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Reconstructing caribou seasonal biogeography in Little Ice Age (late Holocene) Western Alaska using intra-tooth strontium and oxygen isotope analysis

Ciara Gigleux[a,*], Vaughan Grimes[b], Thomas Tütken[c], Rick Knecht[a], Kate Britton[a,d]

[a] Department of Archaeology, University of Aberdeen, St. Mary's Building, Elphinstone Road, Aberdeen AB24 3UF, UK
[b] Department of Archaeology, Memorial University, St. John's, NL A1C 5S7, Canada
[c] Institut für Geowissenschaften, AG für Angewandte und Analytische Paläontologie, Universität Mainz, J.-J. Becherweg 21, 55128 Mainz, Germany
[d] Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Deutscher Platz 6, 04103 Leipzig, Germany

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ABSTRACT

The palaeobiogeography of key prey-species can provide valuable insights into animal-human interactions, human subsistence activities and landscape use in the past. In many contemporary indigenous Arctic societies, caribou (*Rangifer tarandus* spp.) are an important seasonal subsistence species, and recent climatic shifts have influenced the seasonal and spatial distribution and migrations of herds. The impact of larger scale climatic change on this species, such as that experienced during the Little Ice Age (LIA), is not known, but may provide vital clues about future variability. Here we present sequential strontium ($^{87}Sr/^{86}Sr$) and oxygen ($\delta^{18}O_{CO3}$) isotope data from archaeological caribou tooth enamel from Nunalleq, a 15th to 17th century AD pre-contact Yup'ik village site in Western Alaska, to reconstruct caribou movement patterns in this region during the LIA. The results of these analyses highlight variation in ranging habits over the period of time that the site was occupied, and indicate different ranging behaviours in the region in the past compared to modern herds in the area today. The isotopic data presented here complement the wealth of data derived from other research at Nunalleq, illuminating the influence of changing climatic conditions on prey-species palaeoecology and human-animal interactions at the site.

1. Introduction

Isotopic analyses of sequentially sampled, incrementally-formed tissues are increasingly being utilised in archaeology and palaeoecology to identify and reconstruct seasonal dietary and migratory behaviours in wild animal species in the past (e.g. Britton et al., 2011; Feranec and MacFadden, 2000; Henton et al., 2017; Julien et al., 2012; Metcalfe and Longstaffe, 2014; Pellegrini et al., 2008; Price et al., 2017). Incrementally-developed tissues, such as tooth enamel and dentine, are formed over a relatively short period of time with no remodelling so the sequential sampling of these materials can provide time-series isotopic profiles. In this way, the episodic nature of isotopic variations measured within the tissues – brought about by variations in isotopic inputs related to changes in diet, ingested water, or location during tooth formation – can be established. Strontium isotope measurements in teeth, for example, are related to (geological) location during formation (Bentley, 2006), and – given that oxygen isotope ratios of precipitation vary seasonally at mid-/high-latitudes – oxygen isotope data can be utilised alongside strontium to 'anchor' data within a seasonal context. The utility of intra-tooth strontium and oxygen isotope analysis for the reconstruction of seasonal migratory behaviour in caribou/reindeer (*Rangifer tarandus*) has been recently demonstrated using migratory modern caribou (Britton et al., 2009; Britton, 2010), and has since been applied to European Middle and Late Palaeolithic reindeer (Britton et al., 2011; Price et al., 2017).

When focused on archaeologically-important prey-species, isotope zooarchaeology (the isotope analysis of archaeofaunal remains) studies not only serve to reconstruct the seasonal movements of important extinct and ancestral extant taxa, but also offer insights into animal-human interactions, animal landscape use and past human subsistence strategies. Isotope zooarchaeology also has the potential to allow archaeologists and palaeoecologists to explore changes in animal ecological behaviours over time periods not achievable in modern ecological studies. The influence of modern-day climate and environmental

* Corresponding author.
E-mail addresses: c.gigleux@abdn.ac.uk (C. Gigleux), vgrimes@mun.ca (V. Grimes), tuetken@uni-mainz.de (T. Tütken), r.knecht@abdn.ac.uk (R. Knecht), k.britton@abdn.ac.uk (K. Britton).

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