Climate Change and Cultural Dynamics: A Global Perspective on Mid-Holocene Transitions
David G. Anderson, Kirk A. Maasch and Daniel H. Sandweiss (Editors)

Chapter 7

Influence of Holocene marine transgression and climate change on cultural evolution in southern Mesopotamia☆

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Abstract

The evolution of the earliest complex state-level societies and cities, from small sedentary communities, took place in southern Mesopotamia between 8000 and 5000 cal yr BP during the 'Ubaid and Uruk Periods. Attempts to explain this transition often discount the role of environmental change and evaluate available archaeological evidence for urban-based state development either within a static environmental context or under conditions similar to those of the present. This is no longer tenable given newly available paleoenvironmental records for the region. Postglacial sea-level rise resulted in the inundation and creation of the Arabo-Persian Gulf and rich coastal and aquatic habitats formed in southern Mesopotamia as the marine transgression slowed in the Middle Holocene. These habitats favored the establishment and growth of 'Ubaid Period communities and the efficient transport of goods, ideas, and people throughout the region. High water tables also promoted early experimentation with irrigation agriculture and the expansion of these systems as populations grew and the humid conditions of the Early Holocene gave way to increasing aridity. We argue that the critical confluence of eustatic and climatic changes unique to this circumscribed region favored the emergence of highly centralized, urban-based states.

1. Introduction

Southern Mesopotamia was the site of the earliest large, highly integrated political systems marked by administrative hierarchies and rulers with significant power and authority – so called state-level societies (Rothman, 2001, 2004). As states developed in this region, people became differentiated socially, more specialized economically, and highly integrated and centralized politically (Flannery, 1972). This process resulted in greater interdependence and cooperation between members of society, but it

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also required a majority of people to relinquish autonomy and allow others to have greater economic, social, and political benefits. How and why this occurred in this region first, and later in several other locations around the world during the Middle and Late Holocene, remains a central question in anthropological archaeology (e.g., Postgate, 1992; Blanton et al., 1993; Flannery, 1998; Marcus and Feinman, 1998; Stein, 1998, 2001; Pollock, 1999; Adams, 2000a; Feinman, 2000; Feinman and Manzanilla, 2000; Algaze, 2001a; Rothman, 2004; Yoffee, 2005).

Although there is some evidence for occupation earlier (see below), the first traces of permanent human settlement in southern Mesopotamia occurred in the beginning of the 'Ubaid Period at ~8000 cal yr BP. Between 8000 and 5500 cal yr BP human populations increased and aggregated into small towns and nucleated villages. These communities ultimately provided the foundation for integrated state-level societies and urban centers between 5500 and 5000 cal yr BP, with an associated complex of technological innovations including large-scale irrigation agriculture and writing. A number of theories have been proposed for the earliest known state-level societies including: (1) technological and agricultural innovation (Adams, 1981, 2000b); (2) bureaucratic development necessary to build, maintain, and manage large-scale irrigation necessary for agriculture (Wittfogel, 1957, 1981); (3) information processing and the development of centralization and political hierarchies (Wright and Johnson, 1975, 1985; Wright, 1977, 1994, 1998, 2001); (4) increasing warfare in an environmentally and socially circumscribed area (Carneiro, 1988); (5) increasing intra- and interregional exchange, colonialism, and cross-cultural contact (Wright and Johnson, 1975; Algaze, 1993, 2001b); and (6) religious ideology and the control or mobilization of labor (Hole, 1983). Proponents of multicausal models suggest that state development resulted from several interrelated factors, including characteristics of the regional environment (Flannery, 1972; Redman, 1978; Adams, 1981; Crawford, 1991; Hole, 1994; Stein, 1994, 2001; Rothman, 1994, 2004; Kouchoukos, 1999; Algaze, 2001a; Pournelle, 2003; Wilkinson, 2003). Others have suggested that state formation emerged as a result of intrinsic human social interrelations independent of environmental factors (Pollock, 1992).

The processes leading to the emergence of state-level societies in southern Mesopotamia were multivariate, but we argue that these developments should be considered within the context of environmental change (Fairbanks, 1989; Sanlaville, 1989; Eisenhauer et al., 1992; Petit-Maire, 1992; Sirocko et al., 1993; Teller et al., 2000; Aqrawi, 2001). Changes in environmental conditions are often thought to have played a major role in cultural demise (Weiss et al., 1993; Hodell et al., 1995; Issar, 1995; Weiss, 1997). In contrast, the potential importance of climate and related environmental change is less accepted as a critical variable in the development of cultural complexity, but has recently received increased attention (Hole, 1994; Spier, 1996; Sandweiss et al., 1999; Kennett and Kennett, 2000). Except for Hole (1994; also see Nützel, 2004), however, there has been limited consideration of the potential role of environmental change in the evolution of the state in southern Mesopotamia, where the environment has been incorrectly characterized by some archaeologists as stable during the Holocene (Pollock, 1992). Evaluation of the available paleoenvironmental data demonstrates distinct correlations between the timing of Holocene environmental and cultural changes. These correlations, by themselves, do not prove causality but must be considered when evaluating the timing and nature of emergent cultural complexity in this region.

We propose that this development was stimulated, in part, by increased competition for resources caused by successive changes in sea level, shorelines, and climate specific to this region. In particular, the expansion, and ultimate stabilization of aquatic habitats associated with the marine transgression and more productive compared with today, favored increased population densities and early group formation, community stability, enhanced maritime trade, and the emergence of social hierarchies. The natural diversity of resources in coastal/aquatic habitats, in combination with newly domesticated plants and animals, provided the economic foundation for these developing communities, as they did elsewhere during the Early and Middle Holocene (Binford, 1968; Moseley, 1975; Clark and Blake, 1994). In this contribution we describe these changes within the context of cultural development and discuss the possible implications of these interrelationships.

2. Postglacial environmental change in southern Mesopotamia

Southern Mesopotamia lies in present-day southern Iraq at the head of the Arabo-Persian Gulf. Modern climatic conditions are arid to semiarid with a mean annual rainfall of 139 mm (ranging from 72 to 316 mm; Adams, 1965). Severe dust storms occur during the summer months due to semipermanent low-pressure zones over the Gulf that draw hot, dry winds across the alluvial plain. Because of extreme aridity, agriculture is largely limited to the floodplains of the Tigris–Euphrates–Karun Rivers that converge in an extensive wetland region associated with the El Schatt Delta.

The Arabo-Persian Gulf is roughly 1000 km long and ranges from 350 km to as little as 5 km wide at the Straits of Hormoz, where it joins the Gulf of Oman in the northern Indian Ocean. This is the shallowest inland sea of significant area in the world, the bathymetry reflecting a gently inclined basin with a mean depth of only 40 m and almost nowhere exceeding 100 m except near the Straits of Hormoz (Fig. 7.1c) (Seibold and Vollbrecht, 1969; Sarnthein, 1971; Purser and Seibold, 1973). Late Quaternary changes in sea level played a major role in shaping the environment of this region (Gunatilaka, 1986; Cooke, 1987; Sanlaville, 1989; Teller et al., 2000). Although southern Mesopotamia is located on a subsiding sedimentary basin (Lees and Falcon, 1952), tectonic influences on eustacy, including subsidence, are considered to have been relatively minor compared with glacioeustatic effects during the last 15,000 yr (Macfadyen and Vita-Finzi, 1978; Gunatilaka, 1986; Cooke, 1987; Sanlaville, 1989; Lambeck, 1996; Aqrawi, 2001). This differs from an earlier, widely accepted view that the balance between

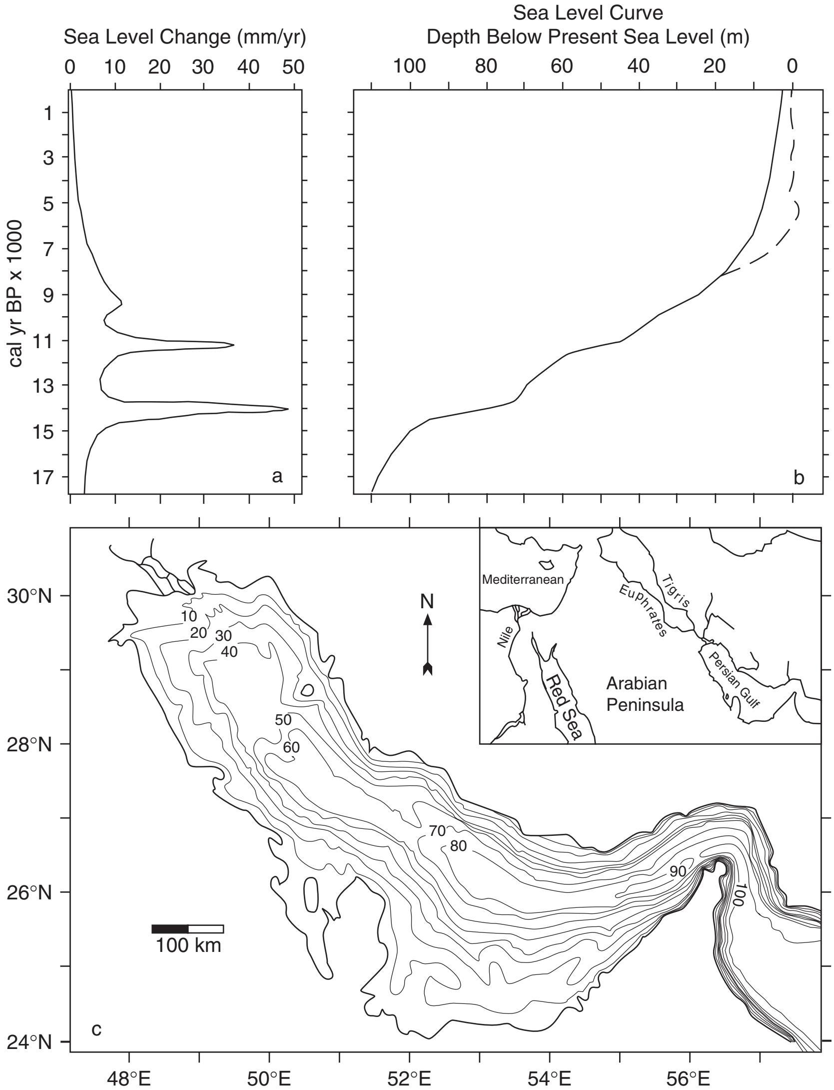

Figure 7.1. (a and b) Sea-level change during the last 18,000 yr (Lighty et al., 1982; Fairbanks, 1989; Sanlaville, 1989; Yafeng et al., 1993). Solid line in (b) shows well-established sea-level curve based on Caribbean corals (Lighty et al., 1982; Fairbanks, 1989); dashed line is local sea-level curve estimated for northern Arabo-Persian Gulf (Sanlaville, 1989; Yafeng et al., 1993). All radiocarbon dates have been calibrated to calendar years (cal yr BP). (c) Modern bathymetry of the Arabo-Persian Gulf (adapted from Sarnthein, 1972).

sedimentation and subsidence rates in southern Mesopotamia maintained the Gulf shoreline and delta close to their present-day positions throughout the Holocene and that inland incursions of the ocean resulted from subsidence (Lees and Falcon, 1952).

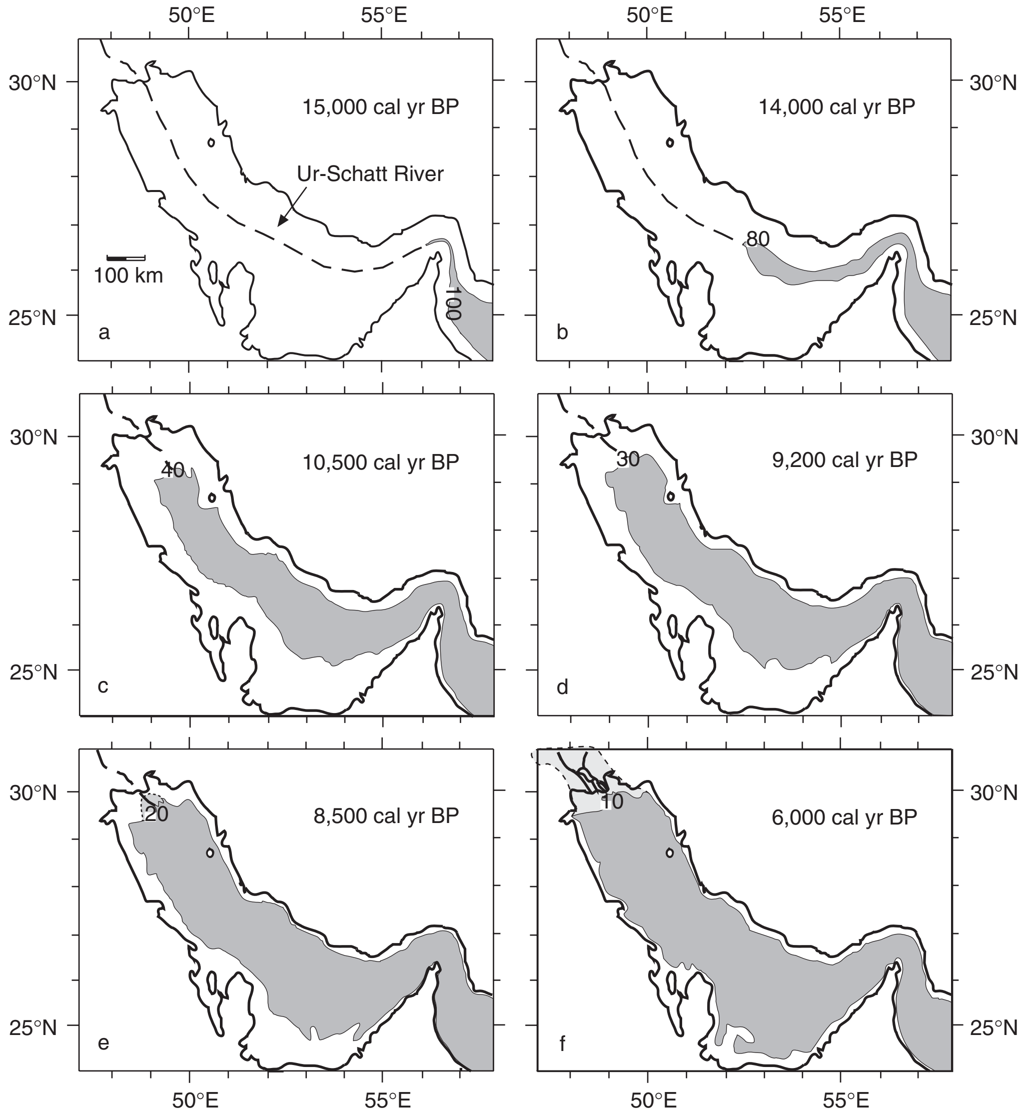

Figure 7.2. Maps of successive time intervals showing the marine transgression into the Arabo-Persian Gulf during Late Pleistocene to Early/Middle Holocene. Sea-level estimates from (Fairbanks, 1989) and based on modern bathymetry (Sarnthein, 1972). Position of the Ur–Schatt River (ancient Schatt River) estimated from bathymetry (Sarnthein, 1972). Marine transgression in southern Mesopotamia at 6000 cal yr BP (F) adapted from (Sanlaville, 1989) and shown in detail in Fig. 7.4.

Environmental conditions during the latest Pleistocene through Middle Holocene were different from those of today in southern Mesopotamia and the Gulf region. About 15,000 cal yr BP, global sea level was still 100 m below present (Fig. 7.1a, b; Fairbanks, 1989). Owing to the shallowness of the Arabo-Persian Gulf, Late Quaternary marine transgression associated with deglaciation was only beginning to enter this dry, subaerial, basin through the Straits of Hormoz (Fig. 7.2a; Vita-Finzi, 1978; Lambeck, 1996). Calcareous detritus in pericoastal dunes in the United Arab Emirates was wind-transported from the exposed Gulf floor during the Late Pleistocene (100,000 to 12,000 cal yr BP; Teller et al., 2000). At this time the Tigris–Euphrates–Karun River system flowed into the Gulf of Oman as the Ur–Schatt (ancient Schatt) River (Seibold and Vollbrecht, 1969; Gunatilaka, 1986) that traversed the full length of the Gulf in its deepest present-day sector. The Ur–Schatt River flowed in an incised canyon, now completely submerged, but still evident in the present-day bathymetry of the middle to lower Gulf (Seibold and Vollbrecht, 1969; Sarnthein, 1971). This canyon was formed by

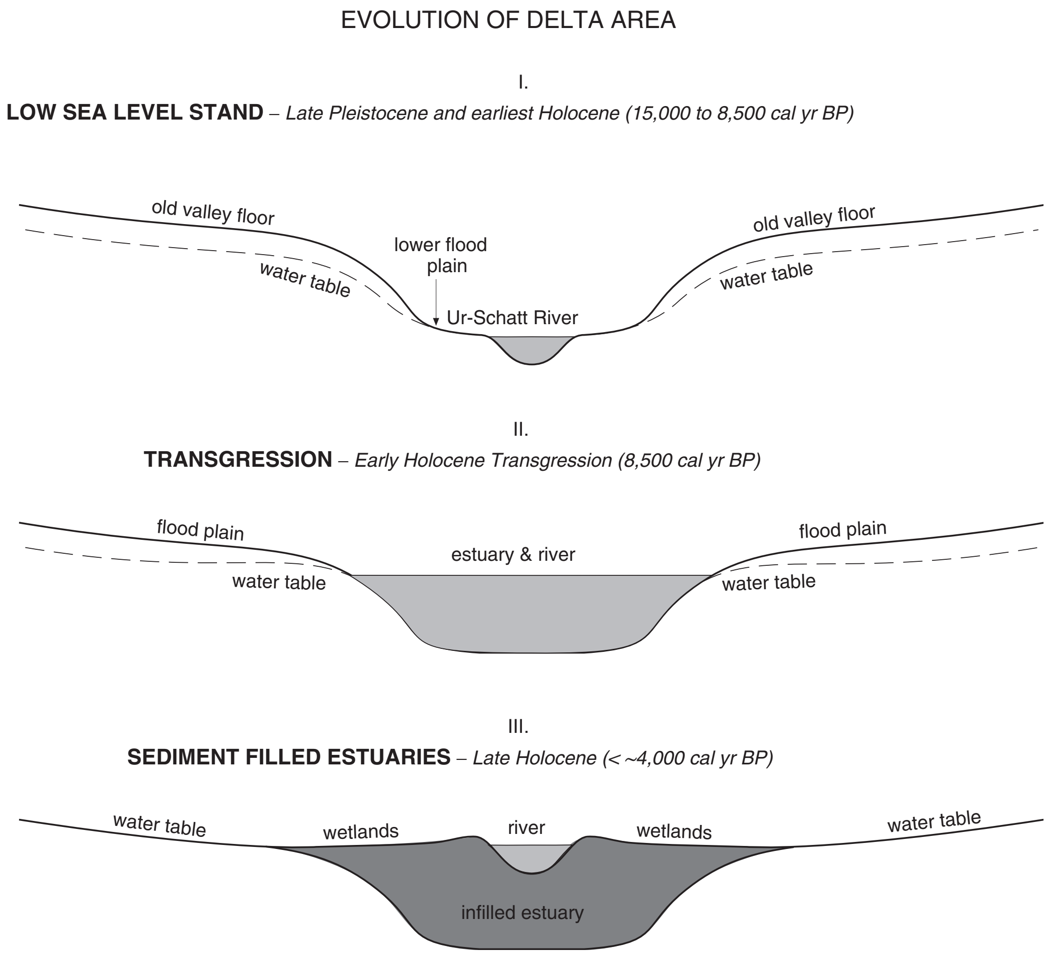

Figure 7.3. Schematic cross sections showing inferred three stages in evolution of the delta region of southern Mesopotamia during the latest Quaternary.

downcutting during low sea levels of the last glaciation. A deep sea canyon extending southwards from the head of the Gulf of Oman (Seibold and Ulrich, 1970) was almost certainly cut by turbidity currents carrying sediments southwards from the head of the Gulf of Oman. Large volumes of sediments appear to have been transported to the Gulf of Oman by the Ur–Schatt River during Quaternary low sea-level stands, implying substantial river flow. At this time, the modern delta did not exist in southern Mesopotamia (Fig. 7.3) and narrow floodplains were restricted to the incised river canyons. Severe aridity at this time is indicated by the presence of drowned ridge and trough features in the northern Arabo-Persian Gulf, interpreted as fossil sand-dune fields (Sarnthein, 1971), in combination with sedimentological (Sarnthein, 1972; Diester-Haass, 1973) and oxygen isotopic data (Sirocko et al., 1993).

Following 15,000 cal yr BP, marine transgression formed the Arabo-Persian Gulf (Fig. 7.2b–f). Sea-level rise during this interval was highly variable, but averaged ~1 cm/yr until ~9000 cal yr BP (Fig. 7.1a), after which the rate of rise slowed (Lighty et al., 1982; Fairbanks, 1989; Warne and Stanley, 1993). The pattern of global sea-level change after 9000 cal yr BP has yet to be firmly established. Sea-level curves from the western Atlantic (Lighty et al., 1982) and southeastern

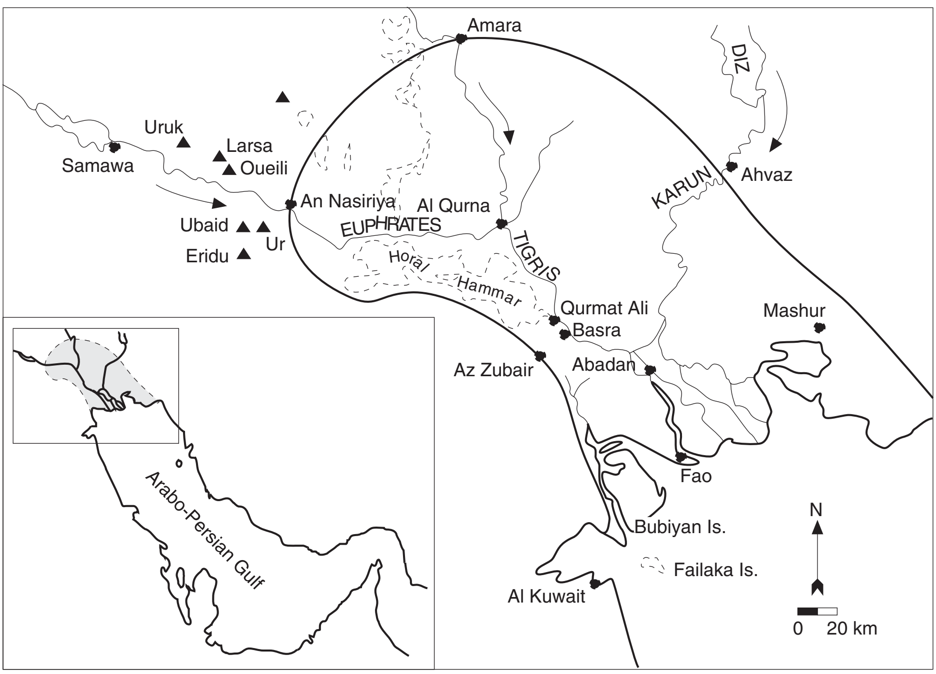

Figure 7.4. Estimated shoreline at 6000 cal yr BP in southern Mesopotamia superimposed on present-day geography. Triangles show locations of early settlements and dots indicate modern cities (adapted from Sanlaville, 1989).

Mediterranean (Warne and Stanley, 1993) show a slow rise with a steadily decreasing rate (average ~0.3 cm/yr) from 7000 cal yr BP to the present (Fig. 7.1b). In these curves, rates of rise are especially slow after 5500 cal yr BP. This pattern compares with sea-level rise estimates based on western Australian evidence of ~0.7 cm/yr from 9800 cal yr BP to a maximum high stand at 6300 cal yr BP, followed by a slight decrease in sea level inferred to be associated with a cessation of polar ice sheet melting (Eisenhauer et al., 1992). In spite of these differences, it is clear that the rate of global sea-level rise decreased significantly between 6300 and 5500 cal yr BP. Rapid rise in sea level during the Early Holocene (Siddall et al., 2003) of ~1 cm/yr created a lateral marine transgression in the Arabo-Persian Gulf of ~110 m/yr, one of the highest rates known for any region. The early stages of this transgression (~15,000 and 11,000 cal yr BP) mainly filled the deeply incised canyon of the Ur–Schatt River in its lower to middle reaches. The transgression later inundated the broader, shallower Gulf region (Fig. 7.4). Most notable rapid rises in sea level in the Arabo-Persian Gulf occurred between 12,000 and 11,500 cal yr BP and again from 9500 to 8500 cal yr BP and during these periods the lateral transgression probably exceeded 1 km/yr (Teller et al., 2000, p. 306).[1]

Inundation of the Arabo-Persian Gulf coincided with an interval of increased seasonal rainfall across the Arabian Peninsula and southern Mesopotamia between ~10,000 and 6,000 cal yr BP. This interpretation is based on a variety of indicators including sedimentological evidence for increased river runoff into the Arabo-Persian Gulf (Diester-Haass, 1973), speleothem records from Israel and Oman (Bar-Matthews et al., 1997; Burns et al., 1998, 2001), pollen evidence for more widespread, less arid vegetation, and the presence of interdune lakes and on the Arabian Peninsula

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[1] This manuscript was initially prepared in response to a talk given by Walter Pitman linking biblical flood mythology to the rapid inundation of the Black Sea during the Holocene, an idea he later published in a book entitled "Noah's Flood: The New Scientific Discoveries About the Event That Changed History" (Ryan and Pitman, 1998). Although it is inherently difficult to link past cultural and environmental developments with mythology, we instead argue based on the environmental and cultural history of southern Mesopotamia that the Sumerian flood myth (as recorded in the Gilgamesh Epic) and the succeeding biblical flood narrative, most likely have their origins in the glacioeustatic latest Quaternary transgression in the Arabo-Persian Gulf; the largest, shallowest inland sea contiguous with the ocean. Flood mythology among maritime societies is virtually universal (http://www.talkorigins.org/faqs/flood-myths.html) and most likely linked to eustatic rises in sea level during the Late Pleistocene and Early Holocene. As Teller et al. (2000) point out, a rapid marine transgression occurred in the Arabo-Persian Gulf during this time and likely displaced people living along this waterway. Such momentous events were surely passed down orally for generations. What makes southern Mesopotamia unique from other parts of the world is that writing developed early, associated with the formation of state-level societies, and this story was ultimately recorded as in the well-known Epic of Gilgamesh. Given Occam's razor, we hypothesize, as do Teller et al. (2000; also see Potts, 1996), that the origins of Biblical flood mythology is most likely in southern Mesopotamia rather than in the vicinity of the Black Sea.

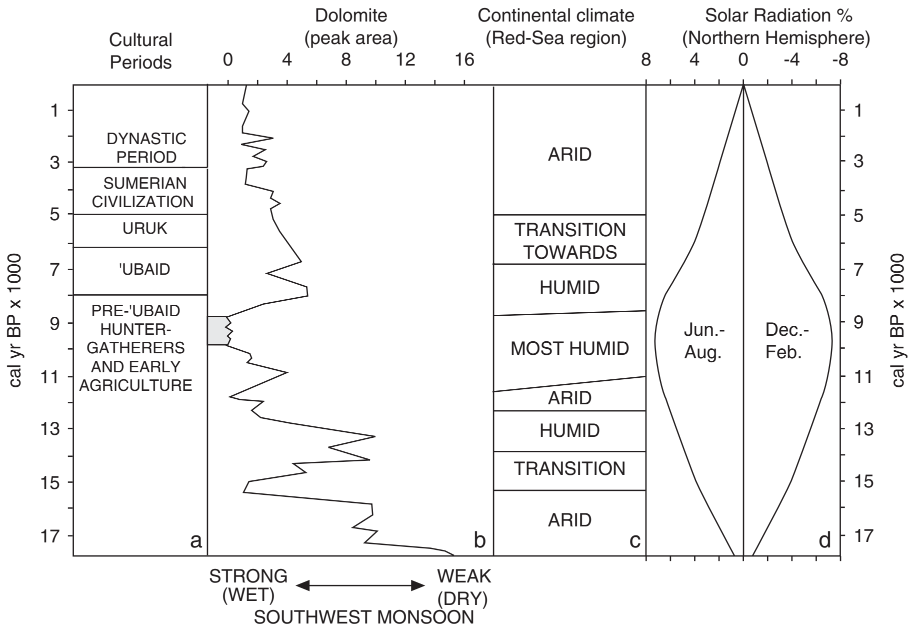

Figure 7.5. Correlations between Late Quaternary climatic changes (1000 cal yr BP = ka; Almogi-Labin et al., 1991; Sirocko et al., 1993) and major cultural periods (a) in southern Mesopotamia (Adams and Nissen, 1972; Wright, H. T. and Rupley, 2001; Rothman, 2004; also see Endnote 2). Fluctuations in dolomite abundance (peak area) values during Late Quaternary in a sediment core from Arabian Gulf (b) reflect changes in aridity in Arabia–southern Mesopotamia region (Sirocko et al., 1993). The gray band on the dolomite curve represents interval of highest humidity. Shown at right (d) is the percent change in solar radiation in the Northern Hemisphere summer (June–August) and winter (December–February) during the last 18,000 yr, resulting from the earth's orbital perturbations (Kutzbach and Gallimore, 1988; Kutzbach and Guetter, 1986). This caused summers to be warmer and winters colder in Arabia and southern Mesopotamia, with seasonal differences and inferred strength of summer monsoons peaking at ~9–10,000 cal yr BP. Note relations with humid–arid cycles in the Red Sea region (c) representing a synthesis of changes in lake levels, vegetation history, and sediment data (Almogi-Labin et al., 1991).

(McClure, 1976; Street-Perrott and Roberts, 1983; Rossignol-Strick, 1987; Roberts and Wright, 1993; Lézine et al., 1998) and southern Mesopotamia (Wright, 1993; Yan and Petit-Maire, 1994) between 9000 and 6000 cal yr BP. Moister conditions are also inferred from an extensive network of ephemeral channels (wadis) over the Arabian Peninsula that run into the Arabo-Persian Gulf and Arabian Sea (Höltz et al., 1984; Dabbagh et al., 1998) and appear to have been more active during the Late Pleistocene and Early Holocene (Wilkinson, 2003). Increased rainfall in this region between ~10,000 and 8,600 cal yr BP is also inferred from an absence of dolomite at this time in a sediment core from the Gulf of Oman (Sirocko et al., 1993) (Fig. 7.5b). Under arid conditions dolomite is formed in coastal, supra-tidal evaporitic environments (sabkas) in the Gulf region and wind-transported to the Gulf of Oman.

Overall, Early Holocene climatic conditions in Arabia were semiarid (~250–300 mm annual rainfall) compared with the aridity of today (50–100 mm) (Whitney et al., 1983).

Paleoceanographic and terrestrial climatic records in the Red Sea region indicate relatively humid conditions between ~12,000 and 6,000 cal yr BP (Almogi-Labin et al., 1991), with the wettest interval occurring between ~10,000 and 7,800 cal yr BP (Haynes et al., 1989; Street-Perrott and Perrott, 1990; Fig. 7.5c). Significant regional increase in rainfall between 11,700 and 5,400 cal yr BP has also been inferred from a decrease in oxygen isotopic values in planktonic foraminifera and pteropods in a Red Sea core (21°N), interpreted to reflect decreased surface water salinities (Rossignol-Strick, 1987). Continental freshwater runoff at this time was sufficiently large to decrease surface water salinities in the Red Sea relative to present-day values. Inferred low salinities peaked between ~8500 and 6700 cal yr BP, then increased to 5400 cal yr BP when average postglacial values were reached (Rossignol-Strick, 1987). Wet (humid) conditions between 9200 and 7250 cal yr BP in this region are confirmed based on increases in terrigenous sediment input and decreased surface water salinities as reflected by oxygen isotopes in foraminifera species in sediment cores from the northernmost Red Sea (Arz et al., 2003; see Fig. 7.6). These data are consistent with pollen records and evidence for high lake levels indicating Early Holocene (10,000–5,500 cal yr BP) increases in precipitation and a pluvial maximum (~10,000–7,000 cal yr BP) in the Levant (Issar, 2003) and throughout sub-Saharan Africa (Kutzbach and Street-Perrot, 1985; Ritchie et al., 1985; Street-Perrott et al., 1985; Petit-Maire, 1986, 1990, 1992; Haynes and Mead, 1987; Pachur and Kröpelin, 1987, 1989; COHMAP, 1988; Haynes et al., 1989; Gasse et al., 1990, 1991; Street-Perrott and Perrott, 1990; Ambrose and Sikes, 1991), coinciding with the so-called hypsithermal climatic interval (Lamb, 1977; Kutzbach and Street-Perrot, 1985; Petit-Maire, 1986; COHMAP, 1988; Gasse et al., 1991). Pollen (Rossignol-Strick, 1987; Roberts and Wright, 1993;Lézine et al., 2002), lake level (McClure, 1976), and marine sediment (Diester-Haass, 1973; Sirocko et al., 1993) data indicate that humid conditions persisted until ~6000 cal yr BP, although a gradual decrease in humidity had begun after ~8000 cal yr BP (Vita-Finzi, 1978, Ritchie et al., 1985). Analysis of paleoclimatic data suggests that Southwest Indian monsoon strength for the broader Asia–East African region was greatest between 11,000 and 5,000 cal yr BP (Overpeck et al., 1996), but in the Middle East, maximum activity seems to have occurred between 9000 and 7000 cal yr BP (Yan and Petit-Maire, 1994; Bar-Matthews et al., 1997; Lézine et al., 1998).

The marine transgression reached the present-day northern Gulf area between 9000 and 8000 cal yr BP (Gunatilaka, 1986; Lambeck, 1996; Aqrawi, 2001), inundating the entrenched Ur–Schatt River valley and forming an extensive marine estuary in the location of the present delta area. The modern delta has since filled the estuary (Cooke, 1987; Aqrawi, 2001). Movement of the coastline associated with the marine transgression was so rapid that sedimentation would have been minimal in the newly developing, open estuary and no delta would have formed

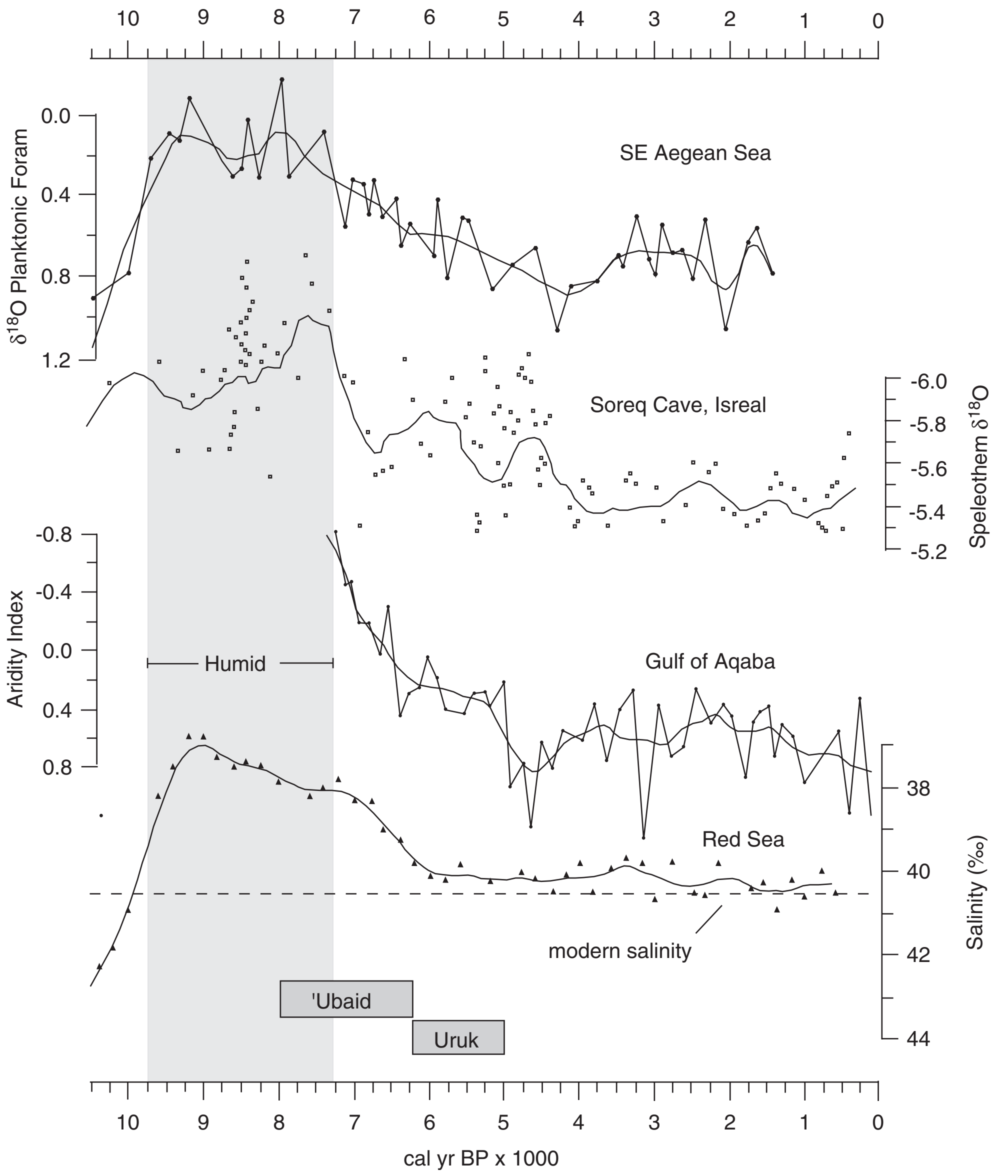

Figure 7.6. Comparison of four climate records from the eastern Mediterranean/Red Sea regions showing Early Holocene humidity and the onset of regional drying after ~7000 cal yr BP (adapted from Arz et al., 2003). Major cultural periods shown at the bottom of the figure.

(Cooke, 1987). From ~9000 cal yr BP onwards, and particularly after ~6000–5500 cal yr BP, sea-level rise slowed globally (Fig. 7.1a,b; Lighty et al., 1982; Fairbanks, 1989) or possibly reached a Holocene maximum at ~6000 cal yr BP (Eisenhauer et al., 1992; Yafeng et al., 1993). In the northern Arabo-Persian Gulf, sea level reached its current elevation at 6000 cal yr BP, was possibly 2.5 m higher between 6000 and 5000 cal yr BP or longer (Lambeck, 1996), and thereafter was relatively stable close to present-day levels (Al-Asfour, 1978; Sanlaville, 1989). Sediments from boreholes in the Tigris–Euphrates Delta indicate marine-brackish conditions in the vicinity of Fao at ~9000 cal yr BP, near Basra at 8000 cal yr BP, and as far north as Nisiriyya by 6000 cal yr BP (Aqrawi, 2001, p. 275). By ~6000 cal yr BP estuaries had expanded to their northernmost limits. Marine deposits of 7000 cal yr BP age have been reported inland (80–100 km) at Lake Hammar and estuarine deposits of this age are also known in cores 40 km farther to the northwest (Hudson et al., 1957; Sanlaville, 1989). The northernmost known extent of estuarine sediments in boreholes of Holocene age is 400 km inland from the present head of the Gulf (Cooke, 1987). Estuarine sediments from bore holes containing foraminifera, marine mollusks, and other marine fossils, reflect brackish to marine conditions during the Middle Holocene near the ancient city of Ur on the Euphrates (Sanlaville, 1989; Aqrawi, 2001) and at Amarah on the Tigris (Macfadyen and Vita-Finzi, 1978; Aqrawi, 2001). Estuaries probably extended even farther northwards following the Tigris–Euphrates–Karun River canyons and formed a variety of productive wetland habitats throughout this region (Pournelle, 2003). Extensive floodplains and associated high water tables would have formed during the Middle Holocene with deceleration of sea-level rise as it began to approach present levels, with the consequent development of a complex mosaic of aquatic habitats (estuaries, rivers, wetlands, and marshes).[2]

By the Middle Holocene, regional climatic conditions had become more arid. This change is indicated by a diversity of evidence including an abrupt increase in aeolian sediment and dune formation on the southern periphery of the Arabo-Persian Gulf at 6000 BP (United Arab Emirates; Bray and Stokes, 2004). Evidence from the Red Sea region indicates a marked trend towards increasing aridity between 7000 and 5000 cal yr BP (Almogi-Labin et al., 1991; Arz et al., 2003). Pronounced regional desiccation by 5000 cal yr BP dried up lakes in the region encompassing Arabia, the Red Sea, and sub-Saharan Africa (McClure, 1976; Ritchie et al., 1985; Pachur and Kröpelin, 1989; Almogi-Labin et al., 1991; Roberts and Wright, 1993; Sukumar et al., 1993). Developing aridity also led to increased dust transport evident in the Arabian Sea after 5300 cal yr BP (Sirocko et al., 1993). In sub-Saharan Africa, lake level and pollen records also indicate that regional desiccation became widespread between 6000 and 5000 cal yr BP (Ritchie et al., 1985; Roberts, 1989; deMenocal et al., 2000).

Major deceleration of sea-level rise after the Middle Holocene led to sediment infilling of the estuary, accelerated by erosion (Melguen, 1973; Cooke, 1987).

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[2] These habitats were highly productive and not comparable to the infilled wetlands of lower productivity inhabited historically by "Marsh Arabs" (Ochsenschlager, 2004). We argue that this lifeway has been used incorrectly as ethnographically analogous to early human populations at the head of the Gulf.

Southeastward progradation of the Mesopotamian Delta commenced, eventually extending ~200 km to the southeast. This led to the development of extensive wetland areas (Larsen and Evans, 1978; Sanlaville, 1989). The trend towards increasing aridity in the broad region continued through the Late Holocene. Aeolian deposits within deltaic sediments were most pronounced in southern Mesopotamia between 5000 and 4000 cal yr BP and point to severe aridity during this interval (Aqrawi, 1993, 1995, 2001). Archaeological evidence for the abandonment of settlements also suggests that southern Mesopotamia became extremely arid during the Late Holocene (Wright, 1981; Nissen, 1988; Weiss et al., 1993). Flood levels in the Nile also declined between 5000 and 4000 cal yr BP (Roberts, 1989) and central African rift lakes desiccated completely between 3400 and 3000 cal yr BP (Ambrose and Sikes, 1991).

The changes in Holocene precipitation and associated shifts of the Sudanian–Sahelian vegetation belt over north Africa (Roberts, 1989), the Arabian Peninsula, and southern Mesopotamia have been linked to changing intensification of summer monsoons related to northward shift of the Intertropical Convergence Zone and the influence of a more moist westerly airstream affecting the Mediterranean region (Kutzbach, 1983; Street-Perrott and Roberts, 1983; Kutzbach and Guetter, 1986; COHMAP, 1988; Roberts and Wright, 1993; Clemens et al., 1996). Holocene fluctuations in the strength of the South Asian monsoon in the Middle East region resulted from differential thermal response of land and ocean surfaces due to orbitally caused (Milankovitch) changes in the strength of the seasonal cycle and solar radiation in the Northern Hemisphere (Kutzbach and Guetter, 1986; Kutzbach and Gallimore, 1988; Clemens et al., 1996). At 9000 cal yr BP, orbital perturbations of the earth were such that the perihelion occurred in July rather than January, as it is today, and the axial tilt of the earth was greater than it is now. As a result, July (summer) average solar radiation in the Northern Hemisphere was ~7% higher than that of today (Kutzbach and Guetter, 1986; Kutzbach and Gallimore, 1988). This caused summers to be warmer and winters colder in Arabia and southern Mesopotamia, with seasonal differences peaking at ~9,000–10,000 cal yr BP. Resulting increase in airflow over Arabia from the Indian Ocean, associated with southwest summer monsoon, led to higher seasonal precipitation (Kutzbach and Guetter, 1986) and upwelling near south Arabia that peaked about 9000 cal yr BP (Prell, 1984). Northern summer monsoons were stronger between 12,000 and 6,000 cal yr BP in conjunction with increased summer radiation (COHMAP, 1988). Associated increased summer monsoon precipitation over tropical lands were ~10–20% (Kutzbach and Guetter, 1986). The broad arid–humid–arid cycle of the Middle East region during the last 18,000 yr, including southern Mesopotamian (Roberts and Wright, 1993), was largely controlled by this change in the seasonal cycle. Increased monsoonal strength during the Early Holocene led to the higher annual precipitation as far north as southern Mesopotamia (Whitney et al., 1983; Kutzbach and Guetter, 1986; Kutzbach and Gallimore, 1988; Roberts and Wright, 1993). Conditions further north remained relatively dry (Kutzbach and Guetter, 1986; Roberts and Wright, 1993). After

~5500 cal yr BP, weakening of the monsoons led to increasing aridity over the Arabian Peninsula (Sirocko et al., 1993).

3. State development in southern Mesopotamia

States with well-developed urban centers and administrative hierarchies first appeared in southern Mesopotamia about 5000 cal yr BP (Late Uruk or LC5; Johnson, 1973; Wright and Johnson, 1975; Adams, 1981; Nissen, 1988, 2001; Postgate, 1992; Pollock, 1999; Rothman, 2004; Yoffee, 2005; Fig. 7.5a). The people of southern Mesopotamia were on the leading edge of what Childe (1950) referred to as the second great revolution – the integration of large numbers of people into one social, economic, and political system ruled by an elite class with the help of an elaborate administrative hierarchy. Archaic states spread quickly in the Near East after this time and developed independently in other parts of the world, including Mesoamerica, South America, and China (Feinman and Marcus, 1998). The development of social differentiation, economic specialization, and ultimately political centralization culminating in the emergence of state-level societies is a central archaeological research question addressed from a variety of perspectives (Flannery, 1972; Blanton et al., 1993; Feinman and Marcus, 1998; Pollock, 1999). Southern Mesopotamia has played an important role in modeling state origins and emergence of centralized administrative hierarchies because of the long tradition of research in the region (Rothman, 2004; Yoffee, 2005).

Origins of the first city dwellers in southern Mesopotamia have long been debated and are crucial for understanding the social, economic, and political processes culminating in the state (see Meissner, 1920; Speiser, 1930; Frankfort, 1956; Kramer, 1963; Oates, 1991; Potts, 1997; Bottéro, 2001). Similarities in architecture and ceramic styles in southern Mesopotamia from the Early 'Ubaid through Late Uruk Periods (~8000 to 5000 cal yr BP) suggest a certain degree of demographic and cultural continuity, rather than the intrusion of outside peoples, prior to the emergence of the state (Oates, 1960). Population continuity is also indicated by a series of superimposed temples at the site of Eridu through this interval (Oates, 1960; Potts, 1997, p. 47). This was the period when some small villages grew in size relative to neighboring settlements and ultimately became the first state centers in which social and political hierarchies developed.

The settlement history of people in southern Mesopotamia prior to 8000 cal yr BP is far from clear. A transition from mobile hunting and gathering to sedentary agriculture is evident in west Asia between 12,000 and 8,000 cal yr BP (Flannery, 1969; Bar-Yosef and Belfer-Cohen, 1989; Henry, 1989; McCorriston and Hole, 1991; Bar-Yosef and Meadow, 1995; Harris, 1996, 1998; Meadow, 1996; Garrard, 1999; Zeder and Hesse, 2000). This was a time of early development of agriculture and animal domestication (Smith, 1998), emergence of small villages, some of which were fortified, and pottery manufacturing in various locations (Redman, 1978). Early agricultural villages in northern Mesopotamia (e.g., Tell es-Sawwan) were generally limited in size to a few hundred people engaged in simple agriculture and animal domestication (Moore, 1985). We suspect that at this time people were living along the Ur–Schatt and associated floodplains, a natural corridor connecting northern Mesopotamia with the interior shallow basin known today as the Arabo-Persian Gulf. This basin was then undergoing rapid marine transgression and stories resulting from this inundation may be the source of biblical flood mythology (Potts, 1996; Teller et al., 2000). Evidence for any settlements along the Ur–Schatt River has since been obscured by flooding and/or covered by sediments.

Some archaeological evidence exists for a pre-‘Ubaid occupation along the northeast coast of the Arabo-Persian Gulf. Furthermore, Neolithic stone tool assemblages (Arabian bifacial tradition; Potts, 1997, p. 52) dating to between 9600 and 5500 cal yr BP are also common near now desiccated inland lakes across the Arabian Peninsula (Zarins et al., 1981; Edens, 1982; Uerpmann, 1992; Potts, 1993, 1997; Edens and Wilkinson, 1998) and at several locations along the western edge of the Arabo-Persian Gulf by at least 7300 cal yr BP (Glover, 1998; Beech et al., 2005; Connan et al., 2005). Visible architecture is rarely encountered at Arabian Neolithic sites, with the exception of small stone structures reported at several coastal locations (e.g., Kuwait, Connan et al., 2005; Qatar, Inizan, 1988, Marawah Island, United Arab Emirates; Beech et al., 2005). Artifact and faunal/floral assemblages from these sites suggest that people combined sheep and goat herding with small game hunting, the collection of local grasses, and even periodic cereal crop farming (Potts, 1993, 1997). This was combined with fishing, shellfishing and other marine resources (e.g., sea turtles; Beach et al., 2005) at several sites along the Arabo-Persian Gulf (Glover, 1998; Connan et al., 2005). These data indicate a mixed foraging and food producing strategy comparable to what Smith (2001) has described as low-level food production. Stone tool assemblages dating to ~8000 cal yr BP are also known from wadi systems in western Iraq that flow into the Euphrates River (Zarins, 1990). Similar stone tool assemblages, although poorly described, are documented in southern Mesopotamia (Potts, 1997, p. 53; Zarins, 1992) where they were found at Ur (Woolley, 1955), near Eridu (Potts, 1997), and at Tell Oueli and Tello (Cauvin, 1979; Inizan and Tixier, 1983). Preceramic sites on the eastern fringe of southern Mesopotamia (Tell Rihan III in the Hamrin and Choga Banut in Kuzistan) dating to ~8500 cal yr BP also suggest linkages between people living in the Zagros and the southern alluvium (Aurenche, 1987). Overall, the archaeological record for this period suggests that significant populations lived across the desert regions of Arabia and Mesopotamia, practicing a diverse range of subsistence strategies tied to a variety of aquatic habitats (e.g., lakes, springs, creeks, rivers) resulting from the northward shift of the south Asian monsoon belt during the Early to Middle Holocene.

The presence of stone tools comparable to the southern Arabian biface tradition is consistent with the idea of a pre-Ubaid occupation earlier than 8000 cal yr BP in southern Mesopotamia (see Oates, 1960, 2004). Exploration for pre-Ubaid sites is impeded by thick alluvial sediments deposited since the near stabilization of sea level at ~6200 cal yr BP and a water table that is higher than when sites of this age were occupied. Even early 'Ubaid sites in the region (e.g., Hajji Muhammad) are deeply buried under alluvium (Huot, 1989), so it is likely that sites of this age are more numerous. Several sites are now known to have slightly earlier ceramics comparable in form to Samarran and Choga Mami assemblages from central and northern Mesopotamia (WS 298, Adams and Nissen, 1972; Tell Oueli, Calvet, 1989; Huot, 1989; see Potts, 1997). Tell Oueli is the most impressive of these sites with early levels, now designated as Ubaid 0 (~8000 cal yr BP; Oates, 2004) that are 5 m thick in places and contain ceramics and cigar-shaped building bricks reminiscent of cultural traditions in northern and central Mesopotamia (Huot, 1989). This is consistent with the idea of a small, relatively sedentary population living around wetlands at the head of the Arabo-Persian Gulf as sea-level rise slowed. Whether they moved into this area as sea level was stabilizing or were pushed from the south with rapid sea-level rise remains unresolved, but if biblical flood mythology originates in southern Mesopotamia it is likely that at least a portion of the resident population on the floodplains of the Ur–Schatt River were displaced to the north because of this marine transgression (Potts, 1996; Teller et al., 2000).

By the beginning of the 'Ubaid Period (~8000 cal yr BP), small villages and towns were more common across greater Mesopotamia. Much of this region was linked through social networks, and similarities in artifacts indicate widespread exchange of goods and knowledge. The archaeological record suggests distinctive demographic trends in southern Mesopotamia and the Susiana Plain during this time. Larger numbers of known settlements dating to the Early 'Ubaid Period result from a combination of greater archaeological visibility (larger sites visible above alluvium) and increases in regional population. At this time the communities of Eridu, 'Usaila, Ur, and Tell al- 'Ubaid were small, averaging about 1 ha in size with estimated populations seldom exceeding 1000 people. These small communities were widely dispersed and lacked the linear distribution typical of settlements dependent on irrigation canals (Adams, 1981, p. 59), although irrigation agriculture was practiced elsewhere in Mesopotamia and was employed in some parts of the southern alluvial plain (Oates and Oates, 1976; Wilkinson, 2003). The carbonized remains of *Triticum monococcum* (Einkorn) and *Hordeum vogare* (Barley) in 'Ubaid 0 (~8000–7500 BP) levels at Tell Oueli also suggest that some form of irrigation was in use (Huot, 1989, 1996), or that the higher humidity evident in Early Holocene climate records was sufficient to sustain rain-fed agriculture, perhaps in combination with opportunistic use of seasonally receding flood zones or the higher water tables close to the head of the Gulf (Kouchoukos, 1999). Early settlements were located on slight rises (turtle backs) within aquatic habitats resulting from seasonal monsoonal rains or in the wetlands at the head of the Arabo-Persian Gulf as sea-level rise slowed (Pournelle, 2003). Such locations were at the interface between fresh and salt water and were optimal for fresh water accessibility, hunting/fishing, transportation, and irrigation agriculture (Oates, 1960). Within this aquatic context, a broad-spectrum economy developed during the ‘Ubaid Period, based upon small-scale agriculture with an emphasis on salt-tolerant crops, animal domestication (e.g., oxen), hunting, fishing, and trade (Woolley, 1929; Huot, 1989; Sanlaville, 1989, p. 14).

By Middle ‘Ubaid times (‘Ubaid 2–3) some communities in southern Mesopotamia grew larger than their neighbors, a two-tiered settlement system that often marks the emergence of hierarchically organized (nonstate) societies (Wright, 1981; Stein, 1994). Important centers included Eridu, Ur, and Uquir (Adams, 1981; Wright, 1981; Wright and Pollock, 1986). Eridu and Ur were particularly large by this time, both having grown to between 9 and 10 ha in size with estimated populations of 2000–3000 people (Adams, 1981). A similar pattern occurred on the adjacent Susiana Plain (southwestern Iran) where Choga Mish expanded rapidly to 11 ha, dwarfing other agricultural communities in the region (Wright and Johnson, 1985). As some communities expanded in size within the Mesopotamian heartland, ‘Ubaid Period ceramics appear in Neolithic settlements and shell middens along the east coast of the Arabian Peninsula (Masry, 1974; Oates et al., 1977; Zarins et al., 1981; Potts, 1993; Uerpmann and Uerpmann, 1996; Glover, 1998). The appearance of ‘Ubaid Period ceramics is associated with the first evidence for a maritime trade network suggested by the remains of a barnacle-covered reed and bituminous boat from coastal Kuwait (Site H3, As-Sabiyah; ‘Ubaid 3, 7300–6900 cal yr BP; Carter, 2002, 2003; Connan et al., 2005). Population expansion continued across the southern Mesopotamian alluvium in Late ‘Ubaid times (‘Ubaid 3–4) and a network of large and small settlements developed with economies based on irrigation agriculture (Wright, 1981; Wright and Pollock, 1986). With this expansion, elements of material culture associated with the ‘Ubaid Period (e.g., uniform pottery style, Berman, 1994; other clay objects-cone-head figurines, sickles, and “nails,” Wright and Pollock, 1986; architecture, Roaf, 1984; Huot, 1989) first appear in northern Mesopotamia (Tobler, 1950; Stein, 1994; Rothman, 2002), a pattern interpreted as political integration centered on the southern alluvium (Algaze, 1993) or cultural replication due to contact with people to the south (Stein, 1994). Interestingly, there is little evidence for warfare in southern Mesopotamia until the end of the ‘Ubaid Period. Settlements were not fortified and ‘Ubaid seals do not show war-related depictions. In contrast, warfare in northern Mesopotamia during this period is suggested by the presence of fortified settlements and interpreted as evidence for intrusive ‘Ubaid expansion from the south (Stein, 1994).

The distribution of wealth items within ‘Ubaid Period sites is suggestive of differential access to economic benefits (Stein, 1994). Economic and political differentiation is also indicated by the hierarchical distribution of settlements, a pattern first visible during the Middle ‘Ubaid Period (Wright, 1981). Unlike hierarchical societies that developed in other parts of the world (Flannery, 1968; Earle, 1987; Clark and Blake, 1994; Clark and Pye, 2000), little evidence exists for elite control of long-distance exchange systems and centralized control of high status craft production (Stein, 1994). Mortuary studies also provide little evidence for social ranking and depictions of rulers are rare (Stein, 1994; Wright and

Pollock, 1986). Instead, 'Ubaid Period society was centered on the temple complex and ideology appears to have played an important organizing role in these communities (Hole, 1994, p. 139; Stein, 1994). These temples occur at focal settlements throughout the region, a pattern that remained remarkably stable for 1500 yr (Stein, 1994). Temples were rectangular in form, oriented to the cardinal directions, and contained altars and offering tables. A series of superimposed temples excavated at the important center of Eridu suggests continuity in settlement and social organization at this location throughout the 'Ubaid Period (Oates, 1960). The first temple in this sequence was constructed during the 'Ubaid 1 phase and subsequent temples were larger and more elaborate. Offerings associated with these temples indicate that aquatic resources (e.g., fish) played a central role in this society (Bottéro, 2001). The economic importance of estuarine and riverine fish is also indicated by faunal remains in 'Ubaid 4 levels at Tell Oueli (Huot, 1989). It is possible that the ideological system represented by the 'Ubaid temple complex was used to legitimize differential access to key elements of the farming system (e.g., water, land, and labor; Stein, 1994) as people began to intensify agricultural production to sustain larger populations in the region. Based on the large size of territories during the Late 'Ubaid Period and some evidence for centralized storage facilities at Tell Oueli (Huot, 1989), Stein (1994) has argued that ideological manipulation was used to mobilize food surpluses to storage facilities at focal communities. Regardless, by the end of the 'Ubaid Period (~6300 cal yr BP)[3] it is clear that some communities were substantially larger than their neighbors, were ruled by hereditary leaders, and were administered by institutionalized administrative organizations.

The economic, social, and political complexity evident at the end of the 'Ubaid Period culminated during the Uruk Period (6300–5000 cal yr BP) with the development of the first urban-based states at ~5000 cal yr BP (Late Uruk or LC5; Johnson, 1973; Wright and Johnson, 1975; Adams, 1981; Rothman, 2004). A significant population expansion occurred in southern Mesopotamia during the 'Ubaid to Uruk Period transition (~6300 cal yr BP), but some areas saw population decline (northern alluvium) as settlements became more concentrated in the southern alluvium (Adams, 1981, pp. 60–61). The city of Uruk-Warka, with deposits extending back into the 'Ubaid Period, was the largest and certainly the most prominent on the southern alluvium through the Uruk Period (Nissen, 2001). This community grew to 250 ha by the end of the Uruk Period and the urban core expanded to 100 ha in size (Finkbeiner, 1991; Nissen, 2001), with an estimated 10,000 inhabitants (Redman, 1978). Most of the elaborate public buildings at Uruk-Warka date to the Late Uruk Period (3–5) and reflect a development of complex

[3] The boundary between the 'Ubaid and Uruk Periods is provisionally placed at ~6,300 cal yr BP based on the recalibration of radiocarbon dates for 'Uruk-related assemblages in greater Mesopotamia (Wright and Rupley, 2001) and personal communication with Joan Oates who has suggested that the boundary date between 'Ubaid and Uruk is sometime before ~6,200 cal yr BP. However, the boundary could be as early as 6,700 cal yr BP in some locations (Hole, 1994).

administrative systems over the course of about 600 yr (Nissen, 2001). The increased size of Uruk-Warka resulted from indigenous population growth (Johnson, 1988–89) or migration of people from adjacent areas. This occurred as communities were abandoned further to the north in southern Mesopotamia and the adjacent Susiana Plain (Johnson, 1973; Adams, 1981), perhaps fostered by increasing aridity evident throughout the region or due to deltaic progradation.

Uruk-Warka was the largest urban center in southern Mesopotamia by the Late Uruk Period (Nissen, 2001), dwarfing even the large settlement of Susa on the adjacent Susiana Plain (~18 ha; Hole, 1987). The urban core of this city was surrounded by a defensive wall and divided into two discrete areas, each containing large free-standing buildings visible from a considerable distance (Heinrich, 1982; Nissen, 2001). Some of these large structures are interpreted as public buildings representing temples, "cult houses," or assembly halls (Schmid, 1980; Heinrich, 1982; Nissen, 2001). Cylinder seals and clay tablets found in dumps behind administrative buildings represent the first writing systems and appear to have been used primarily for information storage and accounting purposes (Nissen et al., 1993). A vigorous economy is suggested by the remains of workshops and kilns in the city center, and substantial evidence exists for craft specialization, with major advances in metallurgy and pottery manufacture visible in the record (e.g., fast wheel; Adams and Nissen, 1972). Artistic achievement also flourished. Clear social and political hierarchies are indicated by artistic representations and by a clay tablet containing a "standard professions list," a categorization of professions from rulers to laborers (Nissen et al., 1993; Nissen, 2000). This list indicates that a strong division of labor was well established and that the hierarchical elements of society likely had roots earlier in the 'Ubaid and Uruk Periods. A strong political authority is also suggested by hints of forced labor and the control of an extensive agricultural irrigation system. This is also indicated by rank-size differences between communities and evidence from cylinder seals showing strong economic, political, and social integration between cities and smaller communities in the region (Wright and Johnson, 1975). Other large cities in the region dating to this time include Kish, Nippur, Gersu, and Ur (Nissen, 2001).

The southern cities of Mesopotamia were linked to other communities in greater Mesopotamia via exchange networks. These networks were crucial for state development because people living on the southern alluvium were able to acquire goods unavailable locally (e.g., high grade wood and metal; Algaze, 1993). By the Late Uruk Period, the movement of goods to southern cities was facilitated by outposts strategically located in areas containing valuable resources or close to natural trade routes affording control over the distribution of these materials (e.g., Godin Tepe, Habub Kabira, Hacinebi Tepe, Jabal Aruda; Algaze, 2001b; Rothman, 2001). The records at these sites suggest that colonists/merchants from southern Mesopotamia were able to gain access to critical materials and wealth objects necessary to support the emerging social hierarchy in the heartland. This occurred during the Late Uruk Period between about 5500 and 5000 cal yr BP and is known as the Uruk expansion (Algaze, 1993, 2001b; Wright and Rupley, 2001). Algaze (2001b) argued convincingly that the process of state development was linked to broader economic interactions that partially enabled leaders to sustain the development of economic, social, and political hierarchies in southern Mesopotamia.

4. Discussion

In southern Mesopotamia the cultural changes leading to integrated state level societies occurred during a 3000 yr period between the beginning of the 'Ubaid Period at ~8000 cal yr BP and the end of the Uruk Period at about 5000 cal yr BP. Although states flourished after 5000 cal yr BP, during the Sumerian Period, the foundations were built during the 'Ubaid (8000–6300 cal yr BP) and Uruk (6300–5000 cal yr BP) Periods. This was a dynamic interval of human cultural evolution, a punctuated series of events, in a long (~80,000 yr; Klein, 1999) history of human hunting and gathering and early agricultural economies (Early Holocene; Moore, 1985). The first urban-based states appeared in southern Mesopotamia and the Susiana Plain, although early sedentary agricultural communities and hunter-gatherers were then well distributed throughout much of the region. We suggest that state development in southern Mesopotamia resulted from human responses stimulated, in part, by a particular succession and confluence of environmental changes unique to this region during the Early and Middle Holocene. Rapid and extensive marine transgression, coupled with higher rainfall, was followed by stabilization of sea level and increasing aridity. Interrelated human responses resulted in intense and increasing competition for favorable resources that were becoming increasingly circumscribed due to aridity and population expansion (Flannery, 1972; Service, 1978; Carneiro, 1988). These changing conditions favored population aggregation, intensified agricultural production, economic specialization, and the formation of social and political hierarchies founded on and reinforced by new or existing ideological systems. In this context, the first urban centers emerged and controlled adjacent communities with elaborate and centralized administrative hierarchies led by a small elite class.

Our hypothesis includes elements of previous models that incorporated several interrelated factors: population increase, environmental and social circumscription, increased warfare, development of extensive irrigation agriculture, and favorable conditions for trade (Haas, 1982; Rothman, 2004). Nevertheless, we argue that any explanation is incomplete if it considers these factors, alone or in combination, in the absence of environmental change. Population increase was a necessary component for the development of state-level societies, but by itself was inadequate (Wright and Johnson, 1975; Adams, 1981). Likewise, state development was possibly the cause rather than the result of large-scale irrigation agriculture and increasing interregional trade (Adams, 1974; Wright and Johnson, 1975). However, large-scale irrigation could not have occurred in this region without sufficiently high, near-stable sea levels necessary for the development of extensive floodplains at river level and a high water table.

Relatively few researchers have stressed climate change as an important factor in contributing to the development of city-based states in southern Mesopotamia. Exceptions are Hole (1994), Nissen (1988), and Sirocko et al. (1993), who suggested that state development was tied to increased regional aridity during the Middle Holocene. Hole (1994) stressed the importance of climatic instability as a major trigger in cultural development, suggesting that short-term environmental shocks encouraged collective action to mitigate them. Sea-level change has also been considered to have caused human migrations and strongly influenced the development of agrarian economies (Van Andel, 1989; Stanley and Warne, 1993; Ryan and Pitman, 1998). Recent work in Egypt has linked deceleration of global sea-level rise between 8500 and 7500 cal yr BP with the formation of the Nile Delta and the initiation of farming settlements (Stanley and Warne, 1993, 1997; Stanley and Chen, 1996). Hole (1994) considered sea-level rise to be insignificant for cultural development in southern Mesopotamia, however, arguing that sea-level rise was too slow for river aggradation to keep pace, but stability of the land surface fostered the extensive use of canal systems and aggregated settlement.

Our view is that climatically induced environmental change is one of several variables leading to the emergence of centralized states in this region. Given the coincidence of major climatic shifts and the emergence of social hierarchies and centralized states, these physical factors should weigh more heavily than other variables that are more difficult to document quantitatively. We argue that certain behaviors were favored (probabilistically, not deterministically) within this dynamically changing environmental and social context that had major evolutionary implications for the formation of social hierarchies and ultimately the institutionalized administrative hierarchies characteristic of urban-based states (see Winterhalder and Goland [1997] for a similar argument with respect to agricultural origins). Therefore, we emphasize decision making or human responses to a changing set of environmental and social circumstances in southern Mesopotamia in three distinct, but continuous stages.

4.1. Stage I: 9000–8000 cal yr BP

Little is known about cultural development during the pre-'Ubaid Period of southern Mesopotamia because populations were likely small and dispersed and the archaeological record is either covered by water and/or buried by alluvium deposited during floodplain aggradation. We suggest that Early Holocene climatic conditions between 9000 and 8000 cal yr BP were an important catalyst for later cultural developments. Climatically this period was the most propitious for people living in this region because of higher humidity and more reliable summer monsoon rainfall (Arz et al., 2003; Petit-Maire et al., 1997). Widely distributed lakes in northern Arabia and southern Mesopotamia, created by seasonal monsoonal conditions, would have favored dispersed settlement and seasonal mobility. The wadi systems of northern Iraq and the floodplains along the Ur–Schatt River provided localized aquatic resources attractive to early populations.

Sparsely distributed stone tools characteristic of the Arabian bifacial tradition provide tantalizing evidence for pre-'Ubaid occupation in the southern Mesopotamia Delta region (Woolley, 1955; Cauvin, 1979; Inizan and Tixier, 1983; Zarins, 1992). These data are consistent with other evidence from along the northeast coast of the Arabo-Persian Gulf and more broadly across the Arabian Peninsula for small preceramic settlements near now-dry lakebeds dating to between ~9600 and 7000 cal yr BP (Potts, 1993). Evidence suggests that people practiced a range of mixed foraging-farming strategies combining the herding of sheep and goats with hunting for wild game and the collection of local grasses and various aquatic resources (Potts, 1997; Beech et al., 2005). We suspect that small groups of semi-nomadic people, practicing similar subsistence strategies, also lived along the Ur–Schatt River during this interval. As the rate of global sea-level rise decreased during the Early Holocene, the extent of transgression increased in the Arabo-Persian Gulf because of the low topographic gradients. Rapid transgression of the shoreline (~110 m per annum) caused continuous displacement of peoples and competition for optimal locations on the shifting boundary between fresh and salt water systems. It also compressed the number of people living along this watercourse into a smaller area, may have stimulated group formation or movement of people into adjacent, uninhabited environments of equal or greater economic potential.

4.2. Stage II: 8000–6300 cal yr BP – 'Ubaid Period

We suggest that the appearance of relatively large communities in southern Mesopotamia at Eridu, Uruk, and other locations reflects an aggregation of sedentary populations adjacent to the newly formed estuaries and associated wetlands (Aqrawi, 2001; Sanlaville, 1989). As Oates (1960, 2004) noted, these habitats would have been ideal locations for access to fresh water, hunting/fishing of terrestrial and aquatic animals, and transportation (also see Pournelle, 2003). The potential for irrigation agriculture also improved with increasing stabilization of sea level by the end of this period. In addition, it is possible that the Arabo-Persian Gulf was less saline and more productive compared to later in time, an idea based on data from the Red Sea suggesting less saline conditions related to the displacement of the monsoonal belt at this time (Arz et al., 2003). Increases in the size and number of settlements in southern Mesopotamia during the Early 'Ubaid Period (Phases 0–1) suggest that regional populations were expanding, a product of indigenous population growth or immigration from elsewhere in greater Mesopotamia. Several focal communities started to emerge at this time (e.g., Eridu, Tell Oueli), positioned on elevated landforms at the head of the Arabo-Persian Gulf. Settlement at several of these communities was remarkably stable through the 'Ubaid Period, a point that is best illustrated by a series of superimposed temples at Eridu (Oates, 1960).

The quantity of fish bone found as offerings in these temples highlights the importance of aquatic habitats at least at this location (Bottéro, 2001).

The nonlinear distribution of these settlements suggests that irrigation agriculture (Adams, 1981) was not an essential or dominant element in the subsistence economy, although it was used elsewhere in greater Mesopotamia (Oates and Oates, 1976; Wilkinson, 2003). Given the humid conditions at the beginning of the 'Ubaid Period and the initial formation of productive wetlands, it seems reasonable to assume that these communities were founded upon more diverse mixed economies that included hunting, fishing, herding, and farming (dry and irrigated fields). Given low regional populations and favorable environmental conditions, we suggest that irrigation agriculture was not essential for the formation and stability of these early 'Ubaid settlements. The more dispersed nature of settlement in the earliest 'Ubaid suggests that populations were less restricted or circumscribed than later in time and that a range of habitats could sustain populations using a mixture of subsistence practices. This economic base would have been facilitated, in part, by varied habitats associated with the newly created wetland areas at the head of the Gulf and lacustrine habitats scattered across the region related to the humid conditions of this period. In other words, as groups increased in size, impacting local habitats and competing for localized resources, there were other economically viable options available. This type of environmental context would have favored splintering of communities rather than integration into larger groups.

During the Middle 'Ubaid Period ('Ubaid 2–3) certain communities grew larger in size relative to surrounding communities and some evidence exists for differential access to resources and control of food stores by elite group members (Stein, 1994). The aggregation of people at focal communities located near optimal wetland locations occurred during a period of rapid regional drying, related to the southern retreat of the South Asian monsoonal belt (Arz et al., 2003), that would have reduced the extent of lacustrine habitats in southern Mesopotamia. Sea level also continued to rise during this interval (7 m or more, Fairbanks, 1989; Eisenhauer et al., 1992) and the expansion of maritime trade along the western margin of the Arabo-Persian Gulf occurred within this environmental context (Carter, 2002, 2003; Connan et al., 2005). At the head of the Gulf, this rise caused a marine inland transgression of at least 200 km, or ~100 m/yr. In this case, low-lying areas were inundated to create a continually changing mosaic of aquatic habitats (Pournelle, 2003), and all but the most stable landforms (those occupied by communities like Eridu or Ur) were flooded. Optimal freshwater and estuarine environments continued to shift inland displacing human populations. This dynamic mosaic would have stimulated increased competition for localized and circumscribed resources and the need to constantly redefine territorial boundaries and village locations as rapidly as within a single generation.

Larger groups formed at optimal locations, where environmental conditions created opportunities for ambitious individuals to exploit competitive advantages. These advantages ultimately formed the basis for the social and political hierarchies that emerged by the end of the 'Ubaid Period (~6300 cal yr BP). It appears that people compared the costs and benefits of joining a larger group and that the benefits (or perceived benefits) were greater than the available alternatives, even at the cost of economic and social subjugation. Under these conditions, the use of ideology, centered on the temple, became increasingly important for legitimizing the emerging economic/social inequities and the status of hereditary leaders. The expansion of Late 'Ubaid settlements down the western margin of the Arabo-Persian Gulf could be related to environmental, demographic, or social pressures in southern Mesopotamia that stimulated migration. It could also be related to new economic opportunities created by major improvements in irrigation agriculture technology or the persistence of seasonal monsoonal rains farther to the south as conditions continued to dry in southern Mesopotamia.

4.3. Stage III: 6300–5000 cal yr BP – Uruk Period

The Uruk Period represents the culmination of earlier developments leading to the first fully urban state-level society by ~5000 BP (Late Uruk or LC5; Wright and Johnson, 1975; Nissen, 1988, 2000, 2001; Crawford, 1991; Rothman, 2004). Populations increased in southern Mesopotamia during the 'Ubaid to Uruk Period transition (~6300 cal yr BP). This demographic trend tracks the expansion of irrigation agriculture as indicated by the greater occurrence of canals dating to this time and of linear settlement patterns suggesting that communities were becoming more reliant on these important systems (Adams, 1981). Increased food surpluses provided a firmer basis for expanding populations and a growing, socially stratified society that included administrators, craftspeople, and other specialists. We also suggest that population expansion during the Uruk Period was no coincidence: demographic growth was favored by improving irrigation technology coupled with high water tables and the expanding floodplains linked to the deceleration of sea-level rise.

The near-stabilization of sea level also favored further enlargement of towns optimally located on the margins of the expanding wetlands at the head of the Arabo-Persian Gulf. Textual evidence indicates that Eridu and Ur were located on the coast about 5000 cal yr BP (Larsen and Evans, 1978; Sanlaville, 1989; Lambeck, 1996). Archaeological evidence suggests that during the 'Ubaid Period communities in the Eridu and Tell Oueli regions became increasingly maritime (Huot, 1989). Even the later Sumerians (~4500 cal yr BP) are considered to have been a maritime culture (Falkenstein, 1951; Jacobsen, 1960). Boat transportation significantly increases the efficiency with which people can deliver resources (agricultural or otherwise) to central places (Ames, 2002). Maritime transport would therefore have helped mobilize food surpluses to focal communities such as Eridu or Ur. The combination of fishing and farming also provides a powerful economic engine for population expansion, while maritime voyages to distant locations facilitated the exchange of ideas and provided exotic goods consumed by emerging elites. Exotic materials served as important status markers and reinforced the existing social and political hierarchies.

In this environmental, demographic, and social context, the settlement of Uruk-Warka emerged as a dominant regional center. First established in the 'Ubaid Period, this community grew in size during the Uruk Period with the most pronounced growth between ~5500 and 5000 cal yr BP (Nissen, 2001). Public architecture and the first writing systems, used primarily for information storage and accounting purposes, appear at this time. These traits point to the existence of an elaborate administrative hierarchy governed by a supreme religious elite that controlled the economic, social, and political affairs of neighboring communities – the first urban-based state in the world. The relatively rapid growth at Uruk-Warka over 500–600 yr parallels the partial abandonment of communities in northern portions of the alluvium and on the adjacent Susiana Plain. Movement of people from hinterland communities suggests that the economic and social opportunity at cities like Uruk-Warka was attractive relative to that available elsewhere. We argue that the foundation for these opportunities was provided, in part, by the expansion of irrigation systems afforded by the near-stabilization of sea level coupled with the infrastructural improvements developed and maintained by the new administrative hierarchy. Decreased agricultural production (e.g., dry farming) on the margins of the southern alluvium, due to increasingly dry conditions throughout Mesopotamia (Arz et al., 2003), would have attracted people to cities then supported by well-developed irrigation systems. Aridification throughout greater Mesopotamia also led to continued environmental and social circumscription in these southern cities, which heightened competition for increasingly localized resources associated with aquatic habitats. The defensive wall around the city of Uruk-Warka is suggestive of social and political instabilities that would have further favored the formation of larger groups for defensive purposes. Social instabilities and the threat of war likely contributed to the decision of many to move from hinterland to urban settings – the best available alternative even with the severe economic and social inequities inherent in the new social order. Under these conditions people were attracted to these new urban centers and accepted the ideological system established by the ruling elite to legitimize their elevated positions. Population expansion and the replication of the Uruk social system fostered its expansion into northern Mesopotamia where Uruk outposts were established to gain additional resources and where similarly organized state-level societies emerged.

5. Conclusions

We argue that urbanism and cultural complexity in southern Mesopotamia resulted from a series of decisions by many people over several millennia under continuously changing environmental, demographic, economic, social, and political conditions. The aggregate effect of these decisions culminated in the first state-level societies in the region. Global eustatic and climate changes influenced dynamic environmental conditions in southern Mesopotamia, along with interrelated changes in human demography, economy, and sociopolitical organization.

Coastal and aquatic habitats played a critical role in shaping the cultural evolutionary history of the region. The earliest stable settlements were established adjacent to newly formed, productive estuaries and associated wetlands as the marine transgression slowed between 8000 and 6300 cal yr BP – the ‘Ubaid Period. These locations were optimally located near fresh water and diverse aquatic habitats, and were ideally positioned for efficient transport of goods and people using watercraft. Small-scale irrigation agriculture could also have been employed along wetland margins where water tables were higher. People living in more marginal parts of southern Mesopotamia moved into larger communities because this action either maintained or improved their economic well-being, even in the face of subjugation by emerging elites.

Continued population growth occurred in southern Mesopotamia during the ‘Ubaid to Uruk transition (~6300 cal yr BP) as sea-level rise decreased significantly between 6300 and 5500 cal yr BP. A deceleration in marine transgression stimulated the expansion of floodplains in southern Mesopotamia and the high water table necessary for large-scale, floodplain irrigation agriculture. Increased food surpluses resulting from irrigation agriculture provided the basis for expanding populations and the developing sociopolitical structure. Increasing aridity in southern Mesopotamia between 6200 and 5000 cal yr BP contributed to further circumscription of populations, increased competition for favorable land and water resources, aggregation of populations in centers close to the rivers and estuaries, greater reliance on irrigation agriculture, and the need for the development of larger population centers for defensive purposes. It is within this context that the important city of Uruk-Warka emerged at the center of the first urban-based state between 5500 and 5000 cal yr BP.

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References

Adams, R. McC., 1965. *Land Behind Baghdad*. University of Chicago Press, Chicago.

Adams, R. McC., 1974. Anthropological perspectives on ancient trade. *Current Anthropology* 15:239–258.

Adams, R. McC., 1981. *Heartland of Cities: Surveys of Ancient Settlement and Land Use on the Central Floodplain of the Euphrates.* University of Chicago Press, Chicago.

Adams, R. McC., 2000a. Scale and complexity in archaic states. *Latin American Antiquity* 11:187–193.

Adams, R. McC., 2000b. Accelerated technological change in archaeology and ancient history. In *Cultural Evolution: Contemporary Viewpoints*, edited by G. Feinman and L. Manzanilla, pp. 95–117. Kluwer Academic, New York.

Adams, R. McC., and H. J. Nissen, 1972. *The Uruk Countryside: The Natural Setting of Urban Societies*. University of Chicago Press, Chicago.

Al-Asfour, T., 1978. The marine terraces of the Bay of Kuwait. In *The Environmental History of the Near and Middle East Since the Last Ice Age*, edited by W. C. Brice, pp. 245–254. Academic Press, New York.

Algaze, G., 1993. *The Uruk World System: Dynamics of Expansion of Early Mesopotamian Civilization.* University of Chicago Press, Chicago.

Algaze, G., 2001a. Initial social complexity in Southwestern Asia: the Mesopotamian advantage. *Current Anthropology* 42:199–233.

Algaze, G., 2001b. The prehistory of imperialism: The case of Uruk Period Mesopotamia. In *Uruk Mesopotamia and Its Neighbors: Cross-Cultural Interactions in the Era of State Formation*, edited by M. S. Rothman, pp. 27–83. School of American Research Press, Santa Fe, NM.

Almogi-Labin, A., C. Hemleben, D. Meischner, and H. Erlenkeuser, 1991. Paleoenvironmental events during the last 13,000 years in the Central Red Sea as recorded by Pteropoda. *Paleoceanography* 6:83–98.

Ambrose, S. H., and N. E. Sikes, 1991. Soil carbon isotope evidence for Holocene habitat change in the Kenya Rift Valley. *Science* 253:1402–1404.

Ames, K. M., 2002. Going by boat: the forager-collector continuum at sea. In *Beyond Foraging and Collecting: Evolutionary Change in Hunter-gatherer Settlement Systems*, edited by B. Fitzhugh and J. Habu, pp. 19–52. Kluwer Academic/Plenum Publishers, New York.

Aqrawi, A. A. M., 1993. Palygorskite in the recent fluvio-lacustrine and deltaic sediments of southern Mesopotamia. *Clay Minerals* 28:153–158.

Aqrawi, A. A. M., 1995. Brackish-water and evaporitic Ca-Mg carbonates in the Holocene lacustrine/deltaic deposits of southern Mesopotamia. *Journal of the Geological Society of London* 152:259–268.

Aqrawi, A. A. M., 2001. Stratigraphic signatures of climatic change during the Holocene evolution of the Tigris-Euphrates delta, lower Mesopotamia. *Global and Planetary Change* 28:267–283.

Arz, H. W., F. Lamy, J. Pätzold, P. J. Müller, and M. Prins, 2003. Mediterranean moisture source for an Early-Holocene humid period in the Northern Red Sea. *Science* 300: 118–121.

Aurenche, O., 1987. Remarques sur le peuplemente de la Mésopotamia. In *La Préhistoire de la Mésopotamia*, edited by J.-L. Huot, pp. 85–89. Editions du CNRS, Paris.

Bar-Matthews, M., A. Ayalon, and A. Kaufman, 1997. Late Quaternary paleoclimate in the Eastern Mediterranean Region from stable isotope analysis of speleothems at Soreq Cave, Israel. *Quaternary Research* 47:155–168.

Bar-Yosef, O., and A. Belfer-Cohen, 1989. The origins of sedentism and farming communities in the Levant. *Journal of World Prehistory* 3:447–491.

Bar-Yosef, O., and R. H. Meadow, 1995. The origins of agriculture in the Near East. In *Last Last Hunters-First Farmers: New Perspectives on the Prehistoric Transition to Agriculture*, edited by T. D. Price and A. B.. Gebauer, pp. 39–94. School of American Research Press, Santa Fe, NM.

Beech, M., R. Cuttler, D. Moscrop, H. Kallweit, and J. Martin, 2005. New evidence for the Neolithic settlement of Marawah Island, Abu Dhabi, United Arab Emirates. *Proceedings of the Seminar for Arabian Studies* 35:37–56.

Berman, J., 1994. The ceramic evidence for sociopolitical organization in 'Ubaid southwestern Iran. In *Chiefdoms and Early States in the Near East: The Organizational Dynamics of Complexity*, edited by G. Stein and M. S. Rothman, pp. 23–33. Prehistory Press, Madison, WI.

Binford, L. R., 1968. Post-Pleistocene Adaptations. In *New Perspectives in Archaeology*, edited by S. R. Binford and L. R. Binford, pp. 313–341. Aldine, Chicago.

Blanton, R., S. Kowalewski, G. Feinman, and L. Finsten, 1993. *Ancient Mesoamerica: A Comparison of Change in Three Regions.* (second edition). Cambridge University Press, Cambridge.

Bottéro, J., 2001. *Everyday Life in Ancient Mesopotamia*. The John Hopkins University Press, Baltimore, Maryland.

Bray, H. E., and S. Stokes, 2004. Temporal patterns of arid-humid transitions in the southeastern Arabian Peninsula based on optical dating. *Geomorphology* 59:271–280.

Burns, S. J., D. Fleitmann, A. Matter, U. Neff, and A. Mangini, 2001. Speleothem evidence from Oman for continental pluvial events during interglacial periods. *Geology* 29:623–626.

Burns, S. J., A. Matter, N. Frank, and A. Mangini, 1998. Speleothem-based paleoclimatic record from northern Oman. *Geology* 26:499–502.

Calvet, Y., 1989. La phase 'Oueili de l'époque d'Obeid. In *Larsa, travaux de 1985*, edited by J.-L. Huot, pp. 129–151. Editions Recherche sur les Civilisations, Paris.

Carneiro, R. L., 1988. The circumscription theory. *American Behavioral Scientist* 31:497–511.

Carter, R., 2002. Ubaid-period boat remains from As-Sabiyah: excavations by the British Archaeological Expedition to Kuwait. *Proceedings of the Seminar for Arabian Studies* 32:13–30.

Carter, R., 2003. The Neolithic origins of seafaring in the Arabian Gulf. *Archaeology International* 2002/2003:44–47.

Cauvin, M.C., 1979. Tello et l'origine de la houe au Proche Orient. *Paléorient* 5:193–206.

Childe, V. G., 1950. The urban revolution. *Town Planning Review* 21:3–17.

Clark, J., and Blake, M., 1994. The power of prestige: competitive generosity and the emergence of rank societies in lowland Mesoamerica. In *Factional Competition and Political Development in the New World*, edited by J. W. Fox and E. M. Brumfiel, pp. 17–30. Cambridge University Press, Cambridge.

Clark, J., and M. Pye, editors. 2000. *Olmec Art and Archaeology in Mesoamerica*. Yale University Press, New Haven.

Clemens, S. C., D. W. Murray, and W. L. Prell, 1996. Nonstationary phase of the Plio-Pleistocene Asian monsoon. *Science* 274:943–948.

COHMAP, 1988. Climatic changes of the last 18,000 years: observations and model simulations. *Science* 241:1043–1052.

Connan, J., R. Carter, H. Crawford, M. Tobey, A. Charrié-Duhaut, D. Jarvie, P. Albrecht, and K. Norman, 2005. A comparative geochemical study of bituminous boat remains from H3, As-Sabiyah (Kuwait), and RJ-2, Ra's al-Jinz (Oman). *Arabian Archaeology and Epigraphy* 16:21–66.

Cooke, G. A., 1987. Reconstruction of the Holocene coastline of Mesopotamia. *Geoarchaeology* 2:15–28.

Crawford, H., 1991. *Sumer and the Sumerians*. Cambridge University Press, New York.

Dabbagh, A. E., K. G. al-Hinai, and M. A. Khan, 1998. Evaluation of the Shuttle Imagining Radar (SIR-C/X-SAR) data for mapping paleo-drainage systems in the Kingdom of Saudi-Arabia. In *Quaternary Deserts and Climatic Change*, edited by A. S. Alsharhan, K. W. Glennie, G. L. Whittle, and C. G. St. C. Kendell, pp. 483–493. Balkema/Brookfield, Rotterdam.

deMenocal, P., J. Ortiz, T. Guilderson, J. Adkins, M. Sarnthein, L. Baker, and M. Yarusinsky, 2000. Abrupt onset and termination of the African Humid Period: Rapid climate responses to gradual insolation forcing. *Quaternary Science Review* 19:347–361.

Diester-Haass, L., 1973. Holocene climate in the Persian Gulf as deduced from grain-size and Pteropod distribution. *Marine Geology* 14:207–223.

Earle, T., 1987. Chiefdoms in archaeological and ethnohistorical context. *Annual Review of Anthropology* 16:279–308.

Edens, C., 1982. Towards a definition of the Rubc al Khali "neolithic." *Atlal* 6:109–124.

Edens, C., and T. J. Wilkinson, 1998. Southwest Arabia during the Holocene: recent archaeological developments. *Journal of World Prehistory* 12:55–119.

Eisenhauer, A., J. Chen, and G. J. Wasserburg, 1992. Holocene sea level determination relative to the Australian continent. *Abstracts from American Geophysical Union Spring Meeting, Montreal*, p. 172.

Fairbanks, R. G., 1989. A 17,000-year glacio-eustatic sea level record: influence of glacial melting rates on the Younger Dryas event and deep-ocean circulation. *Nature* 342:637–642.

Falkenstein, A., 1951. Die Eridu-Hymme. *Sumer* 7:119–125.

Feinman, G. M., 2000. Cultural evolutionary approaches and archaeology: past, present, and future. In *Cultural Evolution: Contemporary Viewpoints*, edited by G. M. Feinman and L. Manzanilla, pp. 3–11. Kluwer Academic/Plenum Publishers, New York.

Feinman, G. M., and J. Marcus, editors. 1998. *Archaic States*. School of American Research, Santa Fe, NM.

Feinman, G. M., and L. Manzanilla, editors. 2000. *Cultural Evolution: Contemporary Viewpoints*. Kluwer Academic/Plenum Publishers, New York.

Finkbeiner, U., 1991. Uruk Kampagne 35–37, 1982–84: Die archäologische Oberflächenuntersuchung. *Ausgrabungen in Uruk-Warka Endberichte* 4. von Zabern, Mainz.

Flannery, K. V., 1968. The Olmec and the valley of Oaxaca: a model for interregional interaction in Formative times. In *Dumbarton Oaks Conference on the Olmec*, edited by E. Benson, pp. 79–110. Dumbarton Oaks, Washington, D.C.

Flannery, K. V., 1969. Origins and ecological effects of early domestication. In *Iran and the Near East in the Domestication and Exploitation of Plants and Animals*, edited by P. J. Ucko and G. W. Dimbley, pp. 73–100. Aldine-Atherton, Chicago.

Flannery, K. V., 1972. The cultural evolution of civilizations. *Annual Review of Ecology and Systematics* 3:399–426.

Flannery, K. V., 1998. The ground plans of Archaic States. In *Archaic States*, edited by G. M. Feinman and J. Marcus, pp. 15–58. School of American Research, Santa Fe, NM.

Frankfort, H., 1956. *The Birth of Civilization in the Near East*. Double Day, Garden City.

Garrard, A., 1999. Charting the emergence of cereal and pulse domestication in south-west Asia. *Environmental Archaeology* 4:67–86.

Gasse, F., M. Arnold, J. C. Fontes, M. Fort, E. Gibert, A. Huc, L. Bingyan, L. Yuanfang, L. Qing, F. Melieres, E. V. Campo, W. Fubao, and Z. Qingsong, 1991. A 13,000-year climate record from Western Tibet. *Nature* 353:742–745.

Gasse, F., R. Téhet, A. Durand, E. Gibert, and J.-H. Fontes, 1990. The arid-humid transition in the sahara and the sahel during the last deglaciation. *Nature* 346:141–146.

Glover, E., 1998. Mangroves, molluscs and man: Archaeological evidence for biogeographical changes in mangrove around the Arabian Peninsula. In *Arabia and its Neighbours. Essays on Prehistorical and Historical Developments Presented in Honour of B. de Cardi*, edited by C. S. Phillips, D. T. Potts, and S. Searight, pp. 221–232. Brepols, Leuven.

Gunatilaka, A., 1986. Kuwait and the Northern Arabian Gulf: a study in Quaternary sedimentation. *Episodes* 9:223–231.

Haas, J., 1982. *The Evolution of the Prehistoric State*. Columbia University Press, New York.
Harris, D.R., 1996. The origins and spread of agriculture and pastoralism in Eurasia: an overview. In: *The Origins and Spread of Agriculture and Pastoralism in Eurasia*, edited by D. R. Harris, pp. 552–573. Smithsonian Institution Press, Washington, D.C.
Harris, D.R., 1998. The origins of agriculture in southwest Asia. *The Review of Archaeology* 19:5–11.
Haynes, C. V., C. H. Eyles, L. A. Pavlish, J. C. Ritchie, and M. Rybak., 1989. Holocene palaeoecology of the Eastern Sahara; Selima Oasis. *Quaternary Science Reviews* 8:109–136.
Haynes, C. V. J., and Mead, A. R., 1987. Radiocarbon dating and paleoclimatic significance of subfossil limicolaria in Northwestern Sudan. *Quaternary Research* 28:86–99.
Henrich, E., 1982. Die Tempel und Heiligtümer im Alten Mesopotamien. Walter de Gruyter, Berlin.
Henry, D., 1989. *From Foraging to Agriculture. The Levant at the End of the Ice Age.* University of Pennsylvania Press, Philadelphia.
Hodell, D. A., J. H. Curtis, and M. Brenner, 1995. Possible role of climate in the collapse of Classic Maya civilization. *Nature* 375:391–394.
Hole, F., 1983. Symbols of religion and social organization at Susa. In *Beyond the Hilly Flanks*, edited by T. C. Young, P. Smith, and P. Mortensen, pp. 315–344. Oriental Institute, Chicago.
Hole, F., editor. 1987. *The Archaeology of Western Iran: Settlement and Society from Prehistory to Islamic Conquest.* Smithsonian Institution Press, Washington, D.C.
Hole, F., 1994. Environmental instabilities and urban origins. In *Chiefdoms and Early States in the Near East: The Organizational Dynamics of Complexity*, edited by G. Stein and M. S. Rothman, pp. 121–143. Prehistory Press, Madison, WI.
Hötzl, H., A. R. Jado, H. Moser, W. Rauert, and J. G. Zötl, 1984. Climatic fluctuations in the Holocene. In *The Quaternary Period in Saudi Arabia*, edited by A. R. Jado and J. G. Zötl, Vol. 2, pp. 301–314. Springer-Verlag, New York.
Hudson, R. G. S., F. E. Eames, and G. L. Wilkins, 1957. The fauna of some recent marine deposits near Basrah, Iraq. *Geological Magazine* 94:393–401.
Huot, J.-L., 1989. 'Ubaidian Villages of Lower Mesopotamia. In *Upon these Foundations: The 'Ubaid Reconsidered, Proceedings from the 'Ubaid Symposium, Elisnore*, edited by E. F. Henrickson and I. Thuesen, pp. 19–42. Museum Tusculanum Press, University of Copenhagen, Institute of Ancient Near Eastern Studies, Copenhagen.
Huot, J.-L., 1996. *Oueli: Travaux de 1987 et 1989*. Éditions Recherche sur les Civilisations, Paris.
Inizan, M.-L., editor. 1988. *Préhistoire à Qatar. Mission archéologique francaise. ii.* Éditions Recherche sur les Civilisations, Paris.
Inizan, M.-L. and J. Tixier, 1983. Tell el 'Oueli: le material lithique. In *Larsa et Oueili, travaux de 1978–1981*, edited by J.-L. Huot, pp. 164–175. Éditions Recherche sur les Civilisations, Paris.
Issar, A., 1995. Climatic change and the history of the Middle East. *American Scientist* 83:350–355.
Issar, A., 2003. *Climate Changes During the Holocene and Their Impact on Hydrological Systems*. Cambridge University Press, Cambridge.
Jacobsen, T., 1960. The waters of Ur. *Iraq* 22:174–185.
Johnson, G. A., 1973. *Local Exchange and Early State Development in Southwestern Iran.* Anthropological Papers 51, Museum of Anthropology, University of Michigan, Ann Arbor.
Johnson, G. A., 1988–89. Late Uruk in greater Mesopotamia: expansion or collapse. *Origini* 14:595–611.
Kennett, D. J., and J. P. Kennett, 2000. Competitive and cooperative responses to climatic instability in Southern California. *American Antiquity* 65:379–395.
Klein, R. G., 1999. *The Human Career: Human Biological and Cultural Origins* (second edition). The University of Chicago Press, Chicago.
Kouchoukos, N., 1999. *Landscape and Social Change in Late Prehistoric Mesopotamia.* Unpublished Ph.D. dissertation, Yale University.

Kramer, S. N., 1963. *The Sumerians*. University of Chicago, Chicago.

Kutzbach, J. E., 1983. Monsoon rains of the Late Pleistocene and Early Holocene: patterns, intensity and possible causes of changes. In, *Variations in the Global Water Budget*, edited by A. Street-Perrott, M. Bern, and R. Ratcliffe, pp. 371–389. Reidel, Dordrecht.

Kutzbach, J. E., and R. G. Gallimore, 1988. Sensitivity of a coupled atmosphere/mixed layer ocean model to changes in orbital forcing at 9000 years B.P. *Journal of Geophysical Research* 93(D1):803–821.

Kutzbach, J. E., and P. J. Guetter, 1986. The influence of changing orbital parameters and surface boundary conditions on climate simulations for the past 18,000 years. *Journal of Atmospheric Science* 43:1726–1759.

Kutzbach, J., and F. A. Street-Perrott, 1985. Milankovitch forcing of fluctuations in the level of tropical lakes from 18 to 0 kyr BP. *Nature* 317:130–134.

Lamb, H. H., 1977. *Climatic History and the Future.* Methuen and Co. Ltd., London.

Lambeck, K., 1996. Shoreline reconstructions for the Persian Gulf since the Last Glacial Maximum. *Earth and Planetary Science Letters* 142:43–57.

Larsen, C. E., and G. Evans, 1978. The Holocene geological history of the Tigris-Euphrates-Karun delta. In *The Environmental History of the Near and Middle East Since the Last Ice Age*, edited by W. C. Brice, pp. 227–244. Academic Press, New York.

Lees, G. M., and N. L. Falcon, 1952. The geographical history of the Mesopotamian plains. *The Geographical Journal* 118:24–39.

Lézine, A., J. Saliège, R. Mathieu, T.-L. Mery, S. Tagliatela, V. Charpentier, and S. Cleuziou, 2002. Mangroves of Oman during the late Holocene: climatic implications and impact on human settlements. *Vegetation History and Archaeobotany* 11:221–232.

Lézine, A., J. Saliège, C. Robert, F. Wertz, and M. Inizan, 1998. Holocene lakes from Ramlat as-Sab'atayn (Yemen) illustrate the impact of monsoon activity in Southern Arabia. *Quaternary Research* 50:290–299.

Lighty, R. G., I. G. Macintyre, and R. Stuckenrath, 1982. Acropora palmata reef framework: a reliable indicator of sea level in the Western Atlantic for the past 10,000 years. *Coral Reefs* 1:5–130.

Macfadyen, W. A., and C. Vita-Finzi, 1978. Mesopotamia: the Tigris-Euphrates delta and its Holocene Hammar fauna. *Geology Magazine* 115:287–300.

Marcus, J., and G. M. Feinman, 1998. Introduction. In *Archaic States*, edited by G. M. Feinman and J. Marcus, pp. 3–13. School of American Research Press, Santa Fe, NM.

Masry, A., 1974. *Prehistory in Northeastern Arabia: The Problem of Interregional Interaction.* Field Research Projects, Coconut Grove, FL.

McClure, H. A., 1976. Radiocarbon chronology of late Quaternary lakes in the Arabian Desert. *Nature* 263:755–756.

McCorriston, J., and F. Hole, 1991. The ecology of seasonal stress and the origins of agriculture in the Near East. *American Anthropologist* 93:46–62.

Meadow, R.H., 1996. The origins and spread of agriculture and pastoralism in northwestern South Asia. In *The Origins and Spread of Agriculture and Pastoralism in Eurasia*, edited by D. R. Harris, pp. 390–412. Smithsonian Institution Press, Washington, D.C.

Meissner, B., 1920. *Babylonien und Assyrien I.* Winters, Heidelberg.

Melguen, M., 1973. Correspondence analysis for recognition of facies in homogeneous sediments off an Iranian river mouth. In *The Persian Gulf*, edited by B. H. Purser, pp. 99–113. Springer-Verlag, Berlin.

Moore, A. M. T., 1985. The development of Neolithic societies in the Near East. In *Advances in World Archaeology*, edited by F. Wendorf and A. Close, Vol. 4, pp. 1–69. Academic Press, New York.

Moseley, M., 1975. *The Maritime Foundations of Andean Civilization.* Cummings, Menlo Park, CA.

Nissen, H.-J., 1988. *The Early History of the Ancient Near East, 9000–2000 BC.* University of Chicago Press, Chicago.

Nissen, H-J., 2000. A Mesopotamian hierarchy in action in ancient Uruk. In *Hierarchies in Action: Cui Bono?*, edited by M. W. Diehl, pp. 210–217. Occasional Paper 27, Center for Archaeological Investigations, Southern Illinois University, Carbondale.

Nissen, H.-J., 2001. Cultural and political networks in the ancient Near East during the fourth and third millennia BC. In *Uruk Mesopotamia and Its Neighbors: Cross-Cultural Interactions in the Era of State Formation*, edited by M. S. Rothman, pp. 149–180. School of American Research, Santa Fe, NM.

Nissen, H.-J., P. Damerow, and R. K. Englund, 1993. *Archaic Bookkeeping*. University of Chicago Press, Chicago.

Nützel, W., 2004. *Einführun de Geo-Archäologie des Vorderen Orients.* Reichert Verlag, Wiesbaden.

Oates, J., 1960. Ur and Eridu, the prehistory. *Iraq* 22:32–50.

Oates, J., 1991. Babylonia and Elam in prehistory. In *Mésopotamie et Elam*, L. de Meyer and H. Gasche, pp. 23–26. Mesopotamian History and Environment Occasional Paper 1, Ghent.

Oates, J., 2004. Ubaid Mesopotamia revisited. In *From Handaxe to Khan: Essays Presented to Peder Mortensen on the Occasion of his 70th Birthday*, edited by K. von Folsach, H. Thrane, and I. Thuesen, pp. 87–104. Aarhus University Press, Aarhus.

Oates, D., and J. Oates, 1976. Early irrigation agriculture in Mesopotamia. In *Problems in Economic and Social Archaeology*, edited by G. Sieveking, I. H. Longworth, and K. E. Wilson, pp. 109–135. Duckworth, London.

Oates, J., T. E. Davidson, D. Kamilli, and H. McKerrell, 1977. Seafaring Merchants of Ur? *Antiquity* 51:221–234.

Ochsenschlager, E. L., 2004. *Iraq's Marsh Arabs in the Garden of Eden*. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Overpeck, J., D. Anderson, S. Trumbore, and W. Prell, 1996. The Southwest Indian monsoon over the Last 18,000 years. *Climate Dynamics* 12:213–225.

Pachur, H. J., and S. Kröpelin, 1987. Wadi Howar: paleoclimatic evidence from an extinct river system in the Southeastern Sahara. *Science* 237:298–300.

Pachur, H. J., and S. Kröpelin, 1989. L'aridification du Sahara Oriental á l'Holocéne moyen et supérieur. *Bulletin of the Society for Géology, France* 237:99–107.

Petit-Maire, N., 1986. Paleoclimates in the Sahara of Mali: a multidisciplinary study. *Episodes* 9:7–16.

Petit-Maire, N., 1990. Will greenhouse green the Sahara? *Episodes* 13:103–107.

Petit-Maire, N., 1992. Lire l'avenir dans les archives géologiques. *La Recherche* 243:566–570.

Petit-Maire, N., L. Beufort, and N. Page, 1997. Holocene climate change and man in the present day Sahara. In *Third Millenium BC Climate Change and Old World Collapse*, edited by H. Nuzhet Dalfes, G. Kukla, and H. Weiss, pp. 289–308. NATO ASI Series I: Global Environmental Change 49. Springer-Verlag, Berlin.

Pollock, S., 1992. Bureaucrats and managers, peasants and pastoralists, imperialists and traders: Research on the Uruk and Jemdet Nasr Periods in Mesopotamia. *Journal of World Prehistory* 6:297–336.

Pollock, S., 1999. *Ancient Mesopotamia: The Eden that Never Was.* Cambridge University Press, Cambridge.

Postgate, J. N., 1992. *Early Mesopotamia: Society and Economy at the Dawn of History.* Routledge, New York.

Potts, D. T., 1993. The late prehistoric, protohistoric, and early historic periods in Eastern Arabia ca. 5000–1200 B.C. *Journal of World Prehistory* 7:163–212.

Potts, D. T., 1996. Dilmun, Le paradis et la transgression Flandrienne. *Collected Papers of the Society for Near Eastern Studies* 5:21–27.

Potts, D. T., 1997. *Mesopotamian Civilization: The Material Foundations.* Cornell University Press, Ithaca, New York.

Pournelle, J. R., 2003. *Marshland of Cities: Deltaic Landscapes and the Evolution of Early Mesopotamian Civilization*. Unpublished Ph.D. dissertation, University of California, San Diego.

Prell, W. L., 1984. Monsoonal climate of the Arabian Sea during the late Quaternary; a response to changing solar radiation. In *Milankovitch and Climate*, edited by A. Berger, J. Imbrie, J. Hays, G. Kukla, and B. Saltzman, pp. 349–366. NATO ASI Series C: Mathematical and Physical Sciences 126. Riedel Publishing Co., Dordrecht.

Purser, B. H., and E. Seibold, 1973. The principal environmental factors influencing Holocene sedimentation and diagenesis in the Persian Gulf. In *The Persian Gulf: Holocene Carbonate Sedimentation and Diagenesis in a Shallow Epicontinental Sea*, edited by B. H. Purser et al., pp. 1–9. Springer-Verlag, New York.

Redman, C. L., 1978. *The Rise of Civilization: From Early Urban Society in the Ancient Near East.* W. H. Freeman and Company, San Francisco.

Ritchie, J. C., C. H. Eyles, and C. V. Haynes, 1985. Sediment and pollen evidence for an Early to Mid Holocene humid period in the Eastern Sahara. *Nature* 314:352–355.

Roaf, M., 1984. Ubaid houses and temples. *Sumer* 43:80–90.

Roberts, N., 1989. *The Holocene: An Environmental History*. Basil Blackwell, New York.

Roberts, N., and H. E. Wright Jr., 1993. Vegetational, lake-level, and climatic history of the Near East and Southwest Asia. In *Global Climates Since the Last Glacial Maximum*, edited by H. E. Wright, J. E. Kutzbach, T. Webb III, W. F. Ruddiman, F. A. Street-Perrott, and P. J. Bartlein, pp. 194–220. University of Minnesota Press, Minneapolis, MN.

Rossignol-Strick, M., 1987. Rainy periods and bottom water stagnation initiating brine accumulation and metal concentrations. *Paleoceanography* 2:333–360.

Rothman, M. S., 1994. Introduction Part I: evolutionary typologies and cultural complexity. In: *Chiefdoms and Early States in the Near East: The Organizational Dynamics of Complexity*, edited by G. Stein and M. S. Rothman, pp. 1–22. Prehistory Press, Madison, WI.

Rothman, M. S., 2001. The local and the regional: introduction. In *Uruk Mesopotamia and Its Neighbors: Cross-Cultural Interactions in the Era of State Formation*, edited by M. S. Rothman, pp. 3–26. School of American Research, Santa Fe, NM.

Rothman, M. S., 2002. *Tepe Gawra: The Evolution of a Small Prehistoric Center in Northern Iraq*. University of Pennsylvania, Museum of Archaeology and Anthropology, Philadelphia.

Rothman, M. S., 2004. Studying the development of complex society: Mesopotamia in the Late Fifth and Fourth Millennia BC. *Journal of Archaeological Research* 12:75–119.

Ryan, W., and W. Pitman, 1998. *Noah's Flood: The New Scientific Discoveries about the Event that Changed History.* Simon and Schuster, New York.

Sandweiss, D. H., K. A. Maasch, and D. G. Anderson, 1999. Transitions in the Mid-Holocene. *Science* 283:499–500.

Sanlaville, P., 1989. Considérations sur l'evolution de la Basse Mésopotamie au cours des derniers millénaires. *Paléorient* 15:5–27.

Sarnthein, M., 1971. Oberflächensedimente im Persischen Golf und Golf von Oman II. Quantitative Komponentenanalyse der Grobfraktion. In *Meteor Forschungsergebnisse, Herausgegeben von der Deutschen Forschungsgesellschaft*, edited by E. Seibold and H. Closs, pp. 1–82. Gebrüder Borntraeger, Berlin.

Sarnthein, M., 1972. Sediments and history of the postglacial transgression in the Persian Gulf and Northwest Gulf of Oman. *Marine Geology* 12:245–266.
Schmid, J. G., 1980. *Die Madrasa des Kalifen al-Mustansir in Baghdad*. Bagh. Forschungen 4. von Zabren, Mainz.
Seibold, E., and J. Ulrich, 1970. Zur Bodengestalt des nordwestlichen Golfs von Oman. In *Meteor Forschungsergebnisse: Herausgegeben von der Deutschen Forschungsgesellschaft*, edited by E. Seibold and H. Closs, pp. 1–14. Gebrüder Borntraeger, Berlin.
Seibold, E., and K. Vollbrecht, 1969. Die Bodengestalt des Persischen Golfs. In *Meteor Forschungsergebnisse: Herausgegeben von der Deutschen Forschungsgesellschaft*, edited by E. Seibold and H. Closs, pp. 31–56. Gebrüder Borntraeger, Berlin.
Service, E. R., 1978. Classical and modern theories of the origins of government. In *Origins of the State*, edited by R. Cohen and E. R. Service, pp. 21–34. Institute for the Study of Human Issues, Philadelphia.
Siddall, M., E. J. Rohling, A. Almogi-Labin, C. Hemleben, D. Meischner, I. Schmelzer, and D. A. Smeed, 2003. Sea-level fluctuations during the last glacial cycle. *Nature* 423:853–858.
Sirocko, F., M. Sarnthein, H. Erlenkeuser, H. Lange, M. Arnold, and J. C. Duplessy, 1993. Century-scale events in monsoonal climate over the past 24,000 years. *Nature* 364:322–324.
Smith, B. D., 1998. *The Emergence of Agriculture*. Scientific American Library, New York.
Smith, B. D., 2001. Low-Level food production. *Journal of Archaeological Research* 9:1–43.
Speiser, E. A., 1930. *Mesopotamian Origins*. University of Pennsylvania, Philadelphia.
Spier, F., 1996. *The Structure of Big History*. Amsterdam University Press, Amsterdam.
Stanley, D. J., and Z. Chen, 1996. Neolithic settlement distributions as a function of sea level-controlled topography in the Yangtze delta, China. *Nature* 24:1083–1086.
Stanley D. J., and A. G. Warne, 1993. Sea level and initiation of Predynastic culture in the Nile Delta. *Nature* 363:435–438.
Stanley D. J., and A. G. Warne, 1997. Holocene sea-level change and early human utilization of deltas. *GSA Today: A Publication of the Geological Society of America* 7(12):1–7.
Stein, G., 1994. Economy, ritual, and power in 'Ubaid Mesopotamia. In *Chiefdoms and Early States in the Near East: The Organizational Dynamics of Complexity*, edited by G. Stein and M. S. Rothman, pp. 35–46. Prehistory Press, Madison, WI.
Stein, G., 1998. Heterogeneity, power, and political economy: some current research issues in the archaeology of Old World Complex Societies. *Journal of Archaeological Research* 6:1–44.
Stein, G., 2001. Understanding ancient state societies in the Old World. In *Archaeology at the Millennium: A Sourcebook*, edited by G. Feinman and D. Price, pp. 353–379. Kluwer Academic, New York.
Street-Perrott, F. A., and R. A. Perrott, 1990. Abrupt climate fluctuations in the tropics: the influence of Atlantic Ocean Circulation. *Nature* 343:607–612.
Street-Perrott, F. A., and N. Roberts, 1983. Fluctuations in closed basin lakes as an indicator of past atmospheric circulation patterns. In *Variations in the Global Water Budget*, edited by A. Street-Perrott, M. Beran, and R. Ratcliffe, pp. 331–345. Reidel, Dordrecht.
Street-Perrott, F. A., N. Roberts, and S. Metcalfe, 1985. Geomorphic implications of late Quaternary hydrological and climatic changes in the Northern Hemisphere tropics. In *Environmental Change and Tropical Geomorphology*, edited by I. Douglas and T. Spencer, pp. 165–183. George Allen and Unwin, London.
Sukumar, R., R. Ramesh, R. K. Pant, and G. Rajagopalan, 1993. A δ^{13} C record of late Quaternary climate change from tropical peats in Southern India. *Nature* 364:703–706.

Teller, J., K. W. Glennie, N. Lancaster, and A. K. Singhvi, 2000. Calcareous dunes of the United Arab Emirates and Noah's Flood: The postglacial reflooding of the Persian (Arabian) Gulf. *Quaternary International* 68–71:297–308.

Tobler, A., 1950. *Excavations at Tepe Gawra*, Vol. 2. University Museum Monograph, University of Pennsylvania, Philadelphia.

Uerpmann, M., 1992. Structuring the Late Stone Age of southeastern Arabia. *Arabian Archaeology and Epigraphy* 3:65–109.

Uerpmann, M., and H.-P. Uerpmann, 1996. Ubaid pottery in the Eastern Gulf–new evidence from Umm al-Qaiwan (U.A.E.). *Arabian Archaeology and Epigraphy* 7:125–139.

Van Andel, T. H., 1989. Late Quaternary sea-level changes and archaeology. *Antiquity* 63:733–745.

Vita-Finzi, C., 1978. Recent alluvial history in the catchment of the Arabo-Persian Gulf. In *The Environmental History of the Near and Middle East Since the Last Ice Age*, edited by W. C. Brice, pp. 255–261. Academic Press, New York.

Warne, A. G., and D. J. Stanley, 1993. Archaeology to refine Holocene subsidence rates along the Nile delta margin, Egypt. *Geology* 21:715–718.

Weiss, H., 1997. Late Third Millennium abrupt climate change and social collapse in West Asia and Egypt. In *Third Millennium BC Climate Change and Old World Collapse*, edited by H. Nuzhet Dalfes, G. Kukla, and H. Weiss, NATO ASI Series Vol. I, 49, pp. 711–723. Springer-Verlag, Berlin.

Weiss, H., M.-A. Courty, W. Wetterstrom, F. Guichard, L. Senior, R. Meadow, and A. Curnow, 1993. The genesis and collapse of Third Millennium North Mesopotamian civilization. *Science* 261:995–1004.

Whitney, J. W., D. J. Faulkender, and M. Rubin, 1983. The environmental history and present condition of Saudi Arabia's northern sand seas. *Open File Report, U.S. Geological Survey*. U.S. Geological Surveys, Washington, D.C, pp. 83–749.

Wilkinson, T. J., 2003. *Archaeological Landscapes of the Near East*. The University of Arizona Press, Tucson.

Winterhalder, B., and C. Goland, 1997. An evolutionary ecology perspective on diet choice, risk, and plant domestication. In *People, Plants, and Landscapes: Studies in Paleoethnobotany*, edited by K. J. Gremillion, pp. 123–160. University of Alabama Press, Tuscaloosa, AL.

Wittfogel, K. A., 1957. *Oriental Despotism: A Comparative Study of Total Power*. Yale University Press, New Haven, CT.

Wittfogel, K. A., 1981. *Oriental Despotism*. Vintage, New York.

Woolley, C. L., 1929. *The Sumerians*. Clarendon Press, Oxford.

Woolley, C. L., 1955. *Ur Excavations IV. The Early Periods*. The British Museum and the University Museum, London and Philadelphia.

Wright, H. T., 1993. Environmental determinism in Near Eastern prehistory. *Current Anthropology* 34:458–469.

Wright, H. T., 1977. Recent research on the origin of the state. *Annual Review of Anthropology* 6:379–397.

Wright, H. T., 1981. The southern margins of Sumer: archaeological survey of the area of Eridu and Ur. In *Heartland of Cities*, edited by R. McC. Adams, pp. 295–324. University of Chicago Press, Chicago.

Wright, H. T., 1994. Prestate political formations. In *Chiefdoms and Early States in the Near East*, edited by G. Stein and M. S. Rothman, pp. 67–84. Prehistory Press, Madison, WI.

Wright, H. T., 1998. Uruk states in southwestern Iran. In *Archaic States*, edited by G. M. Feinman and J. Marcus, pp. 173–197. School of American Research Press, Santa Fe, NM.

Wright, H. T., 2001. Cultural action in the Uruk World. In *Uruk Mesopotamia and Its Neighbors: Cross-Cultural Interactions in the Era of State Formation*, edited by M. S. Rothman, pp. 123–148. School of American Research Press, Santa Fe, NM.
Wright, H. T., and G. A. Johnson, 1975. Population, exchange, and early state formation in Southwestern Iran. *American Anthropologist* 77:267–289.
Wright, H. T., and G. A. Johnson, 1985. Regional perspectives on southwest Iranian state development. *Paléorient* 11/2:25–30.
Wright, H. T., and S. Pollock, 1986. Colloques internationaux CNRS, Préhistoire de la Mésopotamie, 17–19 December 1984. Editions du CNRS, Paris, pp. 317–329.
Wright, H. T., and E. S. A. Rupley, 2001. Calibrated radiocarbon age determinations of Uruk-related assemblages. In *Uruk Mesopotamia and Its Neighbors: Cross-Cultural Interactions in the Era of State Formation*, edited by M. S. Rothman, pp. 85–122. School of American Research Press, Santa Fe, NM.
Yafeng, S., K. Zhaozheng, W. Sumin, T. Lingyu, W. Fubao, Y. Tandong, Z. Xitao, Z. Peiyuan, and S. Shaohua, 1993. Mid-Holocene climates and environments in China. *Global & Planetary Change* 7:219–233.
Yan, Z., and N. Petite-Maire, 1994. The last 140 ka in the Afro-Asian arid/semi-arid transitional zone. *Palaeogeography, Palaeoclimatology, Palaeoecology* 110:217–233.
Yoffee, N., 2005. *Myths of the Archaic State: Evolution of the Earliest Cities, States, and Civilizations.* Cambridge University Press, Cambridge.
Zarins, J., 1990. Early pastoral nomadism and the settlement of lower Mesopotamia. *Bulletin of the American Schools of Oriental Research* 280:31–65.
Zarins, J., 1992. The early settlement of southern Mesopotamia: a review of the recent historical, geological, and archaeological research. *Journal of the American Oriental Society* 112:55–77.
Zarins, J., A. Murad, and K. al-Yish, 1981. Comprehensive Archaeological Survey Program – the second preliminary report on the Southwestern Province. *Atlal* 5:9–42.
Zeder, M. A., and B. Hesse, 2000. The initial domestication of goats (Capra hircus) in the Zagros Mountains 10,000 years ago. *Science* 287:2254–2257.