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Textural analysis to track the history of large herbivores

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Abstract:

Geographic and habitat distributions of large mammals most frequently do not reflect optimal conditions, but rather reflect the effects of restoration programs. An example is the European bison (*Bison bonasus*). This endangered species, which were extinct in the wild at the beginning of 20th century, was reintroduced in Central and Eastern Europe mostly in forests – habitats, which were lately identified as non-optimal (Kerley et al. 2012, Bocherens et al. 2015). Our study aims to explore the dietary habits of bison and other large herbivores in Europe before the spread of agriculture during the Holocene, which considerably modified the landscapes.

Dental microwear texture analysis (DMTA, Scott et al. 2006) provides information on feeding habits and allows for tracking variation in the diet of herbivores in changing environmental conditions. Therefore, this is an appropriate tool to evaluate how human management has influenced the ecology of wild herbivores (Merceron et al. 2014). We explored here the feeding patterns of the European bison and three other large herbivores: moose (*Alces alces*), red deer (*Cervus elaphus*) and extinct aurochs (*Bos primigenius*) originated from Neolithic Swiss settlements (6,000 - 5,000 years old), in the time before farming exerted significantly on the landscapes. Selected Swiss material was the oldest Holocene collection of preserved teeth with sufficient number of specimens from species with different feeding strategies. As a reference we used well studied modern species of ungulates from Białowieża Forest (Poland) characterized by known foraging patterns (Merceron et al. 2014).

Forty-eight individuals of Mid-Holocene herbivores representing four different species: bison ($N = 21$), moose ($N = 2$), red deer ($N = 11$) and aurochs ($N = 14$) and thirty-six specimens of modern red deer ($N = 15$), bison ($N = 15$) and moose ($N = 6$) composed the data set for DMTA. The molds of shearing dental facets were made with a polyvinylsiloxane material (Regular Body Microsystem, Coltene President) and scanned using a confocal DCM8 Leica Microsystems surface profilometer equipped with a $\times 100$ lens ($NA = 0.90$; working distance = 0.9 mm). Data were analysed with Toothfrax and SFrax software following procedures and settings provided by Scott et al. (2006). We analysed three textural parameters: complexity (Asfc), anisotropy (epLsar) and heterogeneity (of complexity; Hasfc81). Results showed significant differences in both Asfc and Hasfc81 between prehistoric European bison and aurochs. The diet of bison in the past has comprised of more grasses than the diet of aurochs. Additionally, the diet of bison was the least variable among the studied ungulates (low values of Hasfc81). Diet of red deer likely includes more woody material (Fig. 1). Comparison of parameters for prehistoric and modern ungulates showed that diet of red deer and moose did not change over time, while the diet of modern bison from Białowieża differed significantly from the diet of prehistoric bison. Modern bison are more engaged in browsing and their diet is more variable than during the Neolithic. This confirms suboptimal or marginal character of forest for this species today (Kerley et al. 2012, Bocherens et al. 2015). DMTA proved to be a method which allows obtaining knowledge about the prehistoric diet of herbivore species. To track the past ecology of modern species before the spread of agriculture and deforestation in Europe, independent proxies such as DMTA should be generalised to guide programs of reintroduction of endangered species such as the European bison in Europe.

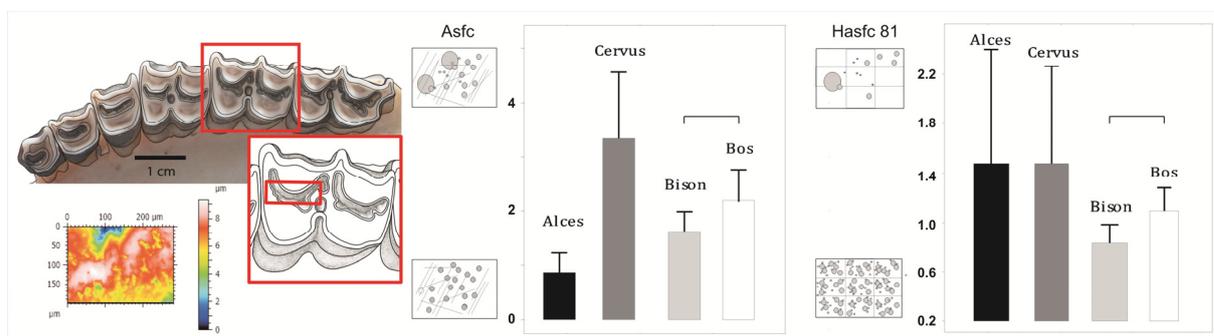


Fig. 1. Dental microwear textural parameters of European bison, moose, red deer and aurochs from Neolithic Swiss localities. Bar-plots (mean and standard

error of the mean) of complexity (Asfc) and heterogeneity (Hasfc81) for the four ungulates. Significant differences are noted with braces.

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