

The use of Holocene bovid fossils to infer palaeoenvironment in Africa

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Abstract

In this paper, we develop an original statistical method to infer palaeoenvironmental conditions from fossil taxonomical assemblages based on the present-day observed environmental characteristics of these taxa. We illustrate this method by analysing present-day and Holocene African bovid (Artiodactyla, Mammalia) species assemblages. Firstly, the modern bovid species occurrences in African environments ranging from tropical rainforest to desert are compiled in order to define the environmental characteristics of each species analysed. Secondly, these modern characteristics are considered in order to construct a statistical model of prediction of actual environmental conditions from the sets of most likely environments associated with each present-day location (station). The model then allows us to infer palaeoenvironmental conditions associated with archaeozoological evidence of 53 Holocene localities from Western Africa. Our results show that a tree cover was well established near rivers and uplands, and constituted refuge areas for human occupation during times of climatic desiccation. This conclusion is discussed in the climatic, environmental and archaeological contexts of the Holocene evolution and prehistory of Western Africa.

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1. Introduction

The relationship between prehistoric cultural evolution and environmental changes has aroused considerable interest. Progressive Holocene climatic desiccation in Northern Africa disturbed natural ecosystems and forced the Neolithic populations to adapt or migrate. A sound knowledge of such environmental fluctuations is necessary if we are to fully appreciate the temporal and spatial variations displayed by these settlement patterns. The oldest Neolithic populations in Africa (ca. 9000 BP) lived in the Sahara area, were more or less mobile, and used a range of lithic and bone tools (e.g., arrow points, knives, scrapers and other skin-working tools, harpoons and hooks) to hunt and fish. From that time, shaping and polishing of grinding tools as well as the increase in

abundance and diversity of potteries relate firstly to more grain consumption and secondly to the development of agriculture from the mid Neolithic onward. At this time (ca. 5000 BP), desiccation made people gradually leave the Sahara area or find refuge in the central Saharan uplands. At the end of Neolithic times, ca. 3000 BP, demographic increase forced the population to progressively settle in villages, at the same time as food production expanded (Vernet, 1996).

Previous studies have shown the role played by climatic variations in social and cultural change during the Neolithic (Di Lernia and Palombini, 2002; Brooks, 2004; Field, 2004; Nicoll, 2004). Pollen, diatoms and lacustrine sediments have provided invaluable insights into the Holocene climates of Africa (Petit-Maire and Riser, 1983; Lézine and Casanova, 1989; Gasse, 2000). In arid areas such reconstructions are limited by a lack of organic plant remains and by destruction of evidence by wind erosion. We here present a new method to statistically infer past environment conditions using taxonomic assemblages found in fossil localities, and we

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illustrate its use with mammalian species found in Holocene archaeological sites.

On the one hand, our method differs fundamentally from the many qualitative or quantitative ones already in existence in the way it is statistically controlled, i.e., it associates a significance level to each palaeoenvironmental inference. Depending on the fossils studied, various methods are already available for estimating vegetation density (open/closed country) and regional moisture. With respect to mammals, some authors use taxonomy (Vrba, 1980), abundance (Klein, 1980), diversity (Aguilar et al., 1999; Andrews and O'Brien, 2000; Olff et al., 2002), morphology and/or size (Janis, 1982; Scott, 1985; Legendre, 1989; Köhler, 1993; Perez-Barberia and Gordon, 1999), or a combination of these approaches (Andrews et al., 1979). Others

rely on observed relations between modern fauna and environment. Hokr (1951) was a pioneer in calculating selected climatic parameters characteristic of mammalian species in Eastern Europe and in constructing climatic curves applicable to fossil assemblages. Nevertheless, none of these descriptive methods allow us to estimate, on the basis of the available data, the statistical level of confidence linked to each inference, and thus to distinguish between samples allowing reliable and unreliable palaeoenvironmental inferences.

On the other hand, our method is based on the analysis of species occurrence rather than abundance in order to propose a method applicable to any kind of sample and robust to most taphonomical problems. Archaeozoological remains are broadly representative of the palaeozoological setting, despite considerable

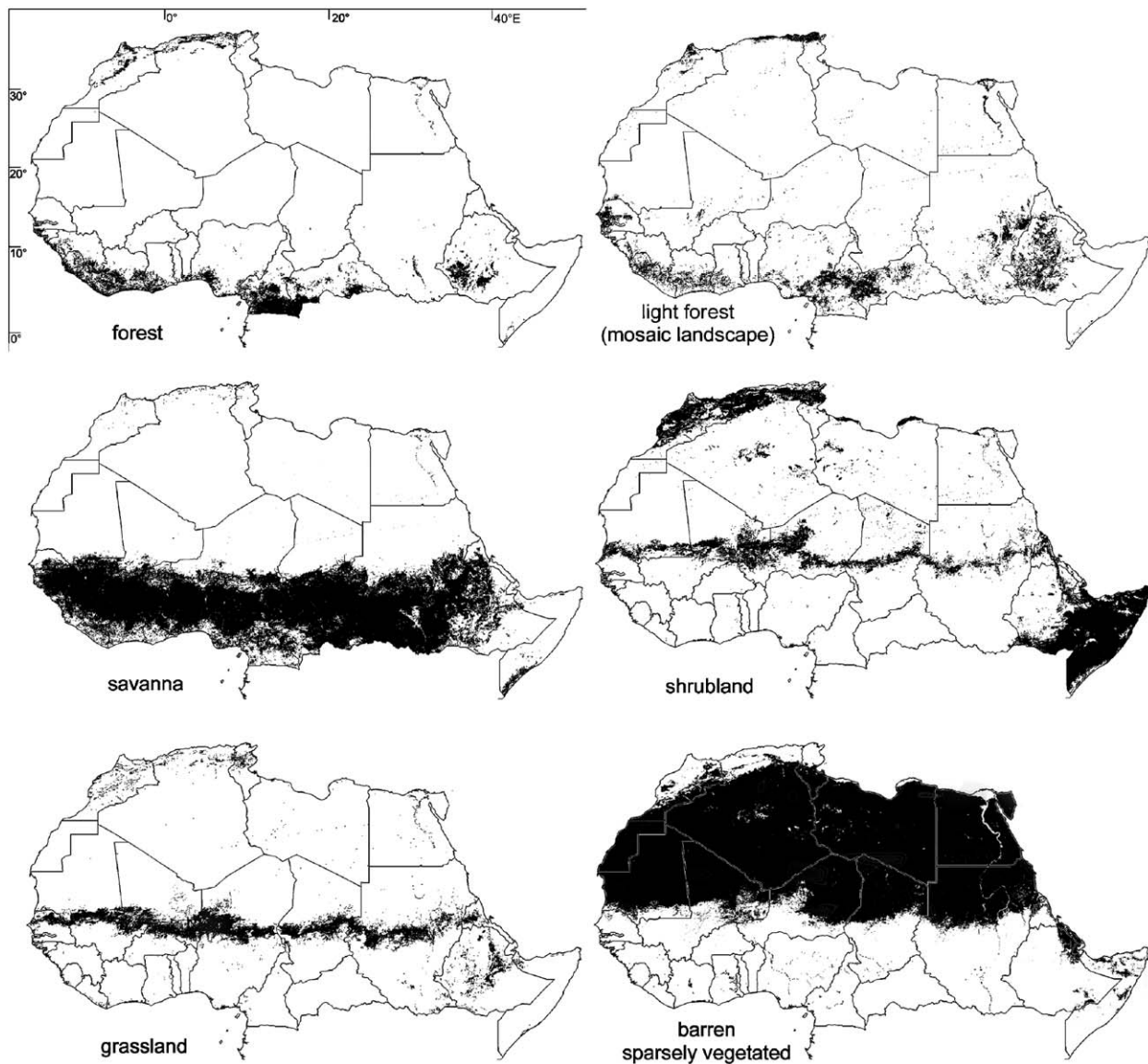


Fig. 1. Vegetation units, from the Global Land Cover Characteristics Database of the United States Geological Survey (map: DIVA-GIS, Hijmans et al., 2002).

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