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What Archaeology Can Tell us about Sustainability and Climate Change: A South African West Coast Perspective

Antonieta Jerardino

Department of Prehistory, Ancient History and Archaeology, University of Barcelona, Spain

Historical perspectives have been an integral component of ecological studies as shown by palaeontological research, historical ecology, genetic, isotopic and other approaches to the reconstruction of past species distributions and community structure as well as the evolution of flora and fauna through time. With the exponential growth of the world's human population over the past century, 60% of humans living within 100 km of the coast [1], and the projected consequences of current climate change, pollution, habitat loss and introduction of alien species, coastal environments appear to face particularly serious challenges when compared to other ecosystems. The need of forecasting the combined effects of all these physical and biological variables with some accuracy is ever more pressing if we are to mitigate and manage such changes effectively.

In recent years, ancient coastal archaeological sites have become not only important sources for understanding human evolution [2-6], as well as early cultural and technological developments [8-9], but have also been increasingly recognized as important sources of palaeoenvironmental and palaeo-ecological reconstructions around the globe [1-3, 5-7]. More recently, coastal archaeological studies have also been considered as a complement to marine conservation and management efforts [10-14].

The South African west coast is an approximately 800 km long coastline dotted with thousands of archaeological sites and traversing at least two rainfall regions and a variety of vegetation zones (Figure 1). The preservation of faunal remains and artefacts is generally good, particularly in the more arid environments north of the Berg River (Figure 1), making them rich sources of information on ancient ecosystems. These "archives" of past human behaviour and environmental change can be substantial and detailed [6,15-18]. It is not rare to find chronologically well resolved sequences in them, but perhaps they are not as detailed as some rock hyrax middens where micro-sampling can establish several millennia long records [19]. West coast sites often have contents that reflect visits over thousands of years [17-18] and, due to their occurrence in a range of environments; they provide valuable palaeo-ecological data on marine and terrestrial systems along an extended latitudinal gradient. From these rich sources, researchers have developed interpretations of past coastal landscapes, marine productivity, possible seasonal use of coastal resources and the degree of human adaptation to marine environments [15-17,20-21].

Current issues of sustainability are closely linked with biodiversity, and the later relies on the understanding of ecosystem functioning and the biogeography of species involved. Archaeology in southern Africa has contributed considerably in documenting Quaternary extinctions and mayor shifts in geographic distribution patterns of terrestrial and marine taxa [22]. For instance along the shores, a typical South African west coast limpet (*Cymbula granatina*) appears in the south-eastern coast between 110 000 and 60 000 years ago in fairly large numbers [23], and a locally rare species of mussel (*Choromytilus meridionalis*) nearly dominates shellfish catches around 10 000 years ago [24]. The west coast case is different. No strict extralimital marine invertebrate species occur there, but more typical south coast molluscs (e.g., *Cymbula oculus*, *Haliotis midae*, *Scutellastra tabularis*, *Scutellastra longicosta, Turbo* sp) occur today naturally in restricted pockets of the west coast, such as the Vredenburg Peninsula, Langebaan and Saldanha Bay (Figure 1). This is mirrored in nearby archaeological sites dating to as far back as 110 000 years ago [25] and also during the late Holocene. Of course, the west coast palaeontological record had already told us that some of these species occurred there around that time if not earlier [26], but being able to track their occurrence along the west coast since then is important for documenting possible intermittent expansions or contractions of their current geographic distribution through time. Interestingly, the alien rocky shore mussel, *Mytilus galloprovincialis*, is absent from all and the youngest Khoisan shell middens, confirming the ecologists estimate for a recent time of its introduction to South African waters [27].

Many fisheries and marine ecosystems around the globe are in a state of crisis, and the need for deeper historical baselines is ever more obvious. Marine biologists dedicated to studying coastal environments

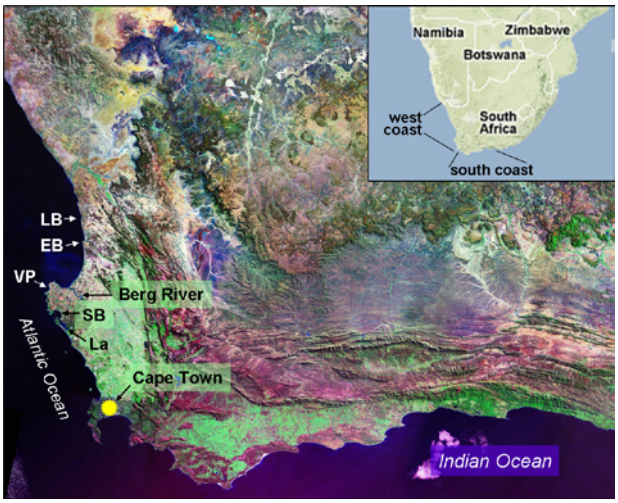

Figure 1: Map of the west coast of South Africa showing locations mentioned in the text with inset of southern Africa. Acronyms of locations: EB, Elands Bay, La, Langebaan; LB, Lamberts Bay; VP, Vredenburg Peninsula. Figure based on free access NASA (1996) satellite picture.

***Corresponding author:** Antonieta Jerardino, Catalan Institution for Research and Advanced Studies (ICREA)/GEPEG, Department of Prehistory, Ancient History and Archaeology, University of Barcelona, c/ Montalegre, 6-8, E-08001 Barcelona, Spain, E-mail: amsjerardino@gmail.com, amsjerardino@ub.edu

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have come to the conclusion that long-term monitoring of reserves and human impacted areas along with experimental studies are key for establishing ecological baselines and building the needed ecological literacy for marine management and conservation [12-13,28]. Given the social and cultural variables involved, these issues are interdisciplinary by nature. The need for even deeper historical baselines than the ones afforded with the study of recently established marine reserves (last three decades on average) highlights the relevance of archaeological data in this regard. As studies worldwide have shown, prehistoric people have caused varying degrees of environmental disturbance [29], with the west coast marine environment of South Africa being no exception [30]. Identifying archaeological evidence for such impacts, however, require fine-grained data over considerable periods of time and teasing out the effects of natural disturbances from those of human origin [14,31]. Consideration of multiple hypotheses, human population densities, vulnerability of biota to human interference, locally visible rather than regionally evident changes in palaeoenvironemental and faunal records as well as aligning applied concepts and methods found in modern fisheries management to archaeological research would allow for an expanded contribution of archaeology to the future health of our coastal ecosystems. A few examples of collaborative work between archaeologists and marine biologists exist but much remains to be done [12,14,30,32].

Our planet has experienced a number of glacial and interglacial cycles during which profound changes in climate and concomitant shifts in ecosystems were experienced including speciation and extinction of taxa. Although not humanly induced or triggered, some of the warming trends experienced during interglacials could be used as analogues for studying current global warming. These ancient warming trends are encoded in both the palaeontological and archaeological records. However, the time-depth of known coastal archaeological sites found on land is largely limited to the last and present interglacial as a result of sea level rise, coastal drowning (possible destruction) of archaeological sites that followed the end of the last glacial period [5,33]. However, west coast archaeological sites containing considerable and reasonably well-preserved cultural, faunal and floral material dating to the last interglacial (~120 000 years ago) are few [4]. From an archaeological perspective, the more recent Holocene period (last 10,000 years) presents us with a better prospect for making comparisons with current climate trends despite dissimilar orbital parameters. The Holocene experienced two warming trends, namely, the so called mid-Holocene "Climatic Optimum" (8000– 4500 years before present) and the "Medieval Warm Epoch" also known as the "Medieval Warm Anomaly" (~ 800–1400 AD) [34-35]. West coast sites of Holocene age are far more numerous, substantial in volume and, more often than not, show a better degree of preservation than their older counterpart. Initially, mid-Holocene arid conditions along the west coast seemed to explain an occupational gap in many west coast sites, but the picture is more complex now that several new sites show evidence of visits at that time. Recent studies seem also to indicate that the Medieval Warm Period in the Elands Bay and Lamberts Bay areas (Figure 1) in particular is mainly represented by high-elevation occupations [16], perhaps suggesting a need for monitoring the surrounding landscape for potential competitors in the context of water shortages and general xeric conditions. While explanations as to where and when people occupied the landscape during these periods help archaeologists to reconstruct prehistoric lifestyles and group interaction, the taxonomic and isotopic analyses of archaeological remains provide reconstructions of past environments in quantified terms. The latter can offer precious information to other scientists in search for modern climatic analogues in order to develop models for making climatic predictions in decades to come. Some work already done at the west coast deserves to be continued [15,18].

The contribution of archaeology to better understand the evolution of marine and terrestrial ecosystems and their management is desirable, feasible and reasonably uncomplicated, but still needs to be done. Initial attempts have already been made in South Africa [11,30] and elsewhere [12,14,36]. Going beyond these exploratory studies would require close interdisciplinary dialogue and trusting this joint effort where questions that had not yet been formulated could also be raised and explored. Methods to answer these would need to be quantifiable in order to make real progress in this regard. Such synergistic discussions will require a sincere willingness to translate and cross-fertilize questions from one field of study onto another. In this way, a richer and more holistic contribution to our respective fields of scientific enquiry could be made which no doubt would improve our recommendations for environmental management and policy making.

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