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## Changing patterns of eastern Mediterranean shellfish exploitation in the Late Glacial and Early Holocene: Oxygen isotope evidence from gastropod in Epipaleolithic to Neolithic human occupation layers at the Haua Fteah cave, Libya



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### ABSTRACT

The seasonal pattern of shellfish foraging at the archaeological site of Haua Fteah in the Gebel Akhdar, Libya was investigated from the Epipaleolithic to the Neolithic via oxygen isotope ( $\delta^{18}\text{O}$ ) analyses of the topshell *Phorcus (Osilinus) turbinatus*. To validate this species as faithful year-round palaeoenvironmental recorder, the intra-annual variability of  $\delta^{18}\text{O}$  in modern shells and sea water was analysed and compared with measured sea surface temperature (SST). The shells were found to be good candidates for seasonal shellfish foraging studies as they preserve nearly the complete annual SST cycle in their shell  $\delta^{18}\text{O}$  with minimal slowing or stoppage of growth. During the terminal Pleistocene Early Epipaleolithic (locally known as the Oranian, with modeled dates of 17.2–12.5 ka at  $2\sigma$  probability, Douka et al., 2014), analysis of archaeological specimens indicates that shellfish were foraged year-round. This complements other evidence from the archaeological record that shows that the cave was more intensively occupied in this period than before or afterwards. This finding is significant as the period of the Oranian was the coldest and driest phase of the last glacial cycle in the Gebel Akhdar, adding weight to the theory that the Gebel Akhdar may have served as a *refugium* for humans in North Africa during times of global climatic extremes. Mollusc exploitation in the Latest Pleistocene and Early Holocene, during the Late Epipaleolithic (locally known as the Capsian, c. 12.7 to 9 ka) and the Neolithic (c. 8.5 to 5.4 ka), occurred predominantly during winter. Other evidence from these archaeological phases shows that hunting activities occurred during the warmer months. Therefore, the timing of Holocene shellfish exploitation in the Gebel Akhdar may have been influenced by the seasonal availability of other resources at these times and possibly shellfish were used as a dietary supplement when other foods were less abundant.

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### 1. Introduction

Molluscs have been a common dietary component for coastal populations throughout the world since the late Pleistocene (e.g.

Marean, 2014). They are a predictable and easily obtainable food resource. They are also highly nutritious, containing abundant protein and essential micronutrients that are important for brain development and nervous system function and which are not as readily available from terrestrial resources (Erlandson, 2001; Broadhurst et al., 2002; Fa, 2008; Kyriacou et al., 2014). In the Mediterranean, mollusc shell remains are present in many archaeological sites from the Lower Palaeolithic to recent times (Colonese et al. 2011).

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