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Inferring animal husbandry strategies in coastal zones through stable isotope analysis: new evidence from the Flemish coastal plain (Belgium, 1st–15th century AD)

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ABSTRACT

In a proof-of-concept study, Britton et al. (2008) demonstrated that the isotopic composition of halophytic plants can be traced in the skeletal tissues of their animal consumers. Here we apply the method to domestic herbivore remains ($n = 303$) from nine archaeological sites in or near the Flemish coastal plain (Belgium), where, prior to embankments, salt-marshes offered extensive pasture grounds for domestic herbivores. The sites span a period of ~1500 years (Roman to late medieval period), during which the coastal landscape was progressively transformed from little managed wetlands to a fully embanked polder area. The bulk collagen data show variations between sites and over time, which are consistent with this historical framework and are interpreted as reflecting environmental change and differences in animal management in the coastal plain throughout the late Holocene. The study demonstrates the immense value of faunal stable isotope analysis for characterising coastal husbandry strategies beyond the means of traditional zooarchaeological techniques.

1. Introduction

Before large-scale land reclamation and embankment schemes changed the nature of its coastlines, north-west Europe possessed vast coastal landscapes of mudflats (intertidal grounds) and salt-marshes (diverse areas of mainly herbaceous, halophytic vegetation on higher ground but still occasionally submerged by seawater). These environments were extensively utilized by humans for hunting, fishing, pasture or the manufacture of salt since prehistoric times (Adam, 1990; Allen, 2000). Charting the history of these rich natural habitats, i.e. their exploitation and active modification by humans, is an active and important area of research into subsistence, sustainability and the mutual dependence of humans and their natural environment (e.g. Rippon, 1997; Ervynck et al., 1999; Bell, 2000).

In a proof-of-concept study, Britton et al. (2008) demonstrated that the isotopic composition of halophytic (salt-tolerating) plants, which tend to be ^{15}N-enriched compared to other terrestrial flora in temperate environments, can be traced in the skeletal tissues of their consumers. Stable isotope analysis of herbivore bone and dentinal collagen therefore allows for the identification of salt-marsh grazing and has the potential to illuminate past animal husbandry in coastal zones beyond the means of traditional zooarchaeology (see also Prummel and van Gent, 2010; McManus et al., 2013). In this paper, we aim to test this approach further by exploring whether carbon and nitrogen stable isotopes are sufficiently sensitive to characterise different animal management strategies and to reflect changes in the coastal environment as a result of natural processes or human intervention. To this end, we analysed sheep (*Ovis aries*) and cattle (*Bos taurus*) remains from a number of archaeological sites in the Flemish coastal plain (Belgium). These cover the period of approximately 1500 years (1st–15th century AD, Roman to late medieval periods) during which the coastal landscape underwent natural changes and various episodes of human intervention until it was completely

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transformed into a fully embanked polder (reclaimed land, protected from inundation by dikes). By the 13th century AD, these events had almost entirely obliterated the extensive tracts of salt-marshes which had previously characterised the coastal landscape (see Ervynck et al., 1999; Verhulst, 1995). By examining faunal isotope data from across the period of transition from coastal wetland to polder, this paper explores animal husbandry practices and especially the occurrence of salt-marsh grazing, along with any potential differences in the management of different domestic species.

2. Settlement and economy in the Flemish coastal plain

The Flemish coastal plain is part of the low-lying south-eastern shore of the North Sea. It consists of an almost 70 km long and 10–15 km wide expanse of mostly Holocene tidal sediments (modern surface 0–3 m asl), which are limited on one side by the coastal dune-belt (now continuous but formerly interrupted by tidal inlets) and on the other by the Flemish central plain, a conglomeration of Pleistocene sandy soils (Maréchal, 1992; Fig. 1). In the 1st millennium AD, prior to the transformation of the area into a polder, the coastal region was a dynamic wetland landscape of mudflats, peat deposits and tidal channels, all of it increasingly colonised by salt-marsh vegetation as the intertidal zone gradually silted up and the landscape was raised to supra-tidal levels (Ervynck et al., 1999; Baeteman et al., 1999, 2002; Tys, 2004b: 262). These processes finally led to the development of vegetation types internationally classified as 'high salt-marshes' but locally described as 'salt-meadows' (Dutch: *zoutweide*, French: *pré salé*, grassland in the high marshes which is exposed to sea-spray but only flooded at exceptionally high tides and therefore particularly suitable for animal pasture). Of numerous small streams and canals, only the river IJzer and the Zwin tidal inlet remain today as permanent water courses (Fig. 1).

The occupation history of the Flemish coastal plain in the first millennium AD was long viewed as governed almost entirely by sea-level changes, which allowed human activity only intermittently (Verhulst, 1980; De Moor and Ozer, 1985). This so-called 'Dunkirk Transgression Model' was only revised in the 1990s, based on new geomorphological research and critical re-analysis of the archaeological evidence (Ervynck et al., 1999; Baeteman, 1999; Baeteman et al., 1999, 2002). Recent approaches to settlement history now put greater emphasis on human agency and changing economic and demographic conditions rather than focussing solely on environmental determinants in order to explain variations in the intensity of human exploitation (Ervynck et al., 1999; Tys, 2004b; Loveluck and Tys, 2006).

The archaeological record for the Flemish coastal plain in the Roman period (1st–4th century AD) demonstrates that a range of activities took place, including fishing, salt production (with associated peat digging), crafts, arable farming, animal husbandry and trade (Thoen, 1973, 1978, 1987), albeit probably at a smaller scale

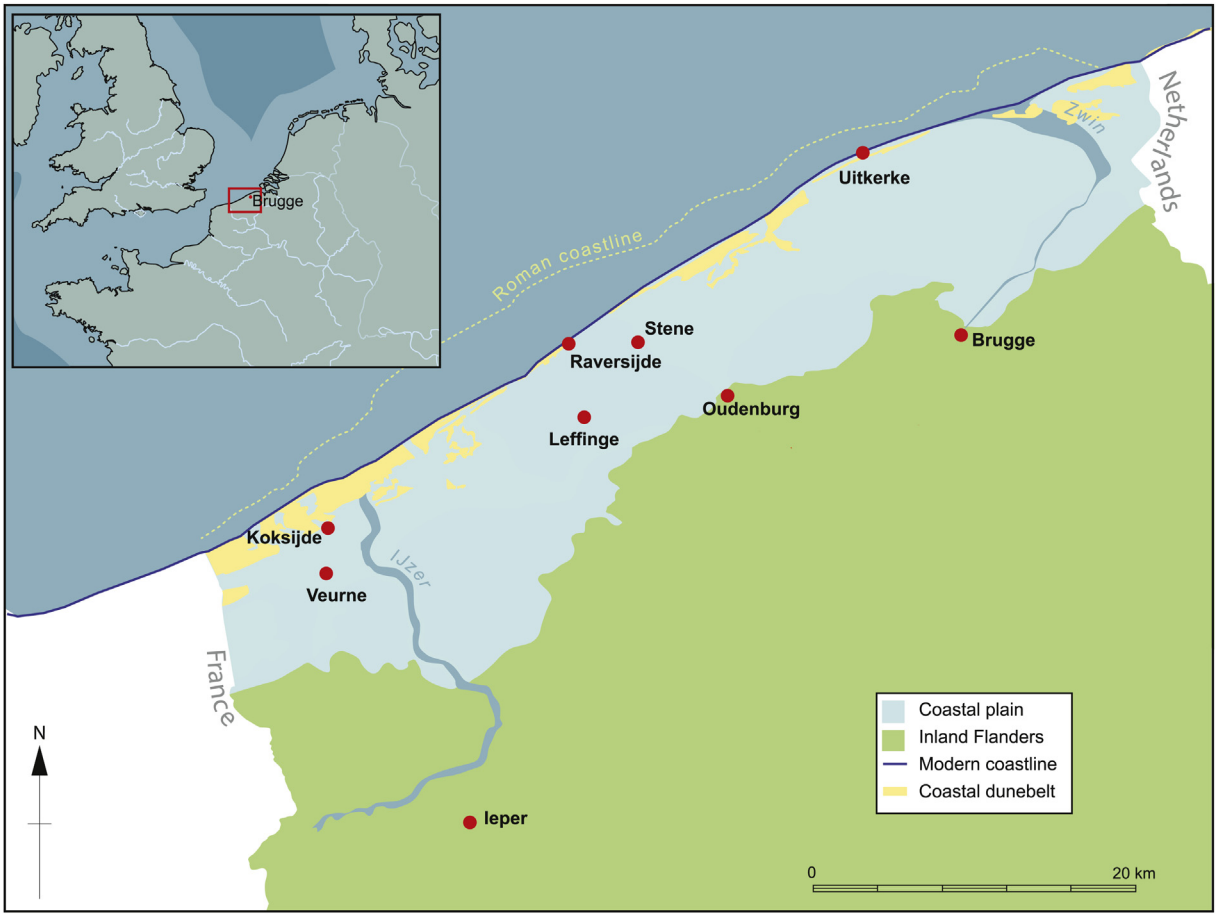

Fig. 1. Map of the study area and sites (adapted from Baeteman et al. in Thoen, 1987; extent of dune-belt after www.kustatlas.be). The geography depicted is an 'averaged view' of a coastal landscape evolving dynamically throughout the period from 1 to 1500 AD, presenting only a 'snap shot' of changes in course of the IJzer and the gradual silting up of the Zwin. The numerous tidal gullies traversing the coastal plain before the medieval embankments are not shown.