

## Late Glacial mammal macrofauna in Slovenia

by Vida Pohar, Ljubljana

### Introduction

The frontier between the state of Slovenia and Austria in the north runs along the ridges of Kozjak and the Karavanke mountain range, to issue not far from Maribor in the Great Pannonian Plain where Slovenia abuts on Hungary in the east and Croatia in the south-east. In the west, the chains of the Julian Alps and the territory westward of the river Soča mark the confines with Italy, meeting the Adriatic coast south of Trieste (fig. 1).

The uneven relief of Slovenia is characterized by enormous contrasts in altitude ranging from sea level up to a height of nearly 3.000 m. A major part of the territory belongs to the high mountains region of the Alps as well as to the mountainous prealpine and to the karstic dinaric area.

Due to considerable climatic oscillations in the course of the Pleistocene period, frequent consecutive glaciations occurred in the alpine territory covering the mountainous parts of Slovenia with ice as well. During the phase of the greatest ice expansion, at the peak of the last (Würm) glacial, single glaciers moved far into the lowlands. The Julian Alps saw the highest glacier, i.e. the Sava glacier, blocking the valley of the rivers Sava Dolinka and Sava Bohinjka. Its terminal moraines were deposited in the east of Radovljica, at a distance of less than 40 km west of Ljubljana. Another major glacier is known from the valley of the river Soča. The Alp ranges, surmounting Kamnik and the Savinja river as well as the Snežnik mountain, were to undergo their own glaciation (fig. 1).

At the peak of the Würm glacial, the snow boundary, running today along the south eastern border of the Alps somewhere at an altitude of 2.700 m, dropped down to at least 1.500 m above sea level, which on our territory entailed a descent of the forest boundary to an altitude of 700–600 m. In this way the entire province of Slovenia, as far as not covered with a glacier bulk, represented a periglacial environment.

At the peak of the third Würm stadial (W III) and during the Late Glacial cold thrusts (Oldest, Older and Younger Dryas) tundra occupied the regions abutting on glaciers as well as the belt above the forest boundary. Major parts of Slovenia were covered with sporadic pine tree and birch stands, while the warmer phases (Bölling and Alleröd interstadial) would see the intrusion of mesophilic deciduous elements, such as *Quercus*, *Tilia*, *Ulmus* and *Fagus* (Šercelj 1970; Culiberg 1991).

There is not a shadow of a doubt that these considerable climatic oscillations resulted in extensive animal migrations in the east-west direction, changing mountains for valleys as well as north for south. And the Pleistocene Man had to follow the animals in the course of these migrations. To protect himself from bad weather conditions and predatory animals he was seeking for shelters in the karstic hollows being rather abundant on our territory. Many caves bear evidence of his presence in the form of hearths, stone and bone implements as well as the remains of his hunting bag. As open air sites with Pleistocene fauna are rarely found and moreover difficult to allocate from the stratigraphical point of view, the remains of the hunting bag discovered in the palaeolithic sites do grant, with respect to chronology, quite

precise data on our Pleistocene fauna. They indirectly provide one of the most important means of supporting the determination of the climate as well as the contemporaneous environment. However, the animal remains discovered in the Palaeolithic sites do not always reflect the former environment, because they are the result of hunting – i.e. man's choice! That's the reason why they do not correspond to the genuine fauna composition. Due to the fact that the Slovene Late Glacial (Epigravettian) sites tend to be dispersed over a geographically rather extensive area (fig. 1), their finds matching each other's contents (table 1 and fig. 2), I have been induced to assume that they do reflect the same environment. Nevertheless I did compare these data with the results of the flora analyses as well as with the  $^{14}\text{C}$ -dates of charcoal obtained from the hearths.

### Review of the Late Glacial fauna sites

The Late Glacial fauna sites are more or less evenly distributed all over the Slovene territory with the exception of the north-eastern part where no such locality has been discovered so far (fig. 1). Here is the list of the sites having been subdued to investigation:

Locality	Geological period
1. Betalov spodmol near Postojna (Fig. 1/1)	Late Glacial
2. Županov spodmol near Sajevče (Fig. 1/2)	cultural horizons of layer 2: C – Older Dryas transition into Alleröd interstadial D – Bölling interstadial AB – W III transition into Late Glacial
3. Babja jama near Ljubljana (Fig. 1/3)	Bölling interstadial
4. Lukenjska jama near Novomesto (Fig. 1/4)	Bölling interstadial
5. Zakajeni spodmol near Prestranek (Fig. 1/5)	layer 2 – Alleröd interstadial layer 3 – Older Dryas
6. Matjaževe kamre near Rovte (Fig. 1/6)	Late Glacial
7. Roška špilja above cave Škocjanske jame (Fig. 1/7)	Late Glacial
8. Poljšiška cerkev near Bled (Fig. 1/8)	Younger Dryas transition into Preboreal
9. Judovska hiša near Črnomelj (Fig. 1/9)	Late Glacial

In view of the chronostratigraphic classification of the Late Glacial fauna localities I recurred to Gross's (1964, 196) subdivision of the Würm glacial, whilst the Woldstedt (1958, 164–165) synopsis was applied to the Late Glacial period. The cultural classification of the tool industries from the previously examined localities (Osole 1967; 1977) as well as from the Gravettian cultural complex (Osole 1979; 1983) were of a great help in cases of denuded fauna inventories.

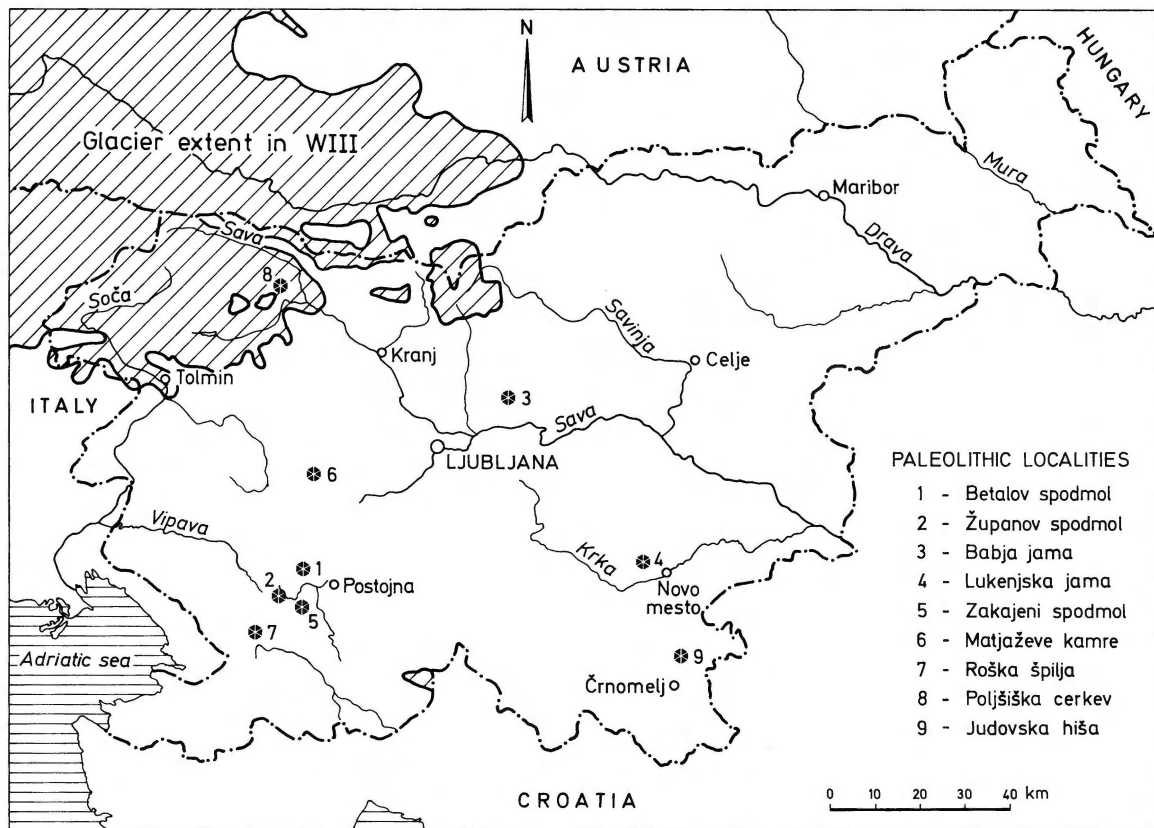


Fig. 1. Topographic map of Slovenia comprising indications of Late Glacial fauna localities.

To reliably render the chronostratigraphic attribution of the above-mentioned sites to the Late Glacial phase, we base it not only on the fauna structure and the cultural classification of the tool industries but also of an absolute charcoal datation from the AB cultural horizon ( $14.830 \pm 150$  B.C.) and the D cultural traces ( $10.640 \pm 70$  B.C.) of layer 2 in the locality Županov spodmol (Osole 1976) as well as of the lower cultural horizon of layer 4 (Osole 1983) in the cave Lukenjska jama ( $10.600 \pm 250$  B.C.).

#### Late Glacial large mammals in Slovenia

The faunistic structure of the Late Glacial localities having been subdued to investigation and pertaining to the period between 15.000 and 8.000 B.C is shown in table 1 and figure 2.

Compared to the sites of the third Würm stadial (Pohar 1994, 91–92), fossil remains of the alpine marmot (*Marmota marmota* – up to 99,2 % in the cave Matjaževe kamre) definitely prevail among the Late Glacial fauna. The reindeer (*Rangifer tarandus* – above 50 % in the Palaeolithic site of Ovčja jama near Postojna), having been so steady at the peak of Würm glacial (W III), is stated only sporadically in the Late Glacial (under 5 % fig. 2).

The beaver (*Castor fiber*) is present in every locality, in the cave Babja jama (Pohar 1985, 122) even with up to 18,9 %. In the Tardigravettian sites of the third Würm stadial its existence was confirmed only in the cave Ciganska jama near Kočevje (Pohar 1992, 171).

Table 1. Review of Late Glacial mammal macrofauna.

Species	A	B	C	D	E	F	G	H	I
<i>Lepus timidus</i> L.	+	-	-	-	-	-	-	-	-
<i>Lepus timidus varronis</i> MILLER	-	+	+	-	-	-	-	-	-
<i>Lepus</i> sp.	+	-	-	+	-	-	-	-	-
<i>Castor fiber</i> (L.)	+	+	-	-	+	+	+	+	-
<i>Marmota marmota</i> (L.)	+	+	+	+	+	+	+	+	+
<i>Cricetus cricetus</i> (L.)	+	+	-	-	-	+	-	-	-
<i>Ursus spelaeus</i> ROSENMÜLLER ET HEINROTH	+	+	-	-	-	-	-	-	-
<i>Ursus arctos priscus</i> GOLDFUSS	-	-	-	-	-	-	+	+	-
<i>Ursus</i> sp.	-	+	-	+	-	-	-	-	-
<i>Martes martes</i> (L.)	+	+	-	-	-	-	-	-	-
<i>Martes</i> sp.	+	-	-	-	-	-	-	-	-
<i>Meles meles</i> (L.)	+	-	-	-	-	-	-	-	-
<i>Canis lupus</i> L.	+	-	-	-	-	+	-	-	-
<i>Canis cf. aureus</i> L.	-	-	-	-	-	-	+	-	-
<i>Vulpes vulpes</i> (L.)	+	+	-	-	-	-	+	-	-
<i>Alopex lagopus</i> (L.)	+	-	-	-	-	-	-	-	-
<i>Vulpes</i> sp.	+	-	-	-	-	-	-	-	-
<i>Felis silvestris</i> SCHREBER	+	-	-	-	-	-	-	-	-
<i>Sus scrofa</i> L.	+	+	+	-	-	+	-	+	+
<i>Cervus elaphus maral</i> GRAY	-	-	-	-	-	-	+	-	-
<i>Cervus elaphus</i> L.	+	+	+	+	+	-	+	+	+
<i>Megaceros giganteus</i> (BLUMENBACH)	+	-	-	-	-	+	-	+	-
<i>Dama dama</i> (L.)	-	-	-	+	-	-	-	+	-
<i>Rangifer tarandus</i> (L.)	+	-	+	-	-	+	+	+	-
<i>Capreolus capreolus</i> (L.)	+	+	-	+	+	-	-	-	-
<i>Alces alces</i> (L.)	+	+	-	-	+	-	+	+	-
<i>Rupicapra rupicapra</i> L.	-	-	-	-	-	+	-	+	-
<i>Capra ibex</i> L.	-	-	-	-	-	+	-	+	-
<i>Bison priscus</i> BOJANUS	+	-	-	-	-	+	+	-	-
<i>Bos</i> seu <i>Bison</i>	+	-	+	+	+	+	+	+	-
<i>Mammuthus primigenius</i> (BLUMENBACH)	+	-	-	-	-	-	-	-	-

A = Županov spodmol, layer 2, cultural horizon AB, D, C (Rakovec 1975; completed by Pohar)

B = Betalov spodmol, layers 5–7 (Rakovec 1959; completed by Pohar)

C = Zakajeni spodmol, layers 2 and 3 (Rakovec 1975; completed by Pohar)

D = Roška špilja, layer 8b (Pohar)

E = Matjaževe kamre, layer 2 (Rakovec 1975; Pohar and Kotnik 1994)

F = Poljšiška cerkev, layer 2 (Pohar 1991)

G = Babja jama, layer 5 (Rakovec 1975; Pohar 1985)

H = Lukenjska jama, layer 4 (Pohar 1983)

I = Judovska hiša, layer 5 (Pohar 1985a)

The occurrence of cave bear (*Ursus spelaeus*) is as sporadic as in the sites belonging to W III (Pohar 1994, 90). It is reported though only in the caves Betalov spodmol and Županov spodmol. In the unpublished list of fauna from the cave Betalov spodmol, the tooth found in the Late Glacial Epigravettian cultural horizon AB of layer 2 was attributed by Rakovec to the cave bear, yet the data was not incorporated in the subsequent elaboration of the Quaternary fauna in Slovenia (Rakovec 1975, Tab. 1). Later on, the above-mentioned find was nevertheless inserted by Osole (1976, 13) in the published list of fauna issued from the cave Županov spodmol yet it was not specifically referred to. Consequently, the researchers were unanimous in the conviction that the cave bear in Slovenia was extinct before the peak of the third Würm stadial (W III). The identification of the undetermined fauna remains from layers 5–7 of Betalov spodmol and the cultural horizon of Županov spodmol provided evidence of the cave bear's prolonged existence traced down to the Late Glacial sequence in these regions (Pohar 1994, 90, 92).

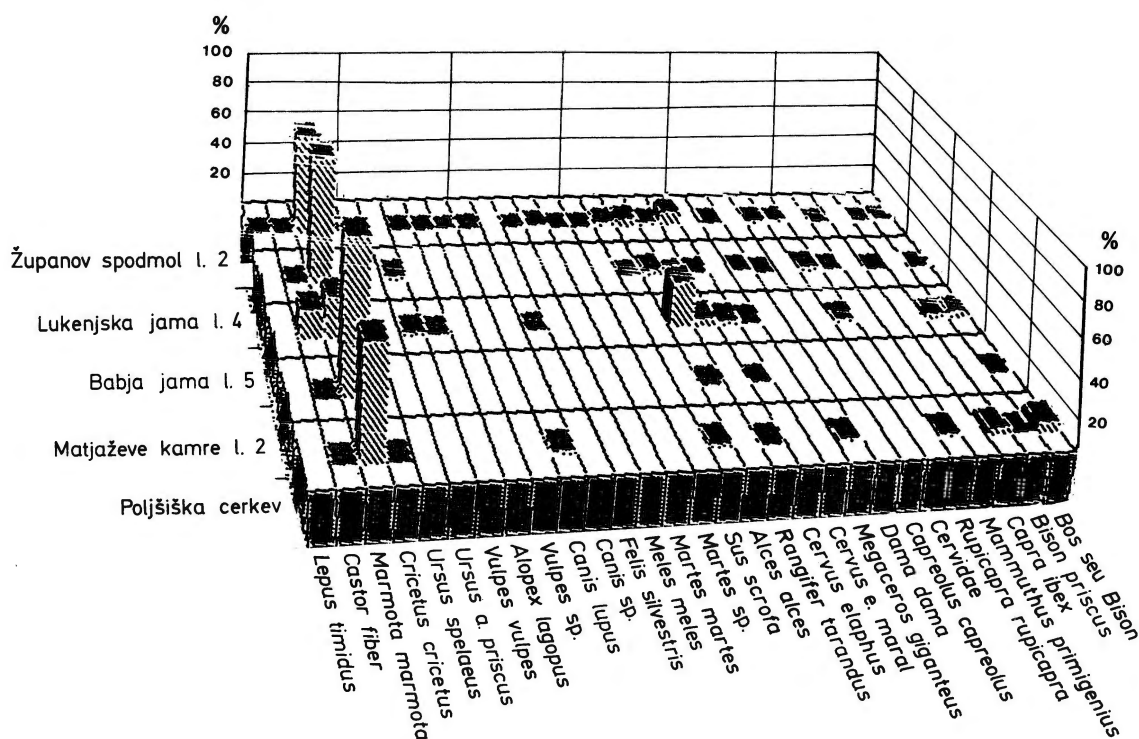


Fig. 2. Fauna assemblage in Late Glacial (Epigravettian) localities.

The brown bear (*Ursus arctos priscus*) appears as rarely as the cave bear. Only the caves Babja jama (Pohar 1985, 122) and Lukenjska jama (Pohar 1983, 94) yielded proofs of its existence. The oldest finds known so far originate from the Lower Würm (W I – Pohar 1981, 250). Turk (1986, 8) discovered them in the sediments belonging to the Middle Würm (W I/II). The brown bear fossil remains from the Palaeolithic sites of the caves Jama v Lozi (Rakovec 1962–1963, 258) and Ciganska jama (Pohar 1992, 171) date from the third Würm stadial. In nearly all the sites the brown bear appears together with the cave bear, as is the case in some other caves in Western and Central Europe (Thenius 1959).

There are only sporadic occurrences of the arctic fox (*Alopex lagopus*), the badger (*Meles meles*), the red fox (*Vulpes vulpes*) and the wild cat (*Felis silvestris*). Since the period of the Middle Würm (W I/II) there

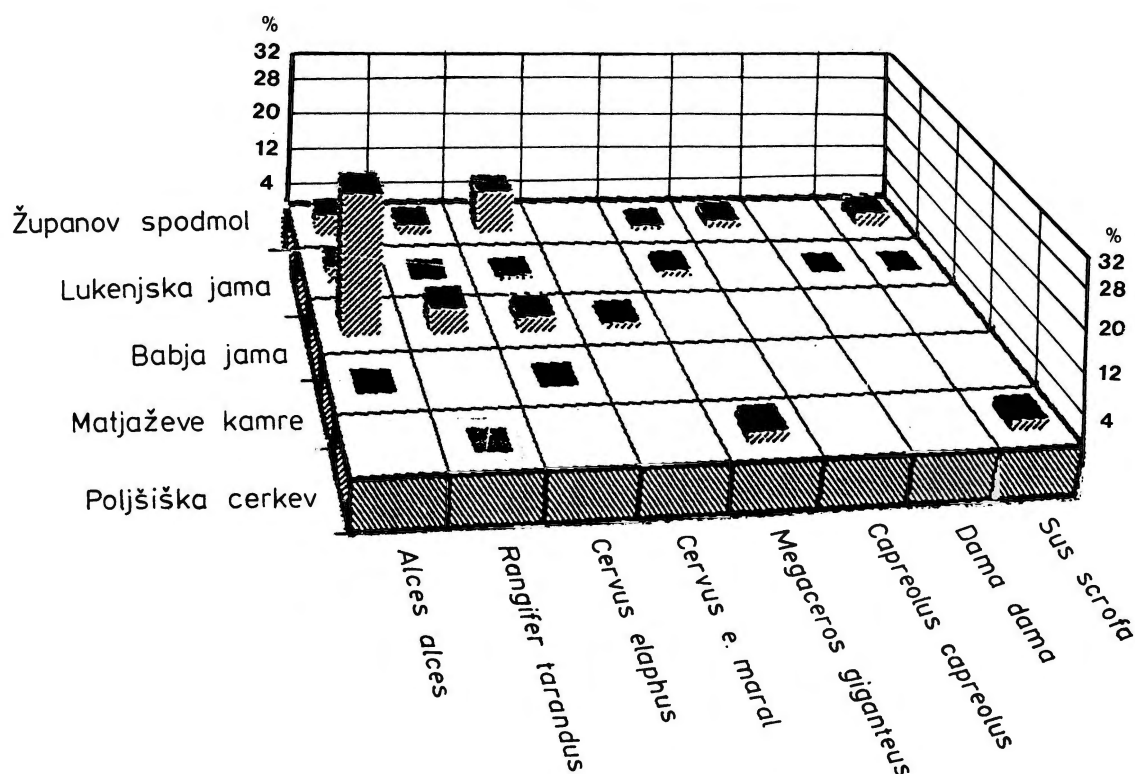


Fig. 3. The cervine and European wild boar assemblage in the Late Glacial (Epigravettian) localities.

have been no large Pleistocene cats (cave lion – *Panthera spelaea*) to be found among them, leaving alone the cave hyaena (*Crocuta spelaea*) being nonexistent since the interstadial W II/III.

The cervine association in the Late Glacial sequence was of the same interesting variety as the one at the peak of the Würm glacial (Pohar 1994, 91), the only difference being brought by the numeric proportion of the individual species. In the Late Glacial sequence the elk absolutely prevails (*Alces alces* – up to 30 % in the cave Babja jama), followed by the red deer (*Cervus elaphus* – 11,5 % in the cave Županov spodmol), the reindeer coming only third in rank (4,7 % in the cave Babja jama).

The giant deer (*Megaceros giganteus*) and the fallow deer (*Dama dama*) are presented by sporadic finds. The roe deer was not found in the W III, while it reappears in the Late Glacial as a member of the cervine family of that time.

The fairly rare representatives of the Late Glacial herbivore association, namely the chamois (*Rupicapra rupicapra*) and the ibex (*Capra ibex*), were found only in the southwestern (in the cave Poljšiška cerkev – Pohar 1991) and southeastern (in the cave Lukenjska jama – Pohar 1983) parts of Slovenia. The aurochs/wisent (*Bis* seu *Bison*) are spotted in all the Late Glacial sites (Table 1), while the woolly mammoth (*Mammuthus primigenius*) is found only in Županov spodmol. Compared to the third Würm stadial (Pohar 1994, 95) the number of European wild boar fossil remains did considerably increase in the Late Glacial localities (Fig. 3).

Among the Late Glacial fauna, the tundra elements maintain their predominance (reindeer) together with the alpine (chamois, ibex, alpine marmot) and steppe representatives (steppe wisent – *Bison priscus*, giant deer, common hamster – *Cricetus cricetus*), yet the population of a more or less expressed forest

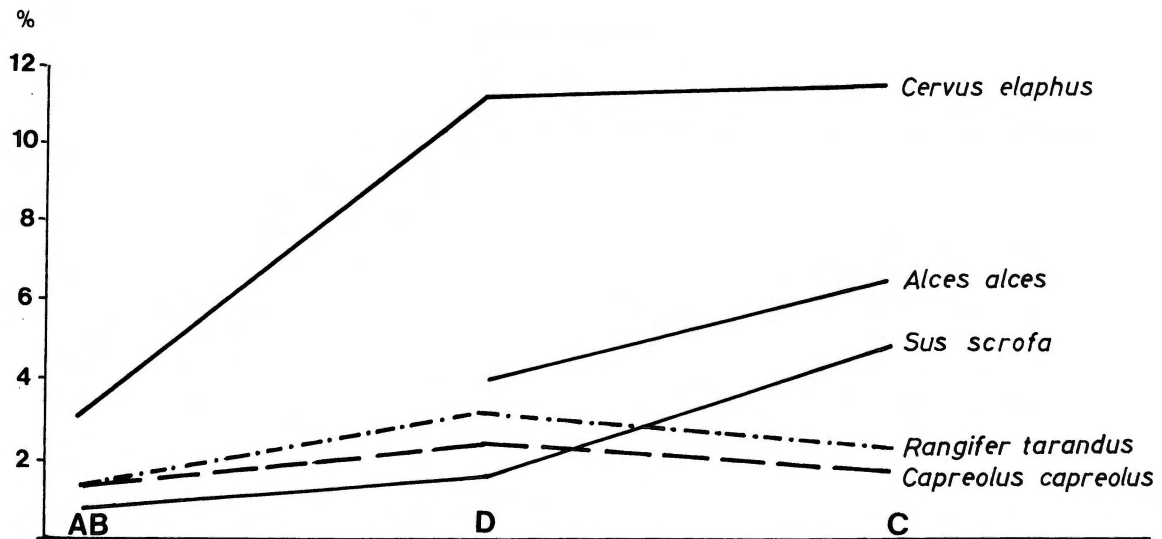


Fig. 4. The cervine and european wild boar assemblage in the Epigravettian cultural horizons AB (transition from W III into the Late Glacial), D (Bölling interstadial) and C (transition of the Older Dryas into the Alleröd interstadial) of the cave Županov spodmol.

habitat persistently claims its predominance (beaver, elk, red deer, roe deer – *Capreolus capreolus*, european wild boar). Such a “mixed” fauna occurring in the same layer during the Late Glacial is due to seasonal migrations caused by strong temperature oscillations.

Having compared the faunistic structure (fig. 2) of some individual Late Glacial localities, we come to the conclusion that their animal structure is not absolutely identical. From the Oldest Dryas to the end of the Younger Dryas the numeric proportion concerning particularly singular cervine species as well as the european wild boar did greatly alter, which is most clearly seen in three Epigravettian cultural horizons of different ages, i.e. AB, D and C in Županov spodmol (fig. 4).

The oldest cultural horizon AB of the cave Županov spodmol (W III transition into the Late Glacial) has yielded but relatively frugal contents of cervine remains, the red deer being the most common (3.1 %), closely followed by the reindeer and the roe deer (1.4 %), the elk being totally absent in this association, while, on the other hand, the european wild boar appears with 0.7 %. The intermediate cultural horizon D (Bölling interstadial) offers a somewhat different picture though. The percentage of the red deer (11.2 %) increases, the elk (4.0 %) figures second as to the number of finds, followed by the reindeer (3.2 %). Compared to the cultural horizon AB the number of finds related to roe deer (2.4 %) and european wild boar (1.6 %) has slightly augmented. In the upmost and youngest cultural horizon C (transition from the Older Dryas into the Alleröd interstadial) the occurrence of the red deer does not show an essential raise, while a considerable increase in the presence of the elk (6.5 %) and the european wild boar (4.8 %) has been indicated, including, however, a drop in the reindeer (2.3 %) and the roe deer (1.7 %).

Among the cervine fauna of the Late Glacial (fig. 3), from its beginning (the Oldest Dryas) through to its final sequence (the Younger Dryas), the red deer was the one to predominate alternating with the elk in boggy areas (e.g. the cave Babja jama).

Each minor climate melioration led to an increased number of subjects of the european wild boar, reaching its climax in the Alleröd interstadial. The reindeer – together with the alpine marmot a fairly

relevant indicator of environments of Late Glacial type – made its first appearance on the Slovene territory in the Lower Würm (Pohar 1981 and 1994), lending itself, at the peak of the Würm glacial (W III), to be the main hunting beast of the people of those times. Its fossil remains were found all over the Slovene territory (Pohar 1994, 91). In the Late Glacial there is a tremendous drop in its frequency, its number being reduced to one single find in the course of Younger Dryas (Pohar 1991, 328). The material excavated so far points to the assumption of the Pivka basin (Inner Carniolian karst) presenting the most southern limit the reindeer ever reached. This is supported by the fact that the Würm fauna excavated from the palaeolithic stations of the Littoral karst (the caves Črni Kal and Roška špilja) lying southward of this line does not yield any trace of the reindeer. Moreover, it is not mentioned by the researchers (Leonardi and Broglio, 1962–1963, 112; Broglio et al. 1963, 328) dealing with the fauna of the north Italian paleolithic stations. The minimal occurrence of the roe deer in the Late Glacial mammal assemblage did not considerably augment in the Older Holocene.

Poljšiška cerkev is considered to be the youngest Late Glacial site (transition from Younger Dryas into Preboreal), yet its fauna assemblage shows a deviation from the expected scheme, conditioned on the nearness of mountains and glaciers. Instead of the red deer and the roe deer, we see the chamois and the ibex in a great number of finds, while the reindeer and the european wild boar appear only sporadically (fig. 2).

Having correlated the animal assemblages from the third Würm stadial and the Late Glacial, we come to the conclusion that a tremendous drop in tundra representatives must have occurred during the course of the Late Glacial. However, the assemblage was far from being just thermophilic – it was a 'mixed' one. According to Firbas (cf. Frenzel 1967, 222) the average July temperatures of the Bölling and Alleröd interstadial used to be 4°C inferior to the present temperatures. Consequently, in the surroundings of our Late Glacial sites they varied between 13°C and 20°C. Even the cold thrust temperature changes of the Late Glacial must have been more timely compared to those of the third Würm stadial.

Pollen analyses from the Ljubljana moor are indicative as well, as they refer to more favourable climatic conditions. According to Šercelj (1962, 30 and 1963, 403) a slow decline of cryophilic coniferous trees is clearly perceptible during the Late Glacial, while mesophilic deciduous and beech trees obviously reappear in traces in the course of the more temperate phases (Bölling, Alleröd interstadial). The anthracotomic studies of charcoal from hearths belonging to the Epigravettian cultural horizons of the localities dealt with have rendered a similar picture (Šercelj and Culiberg 1985).

As far as the number of species is concerned, the Late Glacial fauna was more manifold in Croatia than in Slovenia. In Vindija (1979a, 198) and Veternica (1979, 213–214) Malez stated the presence of the varying hare, the alpine marmot, the beaver, the cave and the brown bear, the wolf, the jackal (*Canis aureus*), the red fox, the european wild boar, the reindeer, the elk, the red deer, the chamois and the steppe wisent (*Bison priscus*). During the Late Glacial period the above-mentioned species ranged throughout our territory as well. The two countries differ only by the presence of the polar fox and the chamois found in Slovenia (Pohar), and the cave lion, the cave hyaena and the woolly rhinoceros (*Coelodonta antiquitatis*) found in Croatia (Malez).

The contemporary fauna discovered in the sites of northern Italy is definitely less abundant than ours. The cave Grotta Sepolcrale del Broion (Leonardi and Broglio 1962–63, 112) disclosed only the degenerated forms of a cave bear and snow vole (*Microtus nivalis*). The fauna in the cave la Grotta E di Ponte di Veia (Broglio et al. 1963, 328) is less meager though. Among the numerous bony remains of small mammals, the snow vole is predominant, while among the large mammals, the wild hare (*Lepus europaeus*) and the alpine marmot prevail. In the underground niche called Grotta Azura (locality of Grotta di Paina) bone remains of cave bear (predominant) were discovered as well as those of the elk, together with single remains of the european wild boar, the roe deer and the red deer (Bartolomei et al. 1988, Tab. 1).



Our Late Glacial fauna assemblage closely resembles the Austrian found in the Magdalénian sites of that country. In caves, such as Luegloch near Köflach (Mottl 1953, 53), Steinbockhöhle near Peggau (Mottl 1953, 54), Dachsloch near Zigöllerkogel in the Austrian Styria (cf. Musil 1980, 18) and others, the bone remains of a closely indeterminable hare, the alpine marmot, rare cave bear, the polar fox, the reindeer, the chamois, most recurrent ibex and the steppe wisent were discovered.

In the Magdalénian sites on the northern side of the Alps (Weniger 1982, 118) the varying hare and the reindeer figured as the most usually hunted game. The German fauna descriptions do not provide any written record concerning the alpine marmot, the animal most frequently hunted on our territory (fig. 2). Yet the arctic representatives include the polar fox, the woolly rhinoceros, the musk ox (*Ovibos moschatus*) and the mammoth as well. The occurrence of the beaver, the cave bear and the brown bear, the red deer, the elk and the roe deer is but sporadic. Hence, we may ascertain, that along the upper part of the Danube river basin, the Late Glacial fauna used to be more cryophilic than the one inhabiting Slovenia in the third Würm stadial.

During the transitional period from Pleistocene to Holocene, it was getting warmer and warmer. The deciduous forest was to overgrow our region, so the reindeer and the polar fox headed north. The chamois and the mountain hare withdrew to the mountains, the mammoth, the cave bear, the giant deer and the steppe wisent became extinct. The research carried out so far supports the assumption that the alpine marmot and the ibex did not survive to the Pleistocene/Holocene boundary on the territory of Slovenia. Their fossil remains have not been traced in any of the mesolithic sites (Pohar 1990). As no occurrence of this species has been reported among the Holocene fauna of the upper-mountainous sites of the cave Mokriška jama (Rakovec 1975, Tab. 19) or the cave Potočka zijalka (S. and M. Brodar 1983), I am induced to presume, that, by the end of the Pleistocene, both of them became extinct on the territory of Slovenia.

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