ]						
Failaka	Kuwait														
Saar	Bahrain		x		x			x							
Bat	Oman	2500–2000 BC	x		x			x							
Umm An-Nar	UAE	2500–2000 BC	x		x			x							
Tell Abraq	UAE	2500–400 BC	x		x			x							
Rumeilah	UAE	1150–350 BC	x		x										
Muweilah	UAE	800–600 BC													
Mleiha	UAE	300 BC–AD 400	x		x			x							
Failaka	Kuwait	300 BC–AD 400	x		x			x							x
Summary stats		% Presence	63%	13%	63%	29%	8%	42%	13%	13%	4%	21%	13%	8%	4%
		Western	64%	18%	64%	55%	18%	27%	18%	27%	9%	36%	27%	18%	0%
		Eastern	62%	8%	62%	8%	0%	54%	8%	0%	0%	8%	0%	0%	8%

Table 2 continued

			Lens culinaris	*Pisum sativum*	*Vicia sativa*	*Vicia ervilia*	*Brassica/ Sinapsis*	*Linum usitatissimum*	*Sesamum indicum*	*Cucumis melo*	*Citrullus lanatus*	*Phoenix dactylifera/ sp.*	*Ficus sp.*	*Vitis vinifera*
Western Arabia														
al-Raqlah	Yemen	3000–2500 BC										x		
Hayt al-Suad	Yemen	2800–2500 BC	x	x	?	?							x	
Jubabat al-Juruf	Yemen	3000–2200 BC	x											
al-Massanah	Yemen	2500–2000 BC												
Wadi Yana'im	Yemen	2250–2000 BC												
Sabir	Yemen	ca. 900 BC					x	x	x					
Hajar Bin Humeid	Yemen	1000 BC–AD 500						x	x					x
Hajar al-Tamrah	Yemen	1100–400 BC										x		
Hajar al-Rayhani	Yemen	500–200 BC										x		
Baraqish	Yemen	700–100 BC										x		x
Raybun	Yemen	900–100 BC									x	x		
Eastern Arabia														
Dalma	UAE	Late 6/ea. 5 M BC										x		
Ras al-Hamra 5	Oman	4500–3500 BC												
Ras al-Jinz 2	Oman	2500–2100 BC										x		
Hili 8	UAE	3000–2000 BC		x						x		x		
Failaka	Kuwait											x		
Saar	Bahrain											x		
Bat	Oman	2500–2000 BC										x		
Umm An-Nar	UAE	2500–2000 BC										x		
Tell Abraq	UAE	2500–400 BC						*t*				x		
Rumeilah	UAE	1150–350 BC												
Muweilah	UAE	800–600 BC										x		

Table 2 continued

			Lens culinaris	*Pisum sativum*	*Vicia sativa*	*Vicia ervilia*	*Brassica/ Sinapsis*	*Linum usitatissimum*	*Sesamum indicum*	*Cucumis melo*	*Citrullus lanatus*	*Phoenix dactylifera*/ sp.	*Ficus* sp.	*Vitis vinifera*
Mleiha	UAE	300 BC–AD 400										x		
Failaka	Kuwait	300 BC–AD 400	x									x		
Summary stats		% Presence	13%	8%	4%	4%	4%	13%	8%	4%	4%	67%	4%	8%
		Western	18%	9%	9%	9%	9%	18%	18%	0%	9%	45%	9%	18%
		Eastern	8%	8%	0%	0%	0%	8%	0%	8%	0%	85%	0%	0%

Percentage of occurrence (presence) across sites/phases indicated for Arabia as a whole and for east and west Arabia. ? = specific identification uncertain; [ ] = reported, but botanical identity dubious; t = present as textile

Levant sees a serious decline in urban settlement in the last decades of the third millennium BC (Matthews 2005). In the Indus, the turn of the millennium also witnesses the end of the Mature Harappan, accompanied by major population shifts and de-urbanisation (Madella and Fuller 2006; Possehl 2002). So-called ‘peripheral’ zones like Arabia exhibit parallel changes, highlighting their close relations with ‘cores’. In Oman, there is an abrupt shift from the Umm an-Nar to the Wadi-Suq cultural phase, marked by a major material culture transformation, a decline in site numbers and a shift from terrestrial to marine fauna at sites like Tell Abraq and Shimal in UAE (Cleuziou 1996; Potts 1997). In Bahrain, *Dilmun* emerges as a state by the end of the third millennium BC, experiencing the ‘culmination of trends in population growth and urbanization’ and a maximum distribution of the Barbar culture (Edens 1992, 94). In central Asia, the Bactria-Margiana Archaeological Complex emerges at the end of the third millennium BC, around perhaps 2200–2100 BC, and subsequently expands onto the Iranian plateau (Hiebert and Lamberg-Karlovsky 1992), during the peak and subsequent decline of Indus Valley urbanism.

This period of instability corresponds to a time of climatic shifts towards drier and more volatile conditions, starting with the 2200 BC event (Staubwasser et al. 2002; Staubwasser and Weiss 2007; Weiss et al. 1993). The extent to which this 2200 BC event was a prime-mover of cultural change probably varied from region to region. Some areas in the wider region at this time saw the emergence of sedentism (e.g. south India), the height of urbanism (Harappa Period 3c), or continued urban growth (Kerma in Nubia), while others, including states in Mesopotamia and the Nile valley, as we have indicated, suffered declines. The impact of the climatic changes probably depended heavily upon local social systems and agricultural strategies (Rosen 2007; Rosen and Rosen 2001). In the Indus region, for example, it was those regions with two-cropping seasons and monsoon rains where there was the most continuity and new settlement growth (Madella and Fuller 2006). It is in this context that the potential of new crops may have been exploited, and long-distance trade relationships may have provided the means through which they were obtained. As we shall see, the movement of crops between Africa and South Asia is one of the most readily identifiable traces of expanding maritime networks in this period.

Despite the climatic and social instability that characterise this period, evidence for maritime activities continues in all areas, although there are also indications that trade and exchange patterns altered significantly in many regions, and in certain places witnessed significant disruptions. In western Arabia, changes in patterns of maritime contact and trade during Phase III may be partly linked to oscillations in Egyptian power. Egyptian shipping, always secondary to overland traffic, decreased with the instability and regionalism that marked the First Intermediate Period. Egyptian maritime activity subsequently resumed during the Middle Kingdom period, when Egypt sent fresh expeditions to Punt via Hammamat and the Port of Mersa Guweisis, to bypass the now powerful kingdom of Kush on the Nile (Kitchen 2002). Excavations at Mersa Guweisis have yielded remains of expedition ships, as well as a few exotic ceramics from the Tihama and remains of African ebony (Bard et al. 2007). After a second lapse in power during the Second Intermediate Period, leading for a time to a fully independent Kush, a reunited and resurgent Egypt projected her rule south during the New Kingdom Period, and evidence for trade again increases (Kitchen 2002). The first visual glimpses of trade with Punt are also seen at this time through Queen Hatshepsut’s record of her expedition (Phillips 1997), discussed earlier. The expedition was explicitly undertaken to cut out middlemen in the southern Nubian trade, via the Nile (Kitchen 2005). Subsequently, maritime trade in the Red Sea appears to have become so habitual that kings ceased to boast about it, and it is generally only referred to in passing (Kitchen 2005). Around 1200 BC, the first pepper appears in the

Egyptian record, positively identified from the dried fruits in the nostrils of the mummy of Ramses II (Plu 1985). This is the first indication of possible contact between Egypt and India, though by what route remains unclear. While its royal association attests to the rarity and high value of this spice at this period, it also can be taken to suggest the possible early beginnings of direct South Asian to Red Sea spice trade.

Further south in the Red Sea, contact also continues, and intensifies, perhaps partly in response to disruptions in the north. Bronze Age developments inland continue those of earlier periods, with megalithic burials, irrigation systems and eventually walled towns emerging, as we have indicated, along the interior desert edge, although dating evidence puts some of these in the early first millennium BC (Edens and Wilkinson 1998). The middle and perhaps early part of the second millennium BC is linked by a number of researchers to the emergence of shared ceramic affinities across the southern part of the Red Sea. Variously referred to as the Afro–Tihama culture (Kitchen 2002), Afro–Arabian cultural complex (Fattovich 1997), or Tihama cultural complex (Fattovich 1999), this sphere of interaction perhaps represents an intensification of an earlier engagement traced through shared lithic sources and techniques by scholars like Zarins, Khalidi and Crassard. Sites extending from Sihi to Subr along the west and southern coasts of Arabia (de Moulins et al. 2003; Durrani 2005, 62–67), for example, exhibit pottery with parallels with older C-group and Kerma cultures of the Middle Nile (Kitchen 2002; Phillips 1998). The Sabir culture itself, which began in the early second millennium BC, was clearly a sea-oriented coastal culture (Ray 2003, 84). The recently discovered Bronze Age megalithic site of al-Midamman in Yemen, which seems to span the late third to early first millennium BC, has also been argued to have parallels not only with the Sabir culture, but also with material on the African side of the Red Sea (Giumlia-Mair et al. 2002; Keall 2004). However, caution is warranted as most material culture, and particularly ceramic comparisons, have been made at a very general rather than typologically specific level, and further research is needed (Durrani 2005, 107–112). Nevertheless, in general, we can infer close contacts between western Arabia and Africa, which were to intensify in the first millennium BC. These trans-Red Sea exchanges are regarded, albeit controversially, as one of the key catalysts in the emergence of complex societies in Eritrea and Ethiopia (Curtis 2008; D'Andrea et al. 2008a; cf. Durrani 2005, 114–125; Phillipson 1998, 41–49).

If evidence for contact, exchange and influence, while intriguing, is often still under-investigated in western Arabia, the picture is somewhat clearer for the eastern littoral of the peninsula. Here as well there is evidence for change with the regional transformations that attend the start of the Middle Bronze Age. Thus, in the Wadi Suq period, we find that the evidence for Harappan trade shifts from Oman to Bahrain. Harappan or Harappan-style material culture falls off rapidly in Omani assemblages, and is replaced by imports mediated through Barbar or Kassite Bahrain (Vogt 1996). Thus *Dilmun* appears to have supplanted *Magan* (though see Potts 1993), and to have monopolised Harappan trade with Mesopotamia. This is corroborated by Mesopotamian textual sources, which no longer mention *Magan* at this time period, but instead refer to *alik Telmun*, seafaring merchants who travel to *Dilmun* (Oppenheim 1954). It is only their destination that changed, however, for their trade remained much the same: they exported garments and oil, for example (texts actually provide little evidence about the items exported; Postgate 1994), and brought back copper (including utensils), beads, gold, lumps of lapis lazuli, ivory-inlaid tables and 'fish-eyes' (perhaps pearls), ivory combs, eye-paint and certain kinds of wood (Oppenheim 1954). However, Mesopotamian seafaring merchants were now provided with funds and merchandise for maritime trade not by temples, but by private individuals. This kind of early investment capitalism is in stark contrast to the kind of relationship that was seen in the preceding period, as well as the royal trade expeditions of Egypt (Oppenheim 1954). The texts also make it clear that there were risks involved with the trade, and that it was expensive due to the costs associated with transport by boat and associated specialist personnel (Oppenheim 1954). Accordingly, such maritime trade was likely the prerogative of a very small, probably elite, component of society. Excavations at sites like Saar (Crawford 1998) also show that local *Dilmun* communities were thriving on the profits of international trade, with private entrepreneurs playing a similar critical role (Matthews 2005).

Beyond the emergence of *Dilmun* as a trading entrepot, there were other changes in Persian Gulf trade at this time. Harappan material culture on Bahrain stresses Harappan-inspired rather than Harappan-imported objects, and items like seals and weights rather than ceramics (Edens 1993; Vogt 1996). The Harappan relationship with *Dilmun* seems, not surprisingly, to have been different from its relationship to neighbouring *Magan*. It led not to the import of large quantities of Harappan goods, but rather to the incorporation of Harappan administrative and ideological frameworks. Thus when sealing procedures were implemented, it was the stamp seal of the Indus Valley, rather than the cylinder seal of Mesopotamia that was adopted (Eidem and Højlund 1993; Vogt 1996; though an origin in Iran, where stamp seals are round rather than square as in the Indus is also possible). The Indus weight system was also used, and later became known to the Mesopotamians as the ‘standard of *Dilmun*’ (Vogt 1996).

Evidence for Harappan trade continues into the Late Harappan period, as evidenced by both archaeological finds and textual sources like the Mari letters (Carter 2001; Warburton 2007). As discussed below, and indicated by ceramic parallels (Carter 2001; Potts 1994c), trade was by this point clearly with the Late Harappan communities of Gujarat, rather than the now disintegrated society of the Indus Valley proper. But after the first quarter of the second millennium BC, trade in the Persian Gulf region greatly diminished in volume and probably geographic scope, even if signs of contact remained for some time (Potts 1994c). *Dilmun* lost contact with the mining centres of *Magan* (Oppenheim 1954), and copper seems to have entered Mesopotamia from the north (Edens 1992; Warburton 2007). *Dilmun* similarly lost contact with the regions that supplied it with stone and timber, and essentially reverted to being an island famous for its dates and sweet water (Oppenheim 1954). Interruptions of archaeological sequences for at least several centuries suggest regional social disintegration in the Persian Gulf (Edens 1992). The relationship between the end of the early *Dilmun* civilization and the final disappearance of the Harappan civilization remains to be clarified (Carter 2001).

African Crops in India and Indian Cattle in Africa from c. 2000 BC: A role for Arabia?

It is in the context of the intensifying trade between Gujarat and Arabia at the start of the second millennium BC that we should probably consider the beginnings of contact between Africa and South Asia. The evidence of African crops, which are unambiguously in Gujarat and Baluchistan in this period, suggests that Gujarat maritime contacts were no longer only with Oman and Dilman but also extended further westwards around Arabia towards Yemen and Africa. At present count, some 33 archaeological sites in South Asia dating from the Middle Bronze Age (c. 2000 BC) through the Iron Age (to c. 300 BC) have evidence for crops of African origin for which botanical identity is acceptable (Table 3; data augmented from Fuller 2003a; with Chanchala 2002; Cooke et al. 2005; Saraswat

Table 3 Sites in South Asia with evidence of crops of African origin (five columns from right), with a selection of other recurrent crop species shown

Site	Phase	*Triticum*	*Hordeum*	*Oryza*	*Panicum sumatrense*	*Setaria/ Brachiaria*	*Vigna radiata*	*Vigna mungo*	*Macrotyloma*	*Sorghum bicolor*	*Pennisetum glaucum*	*Eleusine coracana*	*Vigna unguiculata*	*Lablab purpureus*
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				
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
Hulas	L.Har	X	X	X			X		X	X				
Sanghol					(Kushana)	E.Historic	X	X	X			X	X	X
X		[ ]	X											
Saurashtra/Kutch/Rajasthan														
Shikarpur	L.Har	X			X	X					X			
Rojdi A/B	M.Har		X		X	X		X				?		
Rojdi 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			
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	

Table 3 continued

Site	Phase	*Triticum*	*Hordeum*	*Oryza*	*Panicum sumatrense*	*Setaria/ Brachiaria*	*Vigna radiata*	*Vigna mungo*	*Macrotyloma*	*Sorghum bicolor*	*Pennisetum glaucum*	*Eleusine coracana*	*Vigna unguiculata*	*Lablab purpureus*
Charda, IIA	Iron Age	X	X	X		X	X	X	X			[ ]	X	
Hulaskhera C/D	E.Historic	X	X	X			X				X	[ ]		
Charda, IIB	E.Historic	X	X	X		X	X	X	X			[ ]	X	
North Deccan														
Ojiyana (Rajasthan)	E.Chal	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.Historic	X	X	X			X	X						X

Table 3 continued

Site	Phase	*Triticum*	*Hordeum*	*Oryza*	*Panicum sumatrense*	*Setaria/ Brachiaria*	*Vigna radiata*	*Vigna mungo*	*Macrotyloma*	*Sorghum bicolor*	*Pennisetum glaucum*	*Eleusine coracana*	*Vigna unguiculata*	*Lablab purpureus*
Bhatkuli	E.Historic									X				
Nevasa	E.Historic	X	X	X		?	X	X	X	X	X	X		X
Paithan I	E.Historic		X	X	X	X	X		X		X	X		X
Paithan II	E.Historic	X	X	X	X	X	X	X	X	X	X			X
Paithan III	Medieval	X	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
Hallur	S.Neo.IIIB	X		x?	X	X	X	X	X					X
Sanganakallu	S.Neo.IIIB	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	X		
Hallur	S.Neo.IV			x?		X	X	X	X			X		X
Veerapruam	Iron Age		X	X				X	X					X
Veerapuram	E.Historic			X					X					X
Perur	E.Historic			X	X	X	X	X	X			X	X	X
Kodumanal	E.Historic			X	X	X	X	X	X				X	X
Mangudi	E.Historic			X		X		X	X					
Piklihal	E.Historic				X	X	X		X	X				X

? = identification/dating is problematic; [ ] = reported but deemed a mis-identification. Updated since Fuller 2003a. Abbreviations for periods: Har = Harappan, Chal = Chalcolithic, S.Neo = Southern Neolithic; E = Early, L = Late, M = Mature

2004, 2005; Saraswat and Pokharia 2003). In almost all instances, these crops co-occur with native Indian millets and pulses, and can be seen as additions to an existing system of summer monsoon agriculture (Fuller and Madella 2001; Weber 1998, 342–344). Only in the case of Pirak was *Sorghum*, together with rice (plausibly *japonica* rice) and *Panicum miliaceum* (one of the Chinese millets), added to the established Indus repertoire of winter crops.

Pirak raises the possibility of two distinct diffusion processes for African crops to South Asia: in one, sorghum spread in cultivation systems that were predominantly focused on winter cultivation of barley and bread wheat, whereas in the other, the African crops as a more complete group, including sorghum and four other species, had an apparently non-Arabian and non-Indus Valley pattern of diffusion. Crops of central Asian, and ultimately Chinese, origin may have moved in a counter flow to sorghum, especially *Panicum miliaceum*, but in more limited areas of Pakistan also plausibly East Asian rice (cf. Fuller 2006, 36). The apparently earlier dates for *Panicum* on the Arabian Peninsula, and at Tepe Yahya in southern Iran, suggest that this line of contact was across the Persian Gulf already in the later third millennium BC 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), 2000–1500 BC, with later evidence from Kawa, 800–400 BC (Fuller 2004), but 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 Summers 1988; Miller 1991).

The other domesticate which moved between the Indian subcontinent and Africa, probably via Arabian maritime links, was the South Asia-derived zebu cattle (*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 BC as a counter flow 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 (Hanotte et al. 2002; Zeder 2006). Nevertheless, there was also clearly overland movement of zebu cattle from the Indus through Iran towards the Near East (Kumar et al. 2003), with osteological evidence for some zebus in Mesopotamia and the Levant from the later third and second millennia BC (Bökönyi 1997; Clason 1978; Meadow 1987). While it is possible that zebu then diffused south into Arabia overland, the haplotype frequency data is perhaps more suggestive of a separate direct line of diffusion. However, while this genetic picture implies a route of diffusion it does not provide a date. At present, archaeological evidence in Arabia itself is rather limited, but some movement of zebu into the region by the second millennium BC can be suggested. Archaeozoological evidence for *Bos indicus* has been reported from Tell Abraq by the Wadi Suq period and possibly in the Umm an-Nar phase (Uerpmann 2001).

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; Frisch et al. 2003; Hanotte et al. 2002; 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, and the potential of some indigenous African cattle for resistence 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. These occur in Egypt beginning between 2000 and 1500 BC, in Niger in the second millennium BC and in the Chad Basin in the first millennium BC (Magnavita 2006; but for an earlier cautious review of the evidence, see Grigson 1996). As demonstrated by skull fragments, *Bos indicus* was present in Kenya by 200 BC–AD 100 (Marshall 1989). Marshall (1989) goes on to suggest that *Bos indicus* input may have been important for the emergence of a more specialised pastoralism in East Africa around this time.

In the Middle Bronze Age there is thus clear evidence for movement of biological species between Asia and Africa, which probably involved some degree of transport by boat around the coasts of Arabia. While the role played by Arabian middlemen is unclear (see Concluding Remarks), these species translocations are nevertheless indicators of trade on a greater scale than in previous times. The crops were presumably not themselves the commodities of trade, although, as we have noted, within the Persian Gulf wheat and barley from Mesopotamia were commodities. The monsoonal summer crops, by contrast, are likely to have moved in boats as food for long voyages, and crops were perhaps then introduced into new places through the planting of leftover seeds. In addition, in the context of climatic change and new agricultural strategies from the later third millennium BC, there may also have been more local contexts in which experimentation with novel crops was promoted.

Phase IV: Trade Expansion, Transport Innovation, and Agricultural Change Across Arabia in the Iron Age

Phase IV saw a number of important changes to trade patterns in the Arabian peninsula, within the context of socio-cultural, technological and economic changes in the peninsula and surrounding region. Transport innovations were key, starting with the domestication and spread of the dromedary camel, which facilitated travel through arid regions. Dromedaries were presumably wild in Arabia, and are known to have been hunted during the Bronze Age (Uerpmann and Uerpmann 2002), but it is not until the Late Bronze Age and the start of the Iron Age that they are attested in adjacent regions and can be argued to be domesticated. Camels are depicted first in Egypt in Ramesside art (twelfth century BC) (Pusch 1996), with evidence from bones and dung in Nubia dated from 900 to 800 BC (Rowley-Conwy 1988). Similarly, they come to be known in Mesopotamia from the ninth century BC in Assyrian sources (Köhler-Rollefson 1996; Zeuner 1963). Bone evidence in the Persian Gulf indicates that they have begun to be herded at Iron Age Tell Abraq (Uerpmann and Uerpmann 2002). Camel transport greatly enhanced overland trade within Arabia, and it is probably for this reason that we begin to see more clear evidence for contact between the eastern and western sides of the Arabian Peninsula in the Iron Age. Equally important was the contact that was enabled with neighbouring regions, and that led to the emergence of the famous ‘incense route’ along the western edge of the Arabian Peninsula. As Egyptian power and Red Sea navigation simultaneously fell into decline (Fattovich 2005), a number of prosperous trading kingdoms arose along this route, including in particular Sabaea, Qataban, Hadhramaut and Ma’in in southern Arabia, and to the northeast of the Red Sea, the kingdom of Nabataea, with Petra as its capital (Scarre 1988).

While the ease of camel travel relative to the difficulties of sea navigation favoured the use of overland trade routes in the Red Sea region for most of the first millennium BC, improvements in navigational skills increased competition through time-savings from sea routes. The emergence of a pre-Aksumite state with so-called ‘Sabaean’ characteristics on the plateau in Tigray and Eritrea (Fattovich 1999) may indicate the extent of maritime contacts across the Red Sea in the first half of the first millennium BC. While linguistic, epigraphic and monumental evidence have all been called on to support a Sabaean colonization of the plateau (Fattovich 1999), such assertions remain controversial (Schmidt and Curtis 2001). The increased use of maritime shipping towards the beginning of the AD period did, however, clearly lead to a shift in the balance of power in the Red Sea, which favoured those states with control of the major ports such as Qana, Muza and Eden; the principal beneficiary of these changes being viewed not as southern Arabia but the East African kingdom of Axum (see Scarre 1988, 184).

In the eastern Arabian Peninsula meanwhile, the early Iron Age saw the revitalisation of trade after a period of relative isolation (Magee and Carter 1999). In part, this isolation was perhaps due to increasing aridity and settlement abandonment, from c. 1400 BC, in connected regions, such as southeast Iran (see Magee 2005) and the Lower Indus region (Franke-Vogt 2001). While a significant level of regionalism suggests that interaction beyond the local level was still limited (Franke-Vogt 2001), it is nonetheless clear that increasingly intensive exchange relative to the preceding period was being undertaken in the first millennium BC, involving trade with the Elamites, Iran and perhaps Central Asia (Franke-Vogt 2001). Advances in the technologies of agriculture and transport that may in part have been a response to patterns of aridity and associated changes probably played a role in these new linkages. From c. 1000 BC, there is an explosion in settlements in the Arabian archaeological record, and fortification appears (Magee 2004), changes which may probably be linked to the emergence of *falaj* (*qanat*) irrigation. As a recent review of dating evidence from Iran indicates, this irrigation method seems to have first been established in eastern Arabia, by 1000 BC (Magee 2005), and subsequently adopted in southeastern Iran, allowing an explosion in settlement there from 800 BC (Magee 2005; contra Lightfoot 2000). Also significant would have been the impact of the camel (Magee 2004), which as reviewed above seems to have been domesticated sometime around 1000 BC.

Developments in seafaring were probably also important. Potts has argued that a pendant of this period from Tell Abraq displays a boat with a sharp bow and a triangular sail, which would be the earliest depiction of a lateen sail. The design is highly stylised, however, and more evidence is needed. What does seem clear is the increasingly regular use of the monsoon winds for long-distance sea transport between Arabia and India, which undoubtedly provided a key impetus to sea travel in the Iron Age. As a result of the 'discovery' of the monsoon winds by Red Sea sailors, it gradually became possible for Indian goods to reach Egypt and the eastern Mediterranean basin entirely by sea (Burstein 2002), and Phase IV accordingly saw the beginning proper of the Asian spice trade. Black pepper, from its limited source area in South India, was especially prominent in this trade, as suggested by Roman era records both written and archaeological (Cappers 2006; Miller 1968). The rarity of Indian goods in the archaeological record of western Arabia and the Mediterranean suggests that Indian Ocean trade was relatively small-scale until the end of the first millennium BC, when use of the southeast monsoon by merchantmen based in Roman Egypt became more common (Burstein 2002). After this, the scale and value of trade extended well beyond the limited trade in luxuries (Burstein 2002, 130), with large ships plying the waters of the Indian Ocean. This monsoon-driven trade caused a decisive shift away from Gujarat, with ports such as Muziris (probably modern Pattanam: see Shajan et al. 2008), much further down the coast in Malabar, becoming central foci for Indo-Roman trade (Burstein 2002).

The development of *qanat* irrigation in the Arabian Peninsula in Phase IV permitted important agricultural expansion and intensification in the final Bronze Age and Iron Age.

This allowed not only increased productivity of staple foods to support local populations and crafts workers (and hence trade), but also the adoption of the new crops that entered Arabia, or became widespread in this phase, including some that provide the first evidence for the local production of textile crops. While textiles had already, as we have seen, been a major trade commodity of the third millennium BC in the Persian Gulf, we expect most to have come from Mesopotamia, Iran or the Indus region (cf. Haernick 2002).

One the major textile crops of the ancient world, associated with riverine civilizations of Egypt and Mesopotamia, was flax. While flax was one of the founder crops in the Neolithic Levant, its development as a large-scale textile fibre crop in the late fifth and fourth millennium BC may be associated with the emergence of intensive Mesopotamian agriculture and urbanism (McCorriston 1997). It was also the major fibre crop of Egypt (e.g. Kemp and Vogelsang-Eastwood 2001) and the Indus Valley (Fuller 2008; Fuller and Madella 2001, 337–338). By contrast, it was presumably a Bronze Age import in Arabia. Remains of linen textiles are known back into the third millennium BC from the Umm al-Qaiwan burials (Tell Abraq) (Reade and Potts 1993), but there are no *Linum* macro-remains of this period. The only evidence for flax cultivation in Arabia comes from the Iron Age in Yemen at Hajar Bin Humeid and Sabir (de Moulins et al. 2003). The absence of evidence for local cultivation in eastern Arabia suggests that linen textiles circulated in Persian Gulf trade, but potentially from the Indus as well as Mesopotamia. It also seems reasonable to suggest that Egyptian linens probably moved south in the Red Sea trading sphere.

The other major textile crop of this period was cotton. Although cotton was an important crop in the Indus region (Fuller 2008; Fuller and Madella 2001, 337–338), it was not cultivated in the Mesopotamian area before the mid first millennium AD (Zohary and Hopf 2000). Classical authors suggest that cotton was established on Bahrain by the time of Alexander (fourth century BC) (Potts 1994b, 239; Watson 1983, 34). This is confirmed by archaeobotanical evidence from the Achaemenid period (c. 550–300 BC) (Tengberg and Lombard 2002). Other classical sources suggest cotton cultivation in other parts of Arabia by the last centuries BC (Watson 1983). It became established in the Nile only during the Roman period (Fuller 2008; Wild et al. 2007).

Cotton and *Linum* both are water-demanding crops, and their cultivation in Arabia under modern climatic conditions (which were established by the end of the third millennium) seems unlikely without appropriate technological innovations. In the Iron Age, with improved irrigation, and probable increased trans-Arabian communication, cultivation of these crops became possible. However, availability of the crop and conditions for cultivation were insufficient, as the tending and harvesting of the crops, and processing of their raw products into finished goods, are highly labour-intensive. In South Asia, the spread of both of these species is associated with local development of craft specialization and increased social complexity (Fuller 2008). Thus the establishment of these species in parts of Arabia probably relates to local land and labour conditions. The extent to which communities around the Arabian Peninsula developed different production and trade strategies in this period, and their effect on the later development of trade in spices and textiles, are issues for further study. Some local textile production might have contributed to intensifying trade. Local production would have highlighted regional differences in textile quality and design, creating complex new demands for different textiles within local systems of social signification. It may also have promoted further diversification in trade towards other high value commodities such as spices.

Conclusion

We would like to make some final points about our review of the data pertaining to early maritime activity in Arabia. Firstly, we have been able to say little here about wider Arabian Sea connections that would certainly have extended down the east African and West Indian coasts, expanding at least indirect trade networks beyond the orbit on which we have focused. This is in large part a simple reflection of the lack of work in these regions, as well as, for the Indian side at least, taphonomic factors that will probably have buried or destroyed many sites. Nonetheless, there is reason to suspect early maritime activity in these regions as well. There is suggestive evidence, for example, from archaeobotanical, zoogeographical, linguistic and historical studies, that there was an Austronesian presence in East Africa by the first millennium BC (Adelaar 2009; Blench 1996, 2006, 2007, 2009; Mbida et al. 2000; Walsh 2007). The pendant made from Zanzibar copal and found in third millennium BC deposits in Mesopotamia (Meyer et al. 1991) also reminds us of the possible early role of small regional exchange networks up and down the east African coast. Recent research has highlighted the early development of coastal maritime and fishing communities in the region. Meanwhile, on the Indian side, if the Gujarati Late Harappans were travelling to the Persian Gulf, they were almost certainly sailing southwards too. But neither this issue, nor the location of coastal settlements between the Late Harappan and the Graeco-Roman periods, have garnered much attention in India.

In terms of overall patterns for the region, some interesting similarities and contrasts have emerged. There appears to have been a roughly simultaneous appearance of maritime resource-using foragers at sites around the Arabian peninsular littoral from the seventh millennium BC. Whether this is a real pattern, or a reflection of rising sea level impacts is currently unclear. Subsequently, the first evidence for maritime trade emerges in the sixth millennium BC, albeit much more clearly in the Persian Gulf. While much of the trade was probably related to prestige and exotic items, more everyday materials like bitumen and stone were also exchanged. There were, nonetheless, probably parallels between trade in exotic Mesopotamian (Ubaid) ceramics in the Persian Gulf and the putative trade in exotic obsidians in southwestern Arabia. These materials probably featured as prestige goods whose acquisition and redistribution conferred status in the context of gradually emerging social hierarchies in the Arabian Peninsula. Both intra-group (gender, age) and inter-group (lineage, kin-group) differences may have been increasingly articulated, perhaps climaxing in Oman with the appearance of the highly visible 'Hafit-type' cairn burials of the late fourth millennium BC. There is a sense that this process was more intense on the eastern Arabian peninsular littoral than the western one, though it is difficult to draw comparisons between regions that have seen such contrasting degrees of archaeological attention. The emergence in the fourth and third millennia BC of Bronze Age state level societies in numerous regions bordering the Arabian Peninsula, in parallel with the rise of new social formations within the peninsula itself, had important implications for maritime trade. Not only did goods begin to move farther than seen previously, but major central foci of wider trade networks developed.

Much of our discussion has focused on reconstructing the emergence of maritime traditions and on tracing the movement of trade items. While the current state of research necessitates such a programme of initial basic compilation and comparison, maritime trade is about far more than the sum total of these elements, and theoretically, there is much progress still to be made. From a maritime perspective, greater consideration of seacraft, their technological development and symbolic elaboration, is needed. It is highly likely that maritime technological innovations had important social and political as well as economic implications (Arnold 1995), and that both boats and the sea attracted significant symbolic attention and elaboration by coastal communities in prehistoric Arabia. With respect to trade, it is clear that its economic aspects are frequently emphasised to the detriment of its social and political dimensions. Trade is for all societies a socio-culturally embedded affair, closely linked to matters of rank, hierarchy, difference, identity, value, custom, and belief. Furthermore, trade is but one aspect of contact, which can also take the form of, or be linked with, alliance building, diplomacy, warfare, and colonialism. These other forms have generally been underappreciated, both in this essay, and the wider literature.

For Arabia, application of world-system models, and core–periphery distinctions, are perhaps most relevant to the social and political dimensions of contact, trade and exchange. Core–periphery models are implicit in much of the literature, and expressed explicitly in some formulations (see in particular Ratnagar 2001). Such models construct Arabia as a periphery, a largely passive set of producing societies dominated by the historical trajectories and power vicissitudes of the urbanised or urbanising states around it. However, patterns of maritime contact and exchange often suggest a relatively limited role for the major states in early maritime ventures. Egypt's obsession with boats belies a largely landlocked society for whom maritime expeditions, at least to the Red Sea, were a major and seldom undertaken expense, whose very infrequency made them a cause for attention in the historical records. Meanwhile, the much vaunted early emergence of watercraft and maritime trade in the Persian Gulf is less likely to have been the prerogative of Mesopotamians on their way to urbanism and statehood than Neolithic Arabians seeking prestige and social power. Later Mesopotamians seem to have found it a major undertaking to get to *Magan*, and subsequently even just *Dilmun*. Neither textual nor archaeological evidence provide much, if any, sign of any of the Mesopotamians having reached India during the Bronze Age. With the Harappans, on the other hand, there are good indications of maritime capability, with texts indicating their physical presence in the Persian Gulf, and geography favouring the emergence of maritime *savoir-faire*, especially for the Kutch and Saurasthra regions (see below). But the role of the Harappans should not be overemphasised. There are no signs to date, as Cleuziou and Possehl have emphasised, for formal Harappan ports, with quays, warehouses, broad roads and/or trade good detritus, and it seems likely that, contrary to some of the implications in the literature, Harappan trade with regions to the west was always relatively informal, involving small-scale ports and local communities (Cleuziou 2003; Possehl 1996; see also Vogt 1996).

In contrast to the scenario of state-domination of the Bronze Age Arabian and subsidiary seas, what we actually have are local, increasingly complex and maritime-competent, coastal Arabian communities. These communities are by no means cut off from wider Bronze Age developments, but they do appear to engage in production as much for themselves and for regional trade networks as for the foreign powers that texts suggest they trade with. The coastal maritime communities of Oman, perhaps the best studied of the non-urban littoral Bronze Age societies, are an excellent example. These societies engage in extremely active trade along both inland and maritime routes, as active agents in their own right. Thus, we may note that even when *Magan* supplanted *Dilmun* as the main trading partner for Harappan and Mesopotamian seafarers, in the second half of the third millennium BC, there was no sign of colonial powers controlling this activity. Furthermore, Omanis made excellent use of their raw materials for their own purposes, and selectively procured foreign items according to indigenous value systems that clearly differed from those of the major nearby states. They in addition displayed increasing maritime competence. Evidence from the site of Ras al-Jins (RJ-2) suggests that use of simple bitumen-coated, reed-built boats on the east coast of Oman in the first half of the third millennium BC is followed by the adoption of plank-built wooden boats in the second half of the millennium, some time around 2300 BC (Cleuziou and Tosi 1997, 2007). Mention of 'Magan type' boats (Vosmer 2003) in the Ur III text may refer to the development of regional boat styles. While their role is often overlooked, it is clear that small-scale coastal communities also played a dynamic role in the intensive trade systems that developed in the Bronze Age (Charpentier 1996; Cleuziou 2003). It is perhaps useful to think less in terms of a traditional picture of maritime trade concentrated in the hands of a few major players, and more in terms of diversely composed, distributed networks of agents engaged in contact at a variety of scales.

Another social aspect of maritime contact and exchange that deserves consideration is distance, and its implications for systems of value and prestige. Mary Helms has emphasised the cosmological dimensions of space, and the role that travel to spaces beyond the known horizon has long played in constructing esoteric knowledge and political advantage (Helms 1988). Whether for those who voyage, or those who enable voyaging to take place, travel to distant places has often been employed as a source of political and economic currency, particularly when accompanied by the import of exotic goods. As with the subsequent Indian Ocean-wide spice trade, goods from distant locales were probably employed by ancient Arabians to advertise wealth and create prestige. The ocean, in particular, is a space whose many mysteries and dangers probably served to accentuate the importance of people and items who moved long distances along it (see examples in Helms 1988). The value attached to distance in early trade networks may help explain why evidence for direct contact between Mesopotamia and Harappa actually decreases during the course of the Bronze Age. In the early Bronze Age, Harappans at least seem to be travelling all the way to Mesopotamia to obtain particular trade items. In the centuries prior to the beginning of the Middle Bronze Age, however, when trade is a more common affair involving everyday as well as exotic items, there is little evidence for such contact. It is possible that the allure of voyaging all the way to Mesopotamia decreased for the Harappans as trade became more commonplace and many items became available in the much nearer region of *Magan*.

Finally, we turn to the question of crop transfer. More than 50 years ago Sauer (1952) noted the potential role of the Arabian Peninsula as a dispersal corridor, while 20 years ago Cleuziou and Tosi (1989, 15) referred to 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 BC remains a puzzle. Our analysis suggests two potential key players in their transfer, one or both of which are likely to have been active seafarers in the north Arabian Sea. The first is the coastal societies of Oman who demonstrate very clearly a long-term maritime orientation and seafaring tradition. Not only do they show evidence for deep-sea fishing from an early date, but they also develop wooden boat technology just prior to the time that the first African crops are recorded in India. They would have had knowledge of the monsoon, but also may have simply skirted the Makran coast, moving further eastwards beyond the parts of the Iranian littoral with which they were already familiar. In addition, Oman had clearly developed fairly complex, intensively trading societies by the third millennium BC, as suggested also by the Akkadian reference to the 32 kings and cities of *Magan* (Edens 1992, 128; Cleuziou 1996). A number of authors have accordingly suggested a possible role for Oman in the trade between the Persian Gulf and Harappa, and we may thus extrapolate a possible place for them in the story of the Africa–India species translocations. Against this can be put the lack of unambiguous finds of sorghum—or any of the other African crops (*Pennisetum*, *Lablab*, *Vigna unguiculata*) established early on in South Asia—from eastern Arabia (once the mis-identified Hili 'sorghum' impression is excluded; see Table 3, above; Fuller 2003).

The other obvious candidate is the Indians, from whom the societies of Oman may well have obtained their wooden watercraft technology (Cleuziou and Tosi 1997). Wood suitable for planks was abundant in India, and the region probably featured long-term construction of and familiarity with wooden boats. There is, in addition, ample evidence that the Harappans travelled at least as far as Mesopotamia. To do so, they would almost certainly have had knowledge of the monsoon, which seems the most likely way for the crops to have travelled, given the absence so far of most of them in the Arabian archaeological record. The Harappans had a series of maritime ports and, particularly in Gujarat, a well-developed maritime tradition. Indeed the Gujaratis have long been known for their Indian Ocean mercantile activities (Chaudhuri 1990; Pearson 2003). In addition, as the centre for Harappan maritime influence shifted from the Indus/Kutch region to Saurasthra and the Gujarat coast around 2000 BC (Lahiri 1999; Possehl 2002; Ratnagar 2004), there would have been even greater likelihood of crop transfer, since the Gujarat summer crop, millet-based agricultural system had much more in common with those of the putative African crops' homeland than did the winter crops of the Indus region. The de-urbanisation process under way in the Indus Valley proper in the first century of the second millennium BC obviously had major implications for trade and other long-distance relationships, but the continuation of Harappan trade with the Persian Gulf through Saurashtra for at least several more centuries implies that the region may have benefited from the transformations to trade network patterns at this time. A Gujarati Harappan impetus for the crop movements is perhaps supported by what appears at present to be a paucity of evidence for African crops in Arabia at the relevant time period, although barriers to the dispersal of crops from the sea into Arabia may be relevant.

The question of who was responsible for the movement of species between Africa and India will at any rate remain open for the moment. It is clear that for this, and many other questions we have touched upon here, more research is needed before clear answers will be obtained. Nonetheless, it is apparent that the local, often small-scale societies of the Arabian peninsula played a so far much underappreciated role in the early maritime contacts and exchanges that emerged in the Arabian Sea. These communities were probably integral to the Bronze Age socio-economic networks that subsequently evolved in the region. With their cosmopolitanism, as peoples who travelled beyond the known world, coming into contact with numerous ethnic groups and cultures, they may have helped bridge highly diverse social formations in the Arabian Sea. It may be expected that understanding of their activities, and of other key processes and peoples in the Arabian peninsula and surrounding seas, will be assisted in future years by further theoretical and methodological developments in the archaeology of Arabia and surrounding regions, as well as contributions from other disciplines like molecular genetics, historical linguistics and palaeoenvironmental studies.

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