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An assessment of Neanderthal adaptations in the Levant using multi-element isotopic and zooarchaeological approaches

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Neanderthals (*Homo neanderthalensis*) survived for several hundreds of thousands of years through changing climatic scenarios and complex ecological, biogeographic, and subsistence-settlement challenges. Archaeologists have written extensively about possible causes for extinction while little has been stated about the obvious ecological and social resilience they demonstrated through millennia of expansion throughout Europe and the near east. Despite decades of focused investigation the question of why they became extinct still remains in doubt. One explanation may come from a body of concepts defined within socio-ecological "resilience theory" that attempts to explain changes in adaptive systems involving destabilizing effects that cause small-scale transformations to explode into larger-scale crises, followed by reorganization and new stable states; this general framework is called panarchy. The results of initial stable isotope analysis on prey species hunted by Neanderthals at Dederiyeh cave, Syria provides proxy palaeobiological, palaeoecological, and palaeoclimatic landmark from which to discuss this potential extinction and replacement hypothesis. Preliminary zooarchaeological and stable oxygen isotope results from dental enamels suggest Dederiyeh cave was probably occupied at least during the fall and winter. Age profiles of key prey species (wild goat, gazelle, and red deer) are similar to sites in the southern Levant and the Caucasus region supporting the view that Neanderthals were capable hunters and proficient at organizing seasonal procurement of key herbivore resources. It also suggests a consistency in hunting behaviour (i.e. the exploitation strategies of prey herbivores across similar physiographical regions) that may have been learned through transmission from groups close by or within a larger biogeographic/metapopulation regional boundary. In the end, Neanderthals may have been incapable of recouping population losses, fully adapting to changing biomes, and unable to "reorganize" themselves after dynamic natural and social changes needed for an "exploitation" phase, whereas a new, pioneering group appearing from out of Africa-anatomically modern humans-could. The significance of this research lies in creating stable isotope proxies for seasonal climatic reconstructions from oxygen isotopes, dietary shifts from carbon isotopes, and keystone herbivore migration and range reconstruction during the dynamic middle stages of Oxygen Isotope climatic Stage 3 (60-40 kya).

Keywords: Neanderthal, Oxygen isotope, Strontium isotope, palaeoecology, OIS 3, fossile