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Shellfishing and human evolution

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ABSTRACT

Southern and northwestern Africa have provided the oldest known shell middens, dating from the Last Interglacial (MIS 5, ~128–71 ka) and the early part of the succeeding glaciation (MIS 4, ~71–59 ka). However, when and if older, suitably situated, stratified coastal sites are found, they are likely to show that routine shellfishing began much earlier, perhaps from the time that people first occupied coasts. Ethnohistoric records suggest that ancient people would have shellfished mainly during twice-monthly periods when the intertidal zone is maximally exposed. Caloric and nutrient return for coastal shellfishing effort can be quite high, but only when the intertidal is exposed, and archaeology implies that like ethnohistorically observed groups, ancient shellfish collectors depended more on terrestrial and marine vertebrates and on plants. Shellfishing can generate highly visible and durable archaeological signatures, and only a few collecting episodes each year could have produced the oldest middens, which span many millennia. Shell middens are so far unknown in European Neanderthal (Mousterian) and succeeding Upper Paleolithic sites, probably because suitably situated sites have yet to be found. Consistently large gastropod size in the oldest known middens suggests that human population growth cannot explain either the occasional presence of "symbolic" artifacts or the innovative burst that coincides with the spread of fully modern Africans to Eurasia 60–50 ka.

1. The antiquity of human shellfishing

Many species exploit intertidal shellfish, but only humans regularly transport them to variably distant open-air localities or rock shelters where repeated discard produces substantial shell heaps or middens. Open-air middens dating from the Present Interglacial [Marine Isotope Stage (MIS) 1], after 12–11 ka (thousands of years ago), dot lower and mid-latitude coasts everywhere. Older open-air middens are largely unknown, probably because most that formed during previous interglacials have failed to survive exposure to the elements, while those that formed during glacial intervals are mainly submerged on continental shelves. Near-coastal caves and rock shelters in southern Africa (Jacobs et al., 2008; Jerardino, 2016; Klein, 2009; Kyriacou et al., 2015; Langejans et al., 2012; Marean, 2014; Will et al., 2015) and in northwestern Africa (Campmas et al., 2015; Dibble et al., 2012; Steele, 2012; Steele and Alvarez-Fernández, 2011; Stoetzel et al., 2014) preserve middens that document central-place shellfishing during the Last Interglacial (MIS 5), between roughly 128 and 71 ka. Although we can be sure that shellfishing continued through the Last Glaciation (MIS 4-2), between about 71 and 11 ka, coastal shelters rarely provide direct evidence, mostly because lower sea levels often displaced the coast 10 km or more from the shelters, beyond the usual daily range of most foragers.

Bajondillo Cave, Spain (Cortés-Sánchez et al., 2011), and Pinnacle Point Cave 13B, South Africa (Marean et al., 2007), suggest that people had begun shellfishing by 160–150 ka, during the latter part of the Penultimate Glaciation (MIS 6). However, near-coastal rock shelters with fills that formed during the Penultimate Glaciation are extremely rare and rock shelters with older fills are rarer yet, either because the shelters collapsed and their contents were eroded away or because high interglacial sea levels flushed their contents (Marean et al., 2014). The known record thus cannot show when people first shellfished, although the nutritive value of shellfish, the ease with which they can be collected, and the range of other terrestrial predators that take them (Carlton and Hodder, 2003; Erlandson and Moss, 2001) suggest that human exploitation began long before 160 ka, perhaps from the time when people first foraged near the water's edge. As discussed below, during periods when a low tide exposes the littoral, the high return rates from shellfishing would probably have made intertidal exploitation an especially attractive option to any near coastal, prehistoric humans. An accumulation of riverine mussel shells that antedates

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500 ka from Trinil, Java (Joordens et al., 2015), may provide early evidence of shellfishing, although it was obtained in the 1890s without regard to context, and its human origin has been inferred only from uniform shell size and putative artificial shell modification. If the Trinil shells came from a midden, it appears to differ from nearly all much more recent middens in the absence of artifacts and vertebrate remains.

Fig. 1 shows the approximate locations of all sites mentioned in the text.

2. Proposed connections between shellfishing and human evolution

Specialists have suggested that shellfishing was linked to human evolution in two key, possibly related ways. The first is that normal brain development and function require nutrients that are abundant in aquatic, especially coastal foods, including shellfish (Broadhurst et al., 1998, 2002; Crawford et al., 2014; Cunnane, 2010; Cunnane and Crawford, 2014; Kyriacou et al., 2014; Parkington, 2001, 2003). The second is that coastal shellfishing is most productive when alignment of the moon and sun results in maximum diurnal exposure of the intertidal zone. Such times, known as "spring low tides", last about 3 days twice each month, coinciding with the new and full moons. In keeping with advance expectations, ethnographically observed coastal dwellers on the southern and southeastern coast of South Africa (Bigalke, 1973; Lasiak, 1992), and in Arnhem Land (Meehan, 1982) and the Meriam Islands (Bird et al., 2004), both northern Australia, exploited shellfish mainly during diurnal spring low tides. At other times people venturing into the intertidal zone will not only find fewer shellfish, they will also run greater risk of being swept away. Abundant shells in a coastal archaeological site might thus imply intellectual mastery of the tidal cycle (Marean, 2014).

The crucial nutrients that abound in the aquatic food chain are iron, iodine, and especially two omega-3, long-chain, polyunsaturated fatty acids, Docosahexaenoic acid (DHA) and Arachidonic acid. DHA in particular tends to be rare elsewhere, and it is a primary structural component of neural tissue (Brenna and Carlson, 2014). The evolution of the uniquely large and complex human brain could thus have required routine access to shellfish, fish, or other aquatic species. If this supposition is correct, intensive exploitation of aquatic foods must have begun by 300 ka, when relative to body mass, the human brain came to approximate its modern size (Ruff et al., 1997). The idea that the human brain evolved in an aquatic setting has passionate advocates among nutritionists, but it has failed to find much favor among paleoanthropologists, probably mostly because large, elaborate brains evolved in human populations everywhere, including ones with little or no access to aquatic foods. The implication is that there must be adequate terrestrial sources for the key fatty acids, perhaps mainly in the brains of terrestrial vertebrates, or that people, particularly pregnant women, can synthesize adequate quantities of DHA in the body (Carlson and Kingston, 2007a, 2007b; Speth, 2012). In either case, the evolution of the human brain would not require aquatic foods, including shellfish.

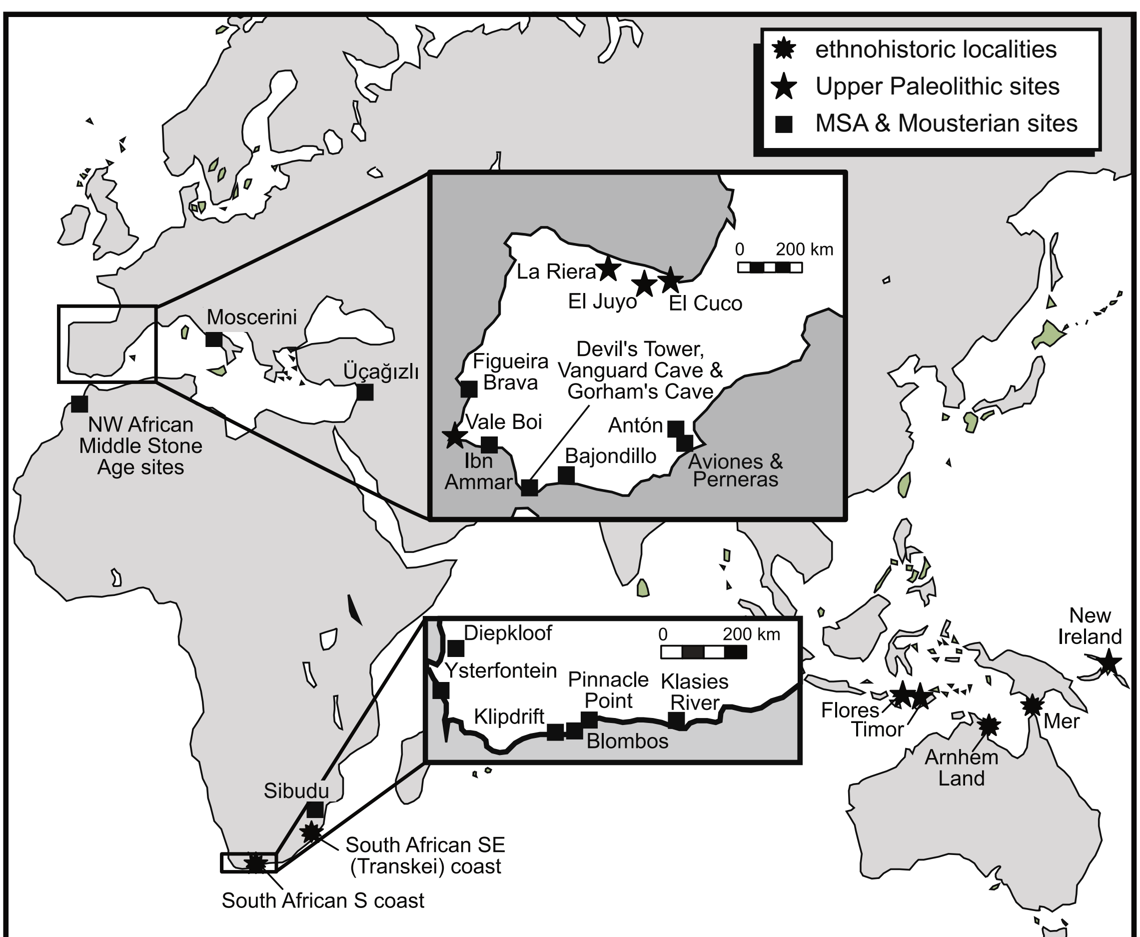

Fig. 1. The approximate locations of the sites mentioned in the text.

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