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Changes in mammalian communities at the Pleistocene-Holocene boundary

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Analysis of the mammal fauna of the last glacial shows that the main factor of mammal distribution was the humidity or aridity and its effect on the flora, rather than the temperature itself. The biome typical of the last glacial in Central Europe, forests of parkland character, does not exist today. The variety of habitats resulted in a rich species diversity, which became poorer with the gradual growth of continuous forests during the Holocene.

1. Introduction

For a long time I have been involved in a study of Pleistocene faunistic terrestrial communities, their composition and changes that depend on a changing environment. The Pleistocene with its climatic oscillations of different length and intensity is particularly suitable for these studies. In this paper I concentrate only on the end of the Last Glacial and the beginning of the Holocene, i.e. on a period of particular importance from the point of view of the formation and composition of the present-day fauna. In order to become acquainted with the present noosphere (a term used by Vernadskij; the biosphere affected by the activity of man) and the changes through which it is presently passing, it is necessary to be familiar with the preceding biosphere, including the regularities of its development, and the mutual relations of inorganic and organic nature. We must realize that changes in communities have occurred before the presence of man and without his intervention, and that they were due to a variety of different ecological factors of a biological, physical and chemical nature. These factors still exist. What is new is the influence of the activities of man, reinforcing or negating some of these factors of change. To understand present changes the knowledge of preceding periods is necessary.

The Last Glacial, despite a number of sometimes even conspicuously warm oscillations, is generally considered to be an extremely cold period, and this fact is sometimes considered highly negative. The analysis of the individual European bioprovinces (Musil 1985), in both the direction of the meridians and of the parallels, shows that the situation in the composition of

animal communities of mammals and in their changes is not so simple as it might seem at first sight. Most species are not markedly stenothermic, but rather eurythermic. Despite this an opinion still prevails that some species were strongly adapted to either a conspicuously cold or warm climate and could not live in a different one. The analysis of their distribution, however, shows that the main factor was the humidity (oceanic climate) or aridity (continental climate) and the effect on the flora, rather than the temperature itself. This was demonstrated by the analyses of the presence of mammals in the Last Glacial in the individual localities studied which were summarily published e.g. in the paper by Musil 1986 (references in that paper). Therefore it is necessary to correct the present views on the pronouncedly "cold loving" animals.

It is sometimes assumed, without further consideration, that the glacials only shifted the present vegetation zones in the direction of the meridians and thus shifted communities towards the south. Although that shift did, of course, take place, it is necessary to realize that at a given geographical latitude the length of the day never changed, nor did the intensity of sunshine, etc., and that, without taking into consideration these facts, it is not possible to compare the present vegetation zones (the tundra, taiga, etc.,) with the preceding ones. For that reason I am of the opinion that a biome typical of the Last Glacial in Central Europe does not in fact nowadays exist. All analyses of fauna and flora point to the fact that Central Europe, in the course of the Last Glacial, almost continuously supported forests of a parkland character, interspersed with large or small steppe regions, and this development was maintained up to the very beginning of the Holocene. Only the Holocene brings an uninterrupted rise of closed forests and their expansion over the territory of Central Europe, with the exception of small regions (Opravil 1962, 1967, 1977, Rybnícková 1974, Valoch et al 1969).

Looking at the species diversity of the mammalian community/the community of mammals at the end of the Last Glacial we can observe that it is high (Table 1). It includes a number of species that are presently found in the northern part of Europe, and also relatively frequently species that become extinct towards the end of the Last Glacial. For the whole region of Central Europe, i.e. from Belgium to the Ukraine, the following species are found: *Vulpes vulpes*, *Capreolus capreolus*, *Martes martes*, *Sus scrofa*, *Lutra lutra*, *Ursus arctos*, *Cervus elaphus*, *Castor fiber*, *Canis lupus*, *Lepus timidus*, *Rupicapra rupicapra*, *Alces alces*, etc. These species still exist, though in different proportions. Furthermore, there are species at present living in different regions.: *Panthera leo*, *Felis silvestris*, *Lynx lynx*, *Bos primigenius*, *Rangifer tarandus*, *Equus* sp, *Gulo gulo*, *Alopex lagopus*, *Ovibos moschatus*, *Capra ibex*, *Saiga tatarica*, etc. Quite a number of species found in the community of the Last Glacial are extinct today: *Equus (A.) hydruntinus*, *Coelodonta antiquitatis*, *Mammuthus primigenius*, *Crocuta spelaea*, *Megaloceros giganteus*, *Ursus spelaeus*, etc. This brief list of large animals points to a rich species diversity in the community. It is due to the variety of habitat, to the presence of forest parklands and to the presence of steppe area within them. Thus, it corresponds to the well known assumption that the more varied the conditions of the habitat, the more species there are represented in the biocenose. They are not temporarily mixed communities as used to be suggested. This was clearly shown by a variety of long-term systematic field excavations carried out (in the modern style) in recent years both in Czechoslovakia and in neighbouring states.

The Holocene meant for Central Europe a gradual onset of continuous forests, i.e. a substantial change of the earlier habitat that now becomes less varied. This is, of course, immediately reflected in the species diversity of the biocenose, which becomes poorer in species, even if we neglect species becoming extinct in the course of the Last Glacial. This means that the Last Glacial is characterized by a much richer community than the Holocene. It is from this angle of view that we must observe the Last Glacial. On this occasion I would like to note that this reduction in the number of species at the beginning of the Holocene was/is not due to man.

Thus it is not true that the fauna of Central Europe was poorer in species in the course of the Last Glacial. On the contrary, the lower species diversity only starts in the Holocene, in a period characterized by a different community structure

and, of course, quite a different quantitative representation of individual species. The Last Glacial, therefore, was not a period disadvantageous for the existence of mammals, and the Holocene, on the other hand, is not an optimum period, as is sometimes assumed.

Communities with greater species diversity are considered more stable than those with lower species diversity. From this viewpoint the present Holocene community must be considered relatively unstable, easily impaired. Therefore, any activity on the part of mankind must be carried out very carefully, because it always affects this community in some way.

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Table 1. Summary (based on Musil 1986, 1988) of finds of mammals from the Last Glacial in Central Europe, particularly from the Alps and their promontories, from the central and southern parts of Germany, from Czechoslovakia, from the central and southern parts of Poland and from the Pannonian lowland. The individual regions differ in the pattern of faunistic associations in the same period. Towards the end of the Pleistocene a number of species become extinct (in the table marked +) and a number of species retreat from the region studied (in the table marked –). The result is a strong restriction of the faunistic association at the beginning of the Holocene. — EW = Early Würm; W1 = Würm 1; 1-2 = Interstadial Würm 1/2, M = Moustérien; W2 = Würm 2; 2-3 = Interstadial Würm 2/3 to first half of Würm 3; W3 = second half of Würm 3.

	EW	W1	1-2	M	W2	2-3	W3	
Erinaceus sp.	x	x	x			x		
Talpa sp.	x	x	x	x	x	x	x	
Sorex sp.	x	x	x	x	x	x	x	
Lepus timidus	x	x	x	x	x	x	x	–
L. europaeus	x					x		
Sciurus sp.	x			x				
Citellus sp.	x	x	x	x	x	x	x	
Marmota sp.		x	x	x	x	x	x	
Castor fiber	x		x			x	x	
Allactaga jaculus		x			x			
Glis sp.		x				x	x	
Cricetus sp.	x	x	x	x	x	x	x	
Lemmus lemmus	x	x	x	x	x	x	x	–
Dicrostonyx torquatus	x	x	x	x	x	x	x	–
Lagurus lagurus	x	x	x	x	x	x	x	
Ochotona pusilla	x	x	x	x		x	x	–
Felis silvestris	x	x	x	x		x	x	–
Panthera leo						x	x	–
P. pardus	x	x	x	x		x		–
Lynx lynx	x	x	x	x		x	x	
Crocuta spelaea	x	x	x	x	x	x	x	+
Canis lupus	x	x	x	x	x	x	x	
Cuon alpinus		x		x				
Vulpes vulpes	x	x	x	x	x	x	x	
Alopex lagopus	x	x	x	x	x	x	x	–
Martes sp.	x	x	x	x	x	x	x	
Mustela sp.	x	x	x	x	x	x	x	

	EW	W1	1-2	M	W2	2-3	W3	
Putorius sp.	x	x	x	x	x	x	x	
Gulo gulo	x	x	x	x	x	x	x	–
Lutra lutra			x				x	
Meles meles	x	x	x	x	x	x		
Panthera spelaea	x	x	x	x	x	x	x	+
Ursus arctos	x	x	x	x	x	x	x	
U. spelaeus	x	x	x	x	x	x	x	+
Mammuthus primig.	x	x	x	x	x	x	x	+
Coelodonta antiquit.	x	x	x	x	x	x	x	+
D. kirchbergensis	x			x				+
Equus sp.	x	x	x	x	x	x	x	–
E. (A.) hydruntinus	x	x	x	x	x	x	x	+
Sus scrofa	x	x	x	x		x	x	
Cervus elaphus	x	x	x	x	x	x	x	
Dama dama							x	
Capreolus capreolus	x	x	x	x		x	x	
Alces alces	x		x			x	x	
Megaloceros gigant.	x	x	x	x	x	x	x	+
Rangifer tarandus	x	x	x	x	x	x	x	–
Bos primigenius	x	x	x	x		x	x	–
Bison priscus	x	x	x	x	x	x	x	–
Saiga tatarica	x	x	x	x	x	x	x	–
Rupicapra rupicapra	x	x	x	x	x	x	x	
Capra ibex	x	x	x	x	x	x	x	–
Ovis sp.	x							–
Ovibos moschatus		x	x	x	x			–

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