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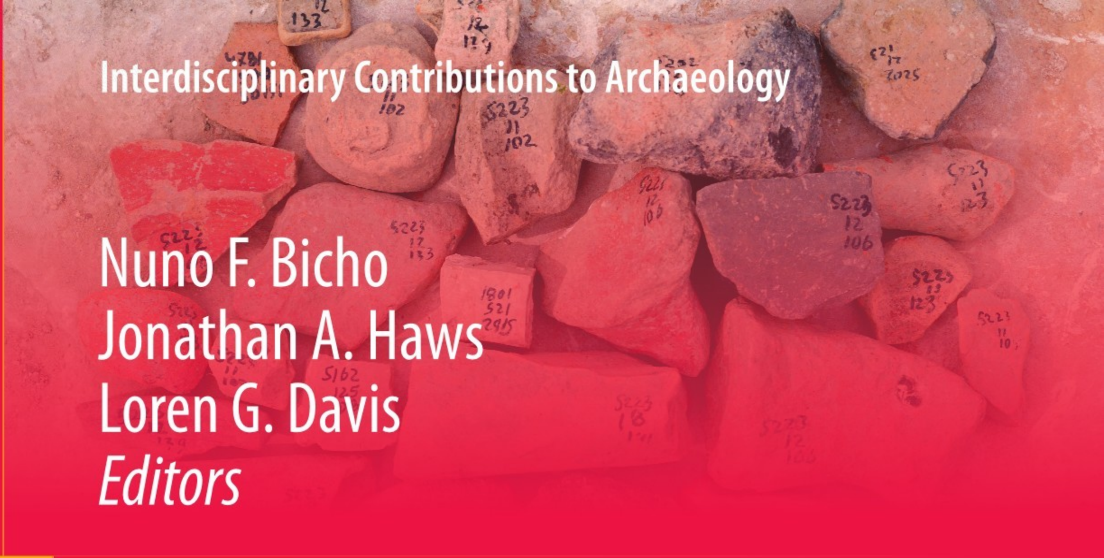

Nuno F. Bicho
Jonathan A. Haws
Loren G. Davis
Editors

Trekking the Shore

Changing Coastlines and the Antiquity of Coastal Settlement

Springer

Trekking the Shore

INTERDISCIPLINARY CONTRIBUTIONS TO ARCHAEOLOGY

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Trekking the Shore

Changing Coastlines and the Antiquity of Coastal Settlement

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Prologue

Nuro F. Bicho, Jonathan A. Haws, and Loren G. Davis

In the last decade, several review articles have laid the groundwork for a new appreciation of prehistoric human coastal adaptations and food resources (e.g., Bailey and Milner 2002; Bailey et al. 2008; Bailey and Flemming 2008; Erlandson 2001; Erlandson and Fitzpatrick 2006). These articles have renewed and updated many themes from previous decades and reframed the importance of coasts for human societies by casting off many negative assumptions about marine resources and environments. Coastal zones are no longer dismissed as marginal areas full of "fall-back" resources of limited economic value. Instead, coastal zones are being recast as primary eco-niches for humans from the earliest periods of prehistory to the present. This perspective shift flows from eight themes driving current interest in coastal archaeology that Erlandson and Fitzpatrick (2006) outlined in their inaugural article for the new *Journal of Island and Coastal Archaeology*. Much of the impetus for renewed interest in the antiquity of coastal adaptations derives from a number of research prerogatives including: the role marine resources played in human evolution and dispersal, including migration routes; improved paleoenvironmental studies that have led to new models for human eco-dynamics in coastal zones; application of new technology to explore, map, and characterize submerged landscapes; the recognition of human impacts on ancient marine environments; and cognitive approaches that use ethnography to inform on past human perceptions of coastal landscapes and seascapes. The majority of this new work has been developed in traditional areas of coastal archaeology including Scandinavia, the British Isles, and the Pacific Rim.

In the spirit of this new focus, we organized two conference symposia on the antiquity of coastal adaptations: one in Lisbon organized by Bicho and Haws for the 2006 UISPP congress, the other in Austin organized by Davis for the 2007 Society for American Archaeology meeting. While the SAA session focused on late Pleistocene colonization of western North America, the UISPP symposium emphasized prehistoric hunter–gatherer coastal adaptations in regions outside traditional research areas. The present volume seeks to expand the spatio-temporal coverage by highlighting the latest research on the antiquity of coastal adaptations.

Coastal Resources in Human Evolution

The earlier use of marine and estuarine resources during the Paleolithic has been documented over the last several decades (Antunes 1990–91, 2000; Barton 2000; Bicho and Haws 2008; Cleyet-Merle and Madelaine 1995; de Lumley 1969; McBurney 1967; Roche and Texier 1976; Roubet 1969; Souville 1973; Stiner 1994; Waechter 1964). Many of the early reports give simple lists of species without any critical review of how they got there or their importance in terms of hunter–gatherer adaptation. In spite of the recognition that most Pleistocene shores are now submerged and potential sites are unavailable, most archaeologists dismissed or ignored this evidence as incidental and concluded that Paleolithic people rarely utilized marine resources.

Within the last two decades, researchers have come to see coastal resources in a new light. Moving beyond energetic considerations that minimize their value, coastal resources are now thought to have played important roles in Paleolithic diet and subsistence (Kuhn and Stiner 2006; Parkington 2001; Pettitt et al. 2003; Stiner et al. 2000). In particular, coastal resources may have played a critical role in the development and expansion of the human brain and retinal quality by providing long-chain polyunsaturated fatty acids, specifically docosahexaenoic acid (DHA) and arachninoid acid (AA) present in the Omega 3 and Omega 6 series (Broadhurst et al. 1998, 2002; Crawford et al. 1999; Cunnane et al. 1993; Parkington 2001; Uauy and Dangour 2006). These fatty acids, invaluable during pregnancy and early childhood, are not produced in the human body (Broadhurst et al. 2002; Jensen 2006; Milligan & Bazinet 2008) but occur naturally in aquatic plants and animals. Many of these resources are easily gathered and thus would have been important elements in Paleolithic subsistence. Some of the easiest resources to collect are marine shellfish that also provide important sources of essential nutrients for brain development. Among edible species of shellfish, limpets produce the highest amounts of AA and DHA, at least during spawning periods (Brazão et al. 2003; Gardner & Riley 1972). Limpets are also the most common species in many of the early sites with coastal resources, including Neanderthal sites, such as Grotta Breuil, in Italy (Stiner 1994), Gorham's and Vanguard caves in Gibraltar (Baden Powell 1964; Barton 2000; Fa 2008; Brown et al. 2011), and Figueira Brava Cave in Portugal (Antunes 1990–91; Callapez 2000). For modern humans there are many early examples in South Africa at Klasies River Mouth (Voigt 1982), Pinnacle Point (Marean et al. 2007), Blombos Cave (Henshilwood et al. 2001b), Ysterfontein 1 (Avery et al. 2008), and Hoedjies Punt 3 (Parkington 2003) (see also Marean 2011; Sealy and Galimberti 2011) and in North Africa (Steele, this volume). For the Upper Paleolithic, there are numerous sites with shell assemblages dominated by limpets in Iberia including La Riera (Ortea 1986), Vale Boi (Bicho and Stiner 2006; Manne et al., this volume), Bajondillo (Cortés et al. 2008), and Cueva de Nerja (Morales et al. 1998).

If diet choice enabled human brain development and expansion then determining the antiquity of coastal adaptations becomes a critical research prerogative.

The current evidence places coastal resource use back to the Middle Pleistocene during which a significant leap in the encephalization quotient occurred with the appearance of *H. heidelbergensis* (Ruff et al. 1997). The presence of *H. erectus* in Indonesia on the island of Flores ~800 ka (Morwood et al. 1998) offers tantalizing evidence for very early sea crossing capability and would suggest good knowledge of tides necessary to make the trip (see Marean 2011). In Europe, the Middle Pleistocene sites Clacton-on-sea and Boxgrove (Roberts and Parfitt 1999) are located in coastal settings but no direct evidence of marine resource use has been documented. So far, the oldest evidence for shellfish consumption (de Lumley et al. 2004; Villa 1983) comes from Terra Amata (400 ka) and Grotte du Lazaret (250 ka) associated with *H. heidelbergensis*. Cognitive abilities are widely thought to have increased markedly in anatomically modern humans ~200 ka (Marean 2011; McBrearty and Brooks 2000). Early modern human shellfish exploitation is evident now at Pinnacle Point in South Africa dated to ~165 ka (Marean et al. 2007; this volume) and the other sites mentioned above. Evidence also exists for coastal settlement and resource utilization by *H. neanderthalensis*, in Italy (Stiner 1994), Portugal (Bicho 2004; Bicho and Haws 2008; Haws et al. 2011), Spain (Cortés, et al. 2008; Zilhão et al. 2010), and Gibraltar (Finlayson 2008; Brown et al. 2011). In any case, this evidence seems to suggest a frequent use of the coastal settings.

In the last two decades, archaeologists have documented human impacts on ancient marine and estuarine animal populations. This has emerged as a major research focus in coastal archaeology leading to a proliferation of data from around the world. For the Holocene, worldwide evidence now exists for "fishing down the food web" in coastal environments (Mannino and Thomas 2002; Rick and Erlandson 2008). For the Pleistocene, Klein (1998; Klein et al. 2004) and Stiner et al. (2000) have measured size diminution in shellfish between the Middle Stone Age/Middle Paleolithic and Late Stone Age/Upper Paleolithic assemblages in Africa and the Mediterranean Basin. Steele, Sealy, and Galimberti (this volume) present data to support and question the nature of the evidence.

Human Dispersal and Migration

Modern human development and diaspora is closely linked to the sea and the coastal settings. The intensive use of marine resources with specialized technologies seems to be an exclusive trait of modern humans. The presence of bone harpoons at Katanga (Yellen 1998) and bone points in association with fish bones in Blombos Cave (Henshilwood et al. 2001a) provide the earliest evidence for innovation. Rose (2007) and Petraglia and Rose (2009) have championed a Red Sea crossing from the East Africa (Kenya, Somalia, Djibouti, and Eritrea) to the Arabian Peninsula (Oman and Yemen), for the dispersion of modern humans out of Africa and into Asia. The sea was a fundamental factor on the dispersal of modern humans to many archipelagos in the Indian and the Pacific oceans, including New Guinea/Papua (>35 ka), Australia (40 ka), New Ireland (30 ka), and the Japanese islands

(26 ka) (Allen et al. 1989; Matsu'ura 1996; Roberts et al. 1990; Thorne et al. 1990). These cases are remarkable because they challenge widely held beliefs that humans lacked significant seafaring capabilities prior to the mid-late Holocene.

Three decades after Fladmark's (1979) logical argument, it now appears that the peopling of the Americas was likely a coastal migration. A coastal migration readily explains the early settlement of Monte Verde at the tip of South America. Coastal settings were highly rich in biomass and offered numerous easy accessible dietary resources. Not surprisingly, the earliest evidence for human settlement along the West coasts of both continents also includes use of coastal resources (Erlandson et al. 2007, 2008; for a critical review see Davis 2011).

Coastal Environments and Human Adaptation

Fifteen years ago, Price (1995) called for increased understanding of the linkages between coastal productivity and the archaeological record of human adaptations. As Perlman (1980) noted previously, coastal environments are highly variable in productivity and attractiveness to humans. As a result, human settlement and resource use in these areas will vary in space and time as productivity changes.

Two of the richest types of coastal environments are associated with estuaries and upwelling zones. Human settlement often occurs in these environments because they are ecotone settings where aquatic and terrestrial ecosystems converge. Thus, it may be possible to predict human settlement intensity in areas with good paleoenvironmental data sets. A substantial body of paleoclimatic and oceanographic research completed in the last couple of decades has enabled ever increasing spatiotemporal resolution of data for paleoenvironmental reconstructions in coastal zones. We now have improved data showing important fluctuations in ocean productivity through time that can be used to build and test models for human settlement that attempt to correlate the two. During cold events in the Pleistocene, upwelling systems strengthened along western Europe as wind circulation intensified due to the growth of ice sheets and compression of temperature gradients towards the equator. Terrestrial ecosystems on the European continent suffered reduced biomass as a result of altered precipitation patterns. Coastal zones were probably critical places for survival along the western margins of the European continent. With lowered sea level, water tables shifted and increased surface water availability near shores (Faure et al. 2002; Sauer 1962). This in turn would have led to the concentration of terrestrial plants and animals in the coastal zone creating a rich ecotone setting for human exploitation. It is not surprising that we find early coastal sites along the western margins of the European continent where upwelling zones occur.

Along the Pacific Rim of the New World, geologic records indicate that, unlike Europe, upwelling systems were apparently quite variable during the Pleistocene, and cold glacial and interstadials periods were accompanied by lower marine productivity. Furthermore, western North American precipitation patterns were greatly enhanced during the Pleistocene, promoting the growth of massive pluvial lakes and highly productive wetland ecosystems throughout modern-day desert regions. Although different than the European situation, North American marine ecosystems are clearly used by the Younger Dryas interval and South American coastal resources are first used during the Bølling-Ållerød period.

Archaeological Record of Coastal Settlement and Resource Use

The archaeological record of coastal settlement is well documented for the period since present sea level was reached in the last few millennia. The best known places include the North Atlantic, especially Scandinavia and the British Isles, and the Pacific Rim. These areas have been investigated for well over a century and have produced a substantial body of evidence for Holocene coastal adaptations. Despite this research there are still many areas that require systematic survey of coastal margins to understand regional variability in coastal settlement and resource use. Chapters by Brown, Manne, Bonomo, Muñoz, Stothert, Tabarev, and Ulm illustrate this variability in the appearance coastal settlement and of marine and estuarine resources (fish, shellfish, shore birds, marine mammals).

The lack of evidence for widespread Pleistocene coastal adaptations has been the subject of discussion and debate for decades (e.g., the Broad Spectrum Revolution model – Brinford 1968; Flannery 1969). The most basic factor limiting the visibility of coastal sites is the position of ancient shorelines. The distance to the shore is a major factor in the location of coastal sites in prehistory. As many have observed, coastal food resources are rarely transported more than 10 km away from the shore and most of the evidence has accumulated with 2–4 km (Meehan 1982; Erlandson 2001). The position of ancient shorelines is critical to the antiquity of coastal adaptations (Bailey and Parkington 1988; Shackleton 1988). This requires local and regional scale studies of offshore bathymetry, submerged landscapes, coastal geomorphology, isostatic rebound, and neotectonism that can be used to build predictive models of coastal settlement and target archaeological survey for early Holocene and Pleistocene coastal sites. Obviously, discovering earlier coastal sites is made difficult by the impact of postglacial sea level rise on the Paleolithic archaeological record. The fact that for the last 120,000 years sea level remained considerably lower than today (–60 to −120 m) means that the continental shelf extended considerably in many places. The now-submerged platform used by Paleolithic hunter–gatherers, was also exposed before the previous sea highstand, the MIS 5e. It is very likely that an incredibly high number of sites were submerged and may still be preserved underwater (Bailey and Flemming 2008). The submerged region is a very large exceeding 16 million km^2 (Bailey 2004), or about 10% of the total current habitable land surface.

Finding the Sites

There are a number of possible situations for discovering earlier coastal sites: submerged sites from previous lowstands, sites from previous interglacial highstands still visible on land, tectonically or isostatically uplifted sites from before the Atlantic transgression. This present volume includes several contributions by Gusick and Faught, Des Lauriers, Mackie, Davis, and Haws that cover these situations.

Submerged Landscapes and Underwater Archaeology

In the early twentieth century, Clement Reid recognized the "lost world" of now-submerged Pleistocene landscapes around the British Isles. His book, *Submerged Forests* (1913), documented the first evidence of the flooded landscape of what is now known as Doggerland. The implications were not lost on Grahame Clark who subsequently articulated the archaeological significance of this drowned landscape (Clark 1936). Over the following decades, geographers and archaeologists began to compile evidence for Pleistocene coastal settlement and resource use around the world. Work focused on the potential for submerged archaeological sites on the inner continental shelf (e.g., Emery and Edwards 1966) and the importance of coastal resources to prehistoric people (e.g., Meighan 1969; Moseley 1975; Sauer 1962). Additional effort was aimed at correlating raised marine platforms with glacial/interglacial cycles. Lacking precise radiometric dating methods, stone artifact typologies were used to establish age control in the Old World. In the 1960s, Richards and Fairbridge (1965, 1970, also Richards 1974) complied annotated bibliographies to systematically compile the global evidence of Pleistocene raised beaches and archaeological sites. The works collectively demonstrated the existence of extensive geological and archaeological records of interglacial sea-level highstands, tectonically raised marine deposits with associated Paleolithic artifacts and potentially widespread evidence for Paleolithic coastal adaptations. In the 1980s, Masters and Flemming (1983) published a landmark volume on the antiquity of coastal adaptations and archaeological evidence for coastal settlement. Their collection, *Quaternary Coastlines and Marine Archaeology: Towards the Prehistory of Land Bridges and Continental Shelves*, evolved out of a Scripps conference focused on sea-level fluctuations, paleoenvironmental setting of submerged prehistoric sites and up-to-date information from surveys and excavations of submerged sites around the world.

Since then, new technologies for deep-sea exploration have been increasingly applied to searching for submerged archaeological sites, including shipwrecks, and landscapes. Robert Ballard's (2008 and Ballard et al. 2001) work in the Black Sea captured the public imagination that is an important element in attracting the necessary funding to support submerged archaeology. Less publicized but equally important research on submerged landscapes and archaeology has been undertaken in many places including the Pacific Northwest (Josenhans et al. 1995; Mackie et al. 2011), Baja California (Gusick this volume), Gulf of Mexico (Dunbar et al. 1992;

Evans et al. 2007; Faught 2004; Gusick and Faught 2011), New England (Coleman & McBride 2008), Newfoundland (Westley and Dix 2006), Ireland (Quinn et al. 2008), the U.K., (Plets et al. 2007), the North Sea (Coles 1998; Gaffney et al. 2008), Denmark (Fischer 1995), Mediterranean Sea, Red Sea, and South Australia (Flatman et al. 2006). Most of these projects are tied to significant questions of anthropological interest or cultural heritage. The striking potential of submerged archaeology is best seen by the discoveries of Tybrind Vig off Denmark and Bouldnor Cliff off the Isle of Wight. These Mesolithic sites have yielded amazing preservation of organic materials that attest to large amount of evidence that is missing from terrestrial sites. As the new technologies become more widely applied we expect to see similar evidence from Paleolithic sites emerge from greater depths. Many ongoing projects have the potential to yield significant new information about the antiquity of coastal adaptations.

In the United States, the National Oceanic and Atmospheric Administration and private interests have funded a new underwater project by James Adovasio and Andy Hemmings to survey and map the submerged landscape and archaeological record off the coast of Northwest Florida using side-scanning sonar, sub-bottom profiling, and diving. The project titled, "*The First Snowbirds: The Archaeology of Inundated Late Pleistocene Landscapes in the Northeastern Gulf of Mexico*" is designed to address the nature and timing of human entry into the New World. On the opposite coast, Gusick and Davis (2009) have also received NOAA funds to search for early submerged shorelines and sites in Mexico's Sea of Cortez. Mackie and Fedje (this volume) have been conducting similar research funded by the Canadian government.

The Deutsches Archäologisches Institut has been conducting an underwater survey of northern Germany. The project, "Sinking Coasts: Geosphere, Climate and Anthroposphere of the Holocene Southern Baltic Sea" (SINCOS II), began after discoveries of late Mesolithic and Neolithic sites offshore in the 1990s.

In the U.K., Byrony Coles (1998) renewed archaeological interest in the submerged landscape of Doggerland with her "speculative survey." Following up on her work, Gaffney et al. (2007) engaged the exploratory oil and gas industry to use their seismic surveys to make highly detailed maps of Doggerland topography and hydrology. Along this vein, the Irish National Strategic Archaeological Research (INSTAR) Programme recently funded a Submerged Landscapes Archaeological Network (SLAN) project to engage cooperative relationships with the Joint Irish Bathymetric Survey in an effort to reconstruct the paleogeography of submerged landscapes and investigate the potential archaeological record.

The recent European Union funding of the transnational and interdisciplinary project *Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf* by the European Cooperation in Science and Technology (COST) program demonstrates a significant commitment to submerged archaeology and the antiquity of coastal settlement. The project is not geared towards data collection as it is building awareness of the significance of drowned landscapes and underwater archaeology as a first step to establishing a framework to bring together scientists, government agencies, commercial and industrial entities to promote research, guide heritage management and policy-making, and understand the impact of future sea-level change. The enormous costs for characterizing and investigating the submerged landscapes and archaeology of the continental shelf require a cooperative engagement between scientists, industry, and government. This framework is designed to encourage sharing knowledge and expertise. This represents another combined academic and governmental agency project that will efficiently use resources to increase the feasibility of submerged landscape archaeology.

The challenge in all of the current underwater research is to get deeper to older submerged landscapes. With seismic surveying, side-scanning sonar and sub-bottom profiling, potential survey areas can be identified but excavation is problematic due to logistics and cost. Nearly all of the projects operate within the limits of SCUBA and getting deeper requires more expensive submersible transport vehicles to conduct extensive excavation.

Visibility on Land

Pleistocene coastal sites are seldom visible on land except under special conditions. During earlier highstands like MIS 5e, the sea was 3–5 m higher than today and coastal sites dated to the Last Interglacial have been found in close proximity to ancient shores. Examples exist from North Africa at Grotte des Contrabandiers (Roche and Texier 1976; Souville 1973; Steele, this volume) and Haua Fteah (McBurney 1967), along the Red Sea at Abdur (Bruggeman et al. 2004; Walter et al. 2000), and South Africa at Klasies River Mouth (Singer and Wymer 1982, Marean 2011), Blombos cave and Pinnacle Point (Marean 2011). Many other possible sites exist in Africa and Eurasia but these are undated and occur in secondary context on raised marine platforms.

In areas with narrow continental shelves and steep bathymetry, the distance to the glacial shorelines is lessened and evidence for coastal settlement and resource use may be found. Situations like this are found along the Iberian Peninsula and include Nazaré and Sesimbra, in central Portugal (Haws et al. 2011), Algarve (Bicho 2004; Bicho and Haws 2008; Manne, this volume), Gibraltar (Brown et al. 2011), Malaga (Morales et al. 1998), and Cantabria (Bailey and Craighead 2003; Gutiérrez Zugasti 2011).

Secondly, in tectonically active areas, coastal uplift may alter the relative distance from sites to the ancient shoreline (Bailey and Flemming 2008; Bicho and Haws 2008; Haws et al. 2011). Many sites including Mira Nascente and Figueira Brava in Portugal (Benedetti et al. 2009; Haws et al. in press, 2011) have been preserved on land due to these processes.

Organization of the Volume

We organized the volume in two sections, based on latitude. Part I includes chapters on North America and Eurasia; Part Two comprises papers on South America, Africa and Oceania (Fig. 1).

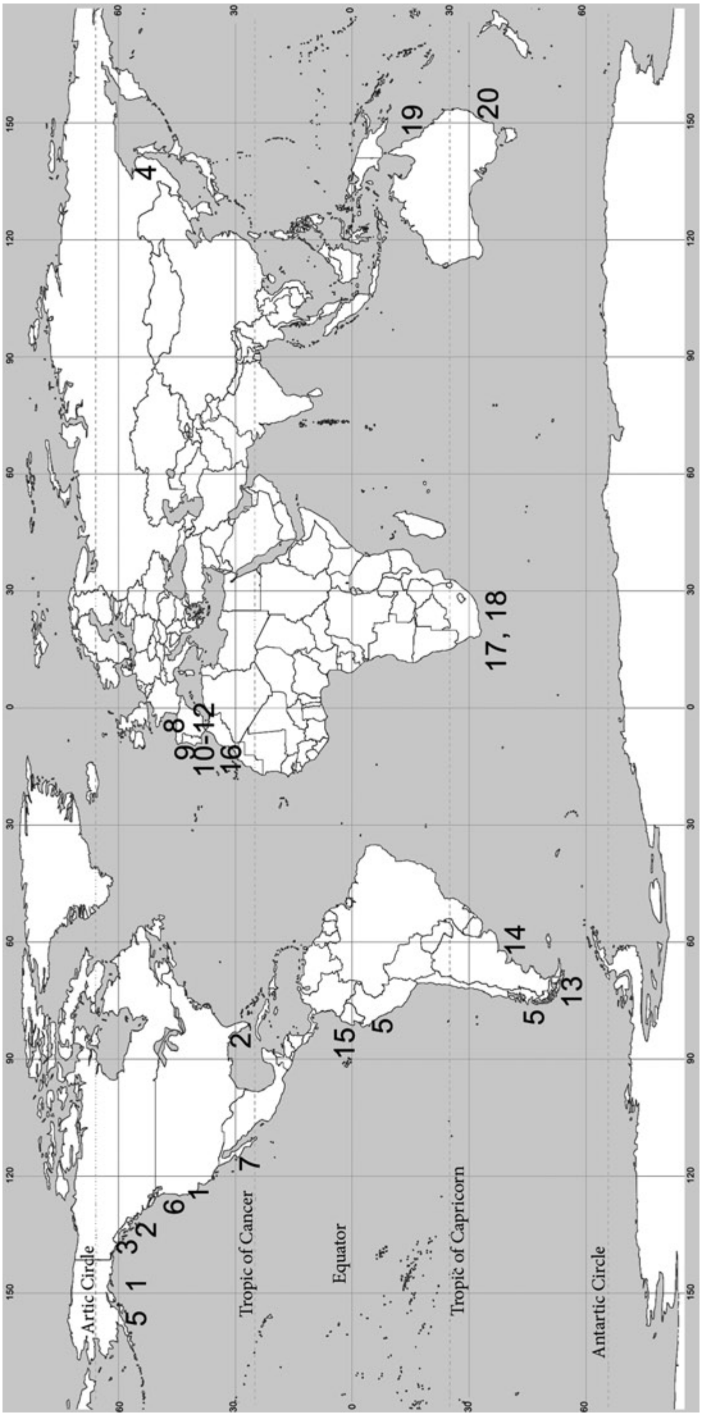

Fig. 1 Map with location of sites from each chapter. Base map adapted from http://kantan-net.main.jp

Davis leads off Part One with a contemporary and provocative review of the archaeological evidence for early coastal settlement of North America. Gusick and Faught present compelling arguments for the importance of underwater archaeology in the study of early coastal human occupations and migration routes for initial peopling of the Americas. The antiquity of North American coastal adaptations is reviewed and critically evaluated in various papers, covering the eastern Pacific from Canada's Northwest Coast (Chap. 3), the Pacific Northwest (Chap. 6), and Baja California (Chap. 7). Willis and Des Lauriers offer a broad view of technological patterns revealed in late Pleistocene-aged coastal sites from North and South America and their implications for early maritime adaptations.

On the other side of the Pacific, Tabarev describes the development and consolidation of salmon fishing in the Russian Far East. Brown et al. and Haws et al. address the late survival of Neanderthals in Iberian coastal zones and their subsequent replacement by modern humans, seen in and Manne and Bicho on Southern Iberia.

Gutiérrez Zugasti centers his discussion on the importance of shellfish exploitation in the Bay of Biscay during the Upper Paleolithic. The question of whether coastal resources were important during the emergence of the Neolithic in Southern Iberia is discussed by Dean and Carvalho, suggesting that in fact, at least in the process of neolithization of Portugal, coastal resources were used as frequently as any terrestrial prey species.

In Part II, chapters by Bonomo, Muñoz, and Stothert on South America focus on early prehistoric coastal settlement and resource use, giving unequivocal evidence for the early use of marine mammals, fish, and shellfish. Attenbrow and Ulm provide similar evidence for southeastern and northeastern Australia, respectively. Chapters by Marean, Steele and Sealy and Galimberti bestow attention (either centrally or peripherally) to the importance of coastal zones for the emergence and spread of modern humans around the African continent.

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References

Allen, J., Gosden, C., and White, J., 1989. Pleistocene New Ireland. *Antiquity* 63:548–561.

Antunes, M., 1990–91. O Homem da gruta da Figueira Brava (ca. 30.000 BP). *Memórias da Academia das Ciências de Lisboa, Classe Ciências*, 31:487–536.

Antunes, M., 2000. The Pleistocene fauna from Gruta da Figueira Brava: a synthesis. *Memórias da Academia das Ciências de Lisboa. Classe de Ciências*, XXVIII, 259–282.

Avery, G., Halkett, D., Orton, J., Steele, T., Tusenius, M., and Klein, R., 2008. The Ysterfontein 1 Middle Stone Age Rockshelter and the evolution of coastal foraging. *South African Archaeological Society Goodwin Series*, 10:66–89.

Baden-Powell, D. F. W., 1964. Gorham's Cave, Gibraltar: report on the climatic equivalent of the marine mollusca. *Bulletin of the Institute of Archaeology*, 4:216–218.

Bailey, G., 2004. World prehistory from the margins: the role of coastlines in human evolution. *Journal of Interdisciplinary Studies in History and Archaeology*, 1:39–50.

Bailey, G., Carrión, J., Fa, D., Finlayson, C., Finlayson, G., and Rodríguez-Vidal, J., 2008. Introduction. The coastal shelf of the Mediterranean and beyond: corridor and refugium for human populations in the Pleistocene. *Quaternary Science Reviews*, 27:2095–2099.

Bailey, G., Craighead, A., 2003. Late Pleistocene and Holocene palaeoeconomies: a reconsideration of the molluscan evidence from Northern Spain. *Geoarchaeology*, 18:175–204.

Bailey, G. and Flemming, N., 2008. Archaeology of the continental shelf: marine resources, submerged landscapes and underwater archaeology. *Quaternary Science Reviews*, 27: 2153–2165.

Bailey, G. and Milner, N., 2002. Coastal hunter-gatherers and social evolution: marginal or central?, *Before farming: the archaeology of Old World Hunter-Gatherers*, 3–4,1–15.

Bailey, G., and Parkington, J., 1988. The archaeology of prehistoric coastlines: an introduction. In: G. N. Bailey and J. Parkington (eds.), The Archaeology of Prehistoric Coastlines, Cambridge University Press, Cambridge, pp. 1–10.

Ballard, R. D., F. T. Hiebert, D. F. Coleman, C. Ward, J. Smith, K. Willis, B. Foley, K. Croff, C. Major, and F. Torre 2001. Deepwater archaeology of the Black Sea: the 2000 season at Sinop, Turkey. *American Journal of Archaeology*, 105:607–623.

Ballard, R. D. (Ed.) 2008. *Archaeological Oceanography* Princeton University Press, Princeton.

Barton, N., 2000. Mousterian hearths and shellfish: Late Neanderthal activities on Gibraltar. In: C. B. Stringer, R. N. E. Barton, and J. C. Finlayson (Eds.), *Neanderthals on the Edge*, Oxbow Books, Oxford, pp. 211–220.

Benedetti, M. M., Haws, J. A., Funk, C. L., Daniels, J. M., Hesp, P. A., Bicho, N. F., Ellwood, B. B. & Forman, S. L., 2009. Late Pleistocene raised beaches of coastal Estremadura, central Portugal. *Quaternary Science Reviews*, 28:3428–3447.

Bicho, N. & Stiner, M., 2006. Gravettian coastal adaptations from Vale Boi, Algarve (Portugal). In Sanchadrian, J., Belén Marquez, A. & J. Fullola y Pericot (eds.) *La cuenca mediterránea durante el Paleolítico Superior. Reunión de la VIII Comisión del Paleolítico Superior.*, pp. 92–107. Fundación Cueva de Nerja: Nerja.

Bicho, N., 2004. The Middle Paleolithic Occupation of Southern Portugal. In: N. Conard (ed.), *Settlement Dynamics of the Middle Paleolithic and Middle Stone Age, Volume II*, Kerns Verlag, Tübigen, pp. 513–531.

Bicho, N., Haws, J., 2008. At the land's end: marine resources and the importance of fluctuations in the coastline in the prehistoric hunter-gatherer economy of Portugal. *Quaternary Science Reviews*, 27:2166–2175.

Brazão, S., Morais, S., Boaventura, D, Ré, P., Narciso, L. & Hawkins, S., 2003. Spatial and temporal variation of the fatty acid composition of *Patella* sp. (Gastropoda: Prosobranchia) soft bodies and gonads. *Comparative Biochemistry and Physiology Part B*. 136:425–441.

Broadhurst, C. L., Cunnane, S. C., & Crawford, M., 1998. Rift Valley lake fish and shellfish provided brain-specific nutrition for early *Homo*. *British Journal of Nutrition*, 79:3–21.

Broadhurst, C. L., Wang, Y., Crawford, M. A., Cunnane, S. C., Parkington, J. E. & Schmidt, W., 2002. Brain-specific lipids from marine, lacustrine, or terrestrial resources: potential impact on early African *Homo sapiens*. *Comparative Biochemistry and Physiology Part B*. 131:653–673.

Brown, K., D. A. Fa, G. Finlayson and C. Finlayson. 2011. Small-game and marine resource exploitation by Neanderthals: The evidence from Gibraltar. In Trekking the shore, harvesting the sea: changing coastlines and the antiquity of coastal settlement. New York, Springer.

Bruggeman, J., Buffler, R., Guillaume, M., Walter, R., von Cosel, R., Ghebretensae, B., and Berhe, S., 2004. Stratigraphy, paleoenvironments and model for the deposition of the Abdur Reef Limestone: context fro an important archaeological site from the last interglacial on the Red Sea coast of Eritreia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 203:179–206.

Callapez, P., 2000. Upper Pleistocene marine invertebrates from Gruta da Figueira Brava (Arrábida, Portugal). *Memórias da Academia das Ciências de Lisboa. Classe de Ciências, XXXVIII*, 83–103.

Clark., J. G., 1936. *The Mesolithic Age in Britain*. Cambridge: Cambridge University Press.

Cleyet-Merle, J. and Madelaine, S., 1995. Inland evidence of human sea coast exploitation in Paleolithic France. In Fischer, A., (ed.), *Man and the sea*, pp. 303–308. Oxbow Monographs, 53. Oxford.

Coleman, D. F., and McBride, K., 2008. Underwater Prehistoric Archaeological Potential of the Southern New England Continental Shelf off Block Island. In: R. Ballard, ed., *Archaeological Oceanography*, p. 200–223. (Princeton University Press),

Coles, B., 1998. Doggerland: a speculative survey. *Proceedings of the Prehistoric Society*, 64:45–82.

Cortés-Sánchez, M., Morales-Muñiz, A., Simón-Vallejo, M. D., Bergadá-Zapata, M. M., Delgado-Huertas, A., López-García, P., López-Sáez J. A., Lozano-Francisco, M. C., Riquelme-Cantal, J. A., Roselló-Izquierdo, E., Sánchez-Marco, A. & Vera-Peláez, J., 2008. Palaeoenvironmental and cultural dynamics of the coast of Málaga (Andalusia, Spain) during the Upper Pleistocene and Early Holocene. *Quaternary Science Reviews*, 27(23–24):2176–2193.

Crawford, M. A., Bloom, M., Broadhurst, C. L., Schmidt, W. F., Cunnane, S. C., Galli, C., Gehbremeskel, K., Linseisen, F., Lloyd-Smith, J., and Parkington, J., 1999. Evidence for the unique function of docosahexaenoic acid during the evolution of the modern hominid brain. *Lipids*, *34, Supplement*, S39–S47.

Cunnane, S. C., Harbige, L. S., & Crawford, M., 1993. The importance of energy and nutrient supply in human brain evolution. *Nutrition and Health*, 9:219–235.

Davis, L., 2011. The North American Paleocoastal Concept Reconsidered. In Trekking the shore, harvesting the sea: changing coastlines and the antiquity of coastal settlement. New York: Springer.

de Lumley, H., 1969. A paleolithic camp site at Nice. *Scientific American*, 220:42–50.

de Lumley, H., Echassoux, A., Bailon, S., Cauche, D., Machi, M.-P.d., Desclaux, E., el Guennouni, K., Khatib, S., Lacombat, F., Roger, T., & Valensi, P., 2004. *Le Sol d'Occupation Acheuéen de l'Unite Archéostrigraphique UA 25 de la Grotte du Lazaret, Nice, Alpes-Maritimes*. Aix-en-Provence: ÉDISUD.

Dunbar, J. S., Webb, S. D. & Faught., M. 1992. Inundated sites in Apalachee Bay, Florida, and the search for the Clovis shoreline. In *Paleoshorelines and Prehistory: An Investigation of Method,* (Eds, Johnson, L. L. & Stright, M.), pp. 117–146. CRC Press, Boca Raton.

Emery, K. O. and R. L. Edwards. 1966. Archaeological potential of the Atlantic continental shelf. *American Antiquity*, 31:733–737.

Erlandson, J. M., 2001. The archaeology of aquatic adaptations: paradigms for a new millennium. *Journal of Archaeological Research*, 9:287–350.

Erlandson, J. and Fitzpatrick, S., 2006. Oceans, Islands, and coasts; current perspectives on the role of the sea in Human Prehistory. *Journal of Island and Coastal Archaeology*, 1:5–32.

Erlandson, J., Moss, M., and des Lauriers, M., 2008. Life on the edge: early maritime cultures of the pacific of North America. *Quaternary Science Reviews*, 27:2232–2245.

Erlandson, J., Graham, M., Bourque, B., Corbett, D., Estes, J., and Steneck. R., 2007. The kelp highway hypothesis: Marine ecology, the coastal migration theory, and the peopling of the Americas. *Journal of Island and Coastal Archaeology*, 2:161–174.

Evans, A., R. Floyd and M. Keith. 2007. *Identifying offshore prehistoric sites from remote sensing data: preliminary site investigation in the Gulf of Mexico*. Paper presented to the 72nd annual meeting for the Society for American Archaeology, Austin.

Fa, D., 2008. Effects on tidal amplitude on intertidal resource availability and dispersal pressure in prehistoric human coastal populations: the Mediterranean-Atlantic transition. *Quaternary Science Reviews*, 27:2194–2209.

Faught, M. K., 2004. The underwater archaeology of paleolandscapes, Apalachee Bay, Florida. *American Antiquity*, 69:235–249.

Faure, H., Walter, R. C. & Grant, D. R., 2002. The coastal oasis: ice age springs on emerged continental shelves. *Global and Planetary Change*, 33:47–56.

Fischer, A. (ed.) 1995. *Man and Sea in the Mesolithic: Coastal Settlement above and below Present Sea Level*. Oxbow, Oxford.

Finlayson, C., 2008. On the importance of coastal areas in the survival of Neanderthal populations during the Late Pleistocene. *Quaternary Science Reviews*, 27:2246–2252.

Fladmark, K. R., 1979. Routes: alternate migration corridors for Early Man in North America. *American Antiquity*, 44:55–69.

Flannery, K. V., 1969. Origins and ecological effects of early domestication in Iran and the Near East. In: P. J. Ucko and G. W. Dimbleby (eds.), The Domestication and Exploitation of Plants and Animals., Aldine, Chicago, pp. 73–100.

Flatman, J., M. Staniforth, D. Nutley, and D. Shefi. 2006. *Submerged cultural landscapes.* Proceedings of the Understanding Cultural Landscapes Symposium. Humanities Research Centre. Flinders University.

Gardner, D. & Riley, J., 1972. The component fatty acids of the lipids of some species of marine and freshwater mollusks. *J. Mar. Biol. ASS. U.K.* 52:827–838.

Gaffney, V., Thomson, K., Fitch, S. (Eds.), 2007. *Mapping Doggerland: the Mesolithic Landscapes of the Southern North Sea*. Archaeopress, Oxford.

Gusick, Amy E. and Loren G. Davis, 2009. *Mal de mer no mas: discovery of an underwater site in the Sea of Cortez*. Paper presented to the 74th Annual Meeting for the Society for American Archaeology, Atlanta.

Gusick, A. and M. Faught., 2011. Prehistoric Archaeology Underwater: A Nascent Subdiscipline Critical to Understanding Early Coastal Occupations and Migration Routes. In Trekking the shore, harvesting the sea: changing coastlines and the antiquity of coastal settlement. New York: Springer.

Gutiérrez Zugasti, F. I., 2011. Changes in the molluscan exploitation patterns during the late Pleistocene and early Holocene in the eastern Cantabria (Spain). In N. Bicho, J. Haws, L. Davis (eds.) Trekking the shore, harvesting the sea: changing coastlines and the antiquity of coastal settlement. New York, Springer.

Haws, J., M. Benedetti, C. Funk, N. Bicho, J. M. Daniels, P. A. Hesp, T. A. Minckley, S. Forman, M. Jeraj, J. F. Gibaja, B. Hockett, in press. Coastal wetlands and the Neanderthal settlement of Portuguese Estremadura. *Geoarchaeology.*

Haws, J., C. L. Funk, M. B. Benedetti, N. F. Bicho, J. M. Daniels, T. A. Minckley, R. F. Denniston, M. Jeraj, J. F. Gibaja and B. S. Hockett. 2011. Paleolithic seascapes along the west coast of Portugal. In Trekking the shore, harvesting the sea: changing coastlines and the antiquity of coastal settlement. New York: Springer.

Henshilwood, C., F. D'Errico, C. W. Marean, R. G. Milo, and R. J. Yates, 2001a. An Early Bone Tool Industry from the Middle Stone Age, Blombos Cave, South Africa: Implications for the Origins of Modern Human Behavior, Symbolism and Language. *Journal of Human Evolution*, 41:631–678.

Henshilwood, C. S., Sealy, J., Yates, R., Cruz-Uribe, C., Goldberg, P. Grine, F., Klein, R., Poggenpoel, C., Van Niekerk, K., and Watts, I., 2001b. Blombos Cave, southern Cape, South Africa: preliminary report on the 1992-1999 excavations of the Middle Stone Age levels. *Journal of Archaeological Science*, 28:421–448.

Jensen, C. L., 2006. Effects of n-3 fatty acids during pregnancy and lactation. *American Journal of Clinical Nutrition*, 83(6):S1452–1457S.

Josenhans, H. W., D. W. Fedje, K. W. Conway and J. V. Barrie. 1995. Post glacial sea levels on the western Canadian continental shelf: evidence for rapid change, extensive subaerial exposure, and early human habitation. *Marine Geology*, 125:73–94.

Klein, R. G., 1998. Why anatomically modern people did not disperse from Africa 100,000 years ago, in T. Akazawa, K. Aoki & O. Bar-Yosef (eds) *Neanderthals and modern humans in Western Asia*: 509–21. New York: Plenum.

Klein, R. G., G. Avery, K. Cruz-Uribe, D. Halkett, J. E. Parkington, T. Steele, T. P. Volman & R. Yates. 2004. The Ysterfontein 1 Middle Stone Age site, South Africa, and early human exploitation of coastal resources. *Proceedings of the National Academy of Sciences*, 101(16): 5708–15.

Kuhn, S. L. & Stiner, M. C., 2006. What's a mother to do? The division of labor among Neandertals and modern humans in Eurasia. *Current Anthropology*, 47:953–980.

Mackie, Q., D. Fedje, D. McLaren, N. Smith and I. McKechnie. 2011. Early Environments and Archaeology of Coastal British Columbia. In Trekking the shore, harvesting the sea: changing coastlines and the antiquity of coastal settlement. New York: Springer.

Mannino. M. and R. Thomas, 2002. Depletion of a resource? The impact of prehistoric human foraging on intertidal mollusc communities and its significance for human settlement, mobility and dispersal. *World Archaeology*, 33:452–474.

Marean, C. W., Bar-Matthews, M., Bernatchez, J., Fisher, E., Goldberg, P., Herries, A., Jacobs, Z., Jerardino, A., Karkanas, P., and Minichillo, T., 2007. Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. *Nature*, 449:905–908.

Marean, C. W., 2011. Coastal South Africa and the co-evolution of the modern human lineage and coastal adaptations. In Trekking the shore, harvesting the sea: changing coastlines and the antiquity of coastal settlement. New York: Springer.

Masters, P. M. and Flemming, N., 1983. *Quaternary Coastlines and Marine Archaeology: Towards the Prehistory of Land Bridges and Continental Shelves*. New York: Academic.

Matsu'ura, S., 1996. A chronological review of Pleistocene human remains from the Japanese archipelago. In *Interdisciplinary Perspectives on the Origins of the Japanese*. In K. Omoto (ed.), pp. 181–197. International Research Center for Japanese Studies.

McBurney, C., 1967. *The Haua Fteah (Cyrenaica) and the Stone Age of the Southeast Mediterranean*. Cambridge University Press.

McBrearty, S. and Brooks, A. 2000. The revolution that wasn't: a new interpretation of the origin of modern human behavior. *Journal of Human Evolution*, 39:453–563.

Meehan, B., 1982. *Shell Bed to Shell Midden,* Australian Institute of Aboriginal Studies, Canberra.

Meighan, C., 1969. Molluscs as food remains in archaeological sites. In Brothwell, D. and Higgs, E. (eds.), *Science in Technology*, pp. 415–422. Thames and Hudson, London.

Milligan, L. A. & Bazinet, R., 2008. Evolutionary modifications of human milk composition: evidence from long-chain polyunsaturated fatty acid composition of anthropoid milks. *Journal of Human Evolution*, 55(6):1086–1095.

Morales, Roselló, E., Hernández, F., 1998. Late Upper Palaeolithic subsistence strategies in Southern Iberia: Tardiglacial faunas from Cueva de Nerja (Málaga, Spain). *European Journal of Archaeology*, 1:9–50.

Morwood, M., O'Sullivan, P., Aziz, F., and Raza, A., 1998. Fission-track ages of stone tools and fossils on the East Indonesian island of Flores. *Nature*, 392:173–176.

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

Ortea, J., 1986. The malacology at La Riera. In: Straus, L. G., Clark, G. A. (Eds.), *La Riera Cave: Stone Age Hunter–Gatherer Adaptations in Northern Spain*. Arizona State University Anthropological Research Papers, 36. Arizona State University Press, Tempe, pp. 289–298.

Parkington, J., 2001. Milestones: the impact of the systematic exploitation of marine foods on human evolution. In: P. V. Tobias, M. A. Raath, J. Moggi-Cecchi, and H. Soodyall (eds.), *Humanity from African Naissance to Coming Millenia*. Firenze University Press, Firenze, pp. 327–336.

Parkington, J., 2003. Middens and moderns: shellfishing and the Middle Stone Age of the Western Cape, South Africa. *South African Journal of Science*, 99:243.

Perlman, S. M., 1980. An optimum diet model, coastal variability, and hunter-gatherer behavior. In: M. B. Schiffer (ed.), *Advances in Archaeological Method and Theory*, vol. 3. Academic, New York, pp. 257–310.

Pettitt, P. B., M. Richards, R. Maggi, and V. Formicola, 2003. The Gravettian burial known as the Prince ('Il Principe'): new evidence for his age and diet. *Antiquity*, 77:15–20.

Petraglia, M. and Rose, J. (eds.), 2009. *The evolution of human population in Arabia: paleoenvironments, Prehistory, and Genetics*. The Netherlands, Springer.

Plets, R., J. Dix, A. Bastos, and A. Best, 2007. Characterization of buried inundated peat on seismic (Chirp) data, inferred from core information. *Archaeological Prospection*, 14:261–272.

Price, T. D., 1995. Some perspectives on prehistoric coastal adaptations and those who study them. In *Man and Sea in the Mesolithic*, edited by Anders Fischer, pp. 423–424. Oxbow Monograph, Oxford.

Quinn, R., W. Forsythe, R. Plets, K. Westley, T. Bell, F. McGrath, S. Benetti, and R. Robinson, 2008. Archaeological applications of the Joint Irish Bathymetric Survey (JIBS) data. *SLAN newsletter*, 4:1–2.

Reid, C., 1913. *Submerged Forests*. Cambridge University Press, Cambridge.

Richards, H. G., 1974. *Annotated Bibliography of Quaternary Shorelines: Second Supplement 1970–1973*. Academy of Natural Sciences, Philadelphia.

Richards, H. G., and R. W. Fairbridge, 1965. *Annotated Bibliography of Quaternary Shorelines, 1945–1964*. Academy of Natural Sciences, Philadelphia.

Richards, H. G., and R. W. Fairbridge, 1970. *Annotated Bibliography of Quaternary Shorelines: Supplement 1965–1969*. Academy of Natural Sciences, Philadelphia.

Rick, T. C., and J. M. Erlandson (Eds.), 2008. *Human Impacts on Ancient Marine Environments: A Global Perspective*. University of California Press, Berkeley.

Roberts, R., Jones, R., Smith, M., 1990. Thermoluminescence dating of a 50,000 year old human occupation site in northern Australia. *Nature*, 345:145–156.

Roberts, M. B., & Parfitt, S., 1999. *Boxgrove: A Middle Pleistocene Hominid Site at Eartham Quarry, Boxgrove, West Sussex.* London: English Heritage.

Roche, J. and Texier, J., 1976. Decouverte de restes humaines dans un niveau aterien superieur de la Grotte des Contrabandiers, a Temara (Maroc). *Comptes Rendus des Sciences de l'Academie des Sciences*, 282:45–57.

Rose, J., 2007. The role of the Saharo-Arabian Arid Belt in the modern human expansion. In Bicho, N. (ed.), *From the Mediterranean basin to the Portuguese Atlantic shore: papers in honour of Anthony Marks*, pp. 57–68.Universidade do Algarve, Faro.

Roubet, F., 1969. Le niveau Aterian dans la stratigraphie cotiere a l'ouest d'Alger. *Paleoecology of Africa*, 4:124–128.

Ruff, C. B., E. Trinkaus, and T. W. Holliday, 1997. Body mass and encephalization in Pleistocene *Homo*. *Nature*, 387:173–176.

Sauer, C., 1962. Seashore – primitive home of man? *Proceedings of the American Philosophical Society*, 106:41–47.

Sealy, J., and M. Galimberti. 2011. Shellfishing and the interpretation of shellfish sizes in the Middle and Later Stone Ages of South Africa. In Trekking the shore, harvesting the sea: changing coastlines and the antiquity of coastal settlement. New York, Springer.

Shackleton, J., 1988. *Marine Molluscan Remains from Franchthi Cave*. Indiana University Press, Bloomington and Indianapolis.

Singer, R. and Wymer. J., 1982. *The Middle Stone Age at Klasies River Mouth in South Africa*. Chicago: University of Chicago Press.

Souville, G., 1973. *Atlas prehistoric du Maroc 1: Le Maroc Atlantique*. CNRS. Paris.

Stiner, M., 1994. *Honor Among Thieves: A Zooarchaeological Study of Neandertal Ecology*. Princeton: Princeton University Press.

Stiner, M., Munro, N. D., and Surovell, T. A., 2000. The tortoise and the hare: Small game use, the Broad Spectrum Revolution, and Paleolithic demography. *Current Anthropology*, 41:39–73.