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Fossil and subfossil bird remains from five Austrian caves

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Abstract. A total of 84 bird taxa were identified. They come from Zwerglloch (68 taxa), Bärenhöhle (10), Hohlensteinhöhle (4), Knochenöhle (5), and Grosse Offenbergerhöhle (25). They all represent recent bird species, and most of them belong to the today breeding fauna of Austria. 27 taxa were found in the Austrian Pleistocene/Holocene cave deposits for the first time.

Key words: Bird remains, Austria, Pleistocene, Holocene, cave deposits.

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I. INTRODUCTION

In 1986 Dr Kurt BAUER of the Museum of Natural History in Vienna gave us bird bone remains collected in five Austrian caves for identification. They come from:

1. Zwerglloch near Rosenburg (Cat.No. 6845/30) in Lower Austria (Niederösterreich),

2. Bärenhöhle near Winden (Cat.No. 2911/1) in the surroundings of Lake Neusiedl in Burgenland,

3. Hohlensteinhöhle near Mariazell (Cat.No. 1831/1),

4. Knochenhöhle near Kapellen (Cat.No. 2861/51), 5. Grosse Offenbergerhöhle near St. Lorenzen (Cat.No. 1733/1)

The last three caves lie in NE Styria (Steiermark) in the Styrian-Lower Austrian Limestone Alps (Steirisch-niederösterreichische Kalkalpen). The situation of all localities is shown on a sketch map (Fig. 1). The smallest number of remains come from Bärenhöhle (18 pieces only), whereas the richest is the fauna from Zwerglloch, containing 482 remains, which belong at least to 68 various taxa.

According to Dr BAUER (in litt.), the material from Zwerglloch was obtained during a careful excavation undertaken by J. BAYER in 1930, but the whole sediment proved to be intricately mixed by the burrowing of generations of badgers *Meles meles*. Bird bones

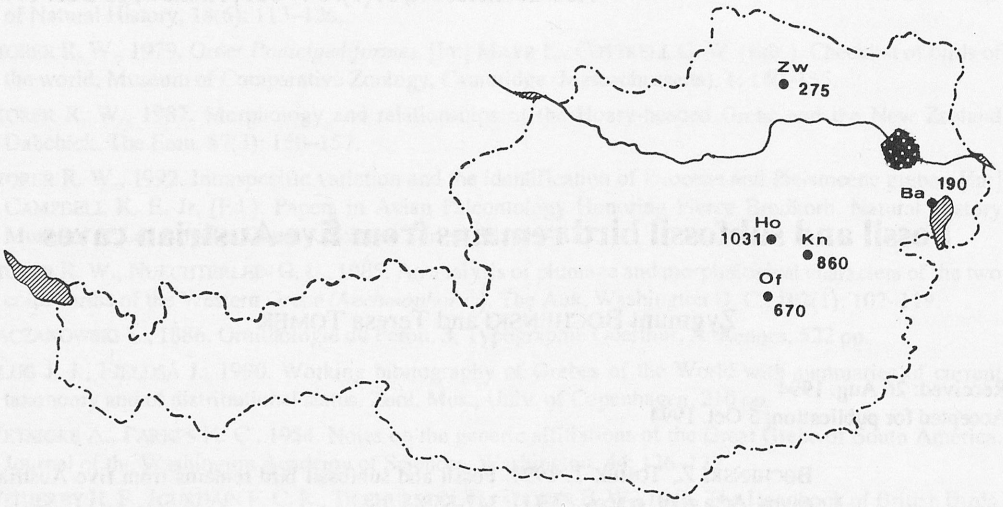

Fig. 1. Distribution of the caves discussed. Ba – Bärenhöhle, Ho – Hohlensteinhöhle, Kn – Knochenhöhle, Of – Offenbergerhöhle, Zw – Zwerglloch. The numbers indicate the altitude of the caves above sea level (in m).

(together with small mammal reemains) from Bärenhöhle were collected from sediment excavated and discarded during the obviously quite careless investigation of the megafauna of this cave in 1930-40. The fauna of Grosse Offenbergerhöhle was collected by washing and sieving a small remnant block of the original sediment removed from the cave during the 2nd World War, when the cave housed technical installations. Finally, the bird bones from Hohlensteinhöhle and Knochenhöhle were salvaged from superficial sediments during the exploration of new-found caves. For those reasons, for none of the caves stratigraphic data are available and the Holocene and Upper Pleistocene materials were mixed together. That is why the minimum number of individuals (MNI) was calculated for all remains of each species; the same was also done in the case of the material from Zwerglloch in spite of the fact that the numbers of samples were given (without their stratigraphic interpretation). In consequence, the scientific value of the material is limited to some zoogeographical and faunistic problems and it cannot be used to study in detail the development of the Austrian bird fauna. Nevertheless, a large number of taxa identified calls for short note on them.

A c k n o w l e d g e m e n t s . We are highly indebted to Dr Kurt BAUER for lending us the bone remains for study, to Dr F. FLADERER of the University of Vienna for his help with gathering Austrian literature, to Ms Barbara VEČER for the data concerning the caves, to Mr W. GSTADER for giving us a specimen of the Snow Finch and to Dr P. VILETTE for sending us the bone measurements of the Snow Finches in his charge.

II. RESULTS

The results of identification are given in Table I. It contains the numbers of remains found in each cave and the minimum numbers of individuals calculated on the basis of the most numerously occurring bones, a comparison of the measurements in the case of symmetric bones and the degree of ossification (full/not full), if perceptible. The minimum number of individuals is omitted only in the case of remains not identified precisely if they may belong to some other individuals listed in the table.

At least 84 various bird taxa were identified, most of them to species level. Two species, the Domestic Hen and Turkey are typical domesticated birds in Europe (the former most probably starting fromthe Neolithic and the latter from the 16th century). The greater part of the wild-living species identified belong to the recent breeding fauna of Austria. Some other species are noted as passage migrants and/or winter visitors, mainly from NE Europe. *Nyctea scandiaca* and *Calcarius lapponicus* belong, acc. to ROKITANSKY (1964), to accidental visitors observed a few times only, and *Lagopus lagopus* not living in Austria during the last few thousand years.

A few taxa listed in Table I need some more explanation or remarks. They include:

Anser erythropus, whose single bones were found in two localities. The complete left humerus from Offenbergerhöhle is typical of the genus *Anser* (the members of the genus *Branta* differ in morphological details); its total length is 110.2 mm which is a little less than in a comparative recent specimen (127.5 mm) – in all other geese of the genus *Anser* the bones are distinctly longer.

Anser cf. *albifrons* – Most of goose bones are very similar to each other and their measurements overlap; the distal articular part of the humerus from Zwerglloch is ca 21.5 mm wide or a little bit wider, and so it lies within the limits of *A. albifrons* which are 21.0-24.4 mm (BACHER 1967). In wild-living *A. anser* these limits are 22.5-27.0 mm, but in the collection of the Institute of Systematics and Evolution of Animals in Kraków there is a small specimen in which this dimension is 21.9 mm. So, probably, the bone belonged to *A. albifrons*, but, on the other hand, a small immature female of the Greylag cannot be absolutely excluded.

Falco sp. (small species) – Two fragments of the mandible (one not fully ossified), found in Offenbergerhöhle, are too damaged to allow their exact identification; they could belong to *F. tinnunculus* (even to the individuals found in that cave), *naumanni*, *subbuteo* or even *columbarius*; this is also true of two not fully ossified ungual phalanges of young falcon.

Lagopus lagopus and *Lagopus mutus* – Many bones of these two species of European grouse (among them the carpometacarpus) are hardly distinguishable. However, the measurements of the grouse carpometacarpi from Hohlensteinhöhle plotted in a scatter diagram (Fig. 2) are highly discriminative as in the case of the tarsometatarsi from this cave (Fig. 3) and from several Polish localities (BOCHEŃSKI 1974). This enables further comparisons of the bone lengths of the fossil and recent Ptarmigans from the Alps. The data concerning the recent birds were calculated from the data given by KRAFT (1972)

Table I

List of bird taxa identified in bony material collected in five caves in eastern Austria. The number of remains (No) and minimum number of individuals (MNI) are given (* – MNI not given because all, or at least most of remains may belong to individuals from this locality identified to species level). The present status of each species in eastern Austria is given in the last column: B – wild breeding, [B] – bred by people, b – known as breeding in the past but now extinct, M – passage migrant (also: vagrant), A – accidental, W – winter visitor (acc.to ROKITANSKY 1964; HARRISON 1982; DWORAK et al. 1993).

Taxa	Zwerglloch		Bärenhöhle		Knochen-höhle		Hohlenstein-höhle		Grosse Offenberger-höhle		Present status in eastern Austria
	No	MNI	No	MNI	No	MNI	No	MNI	No	MNI	
1	2	3	4	5	6	7	8	9	10	11	12
Podiceps cristatus (LINNAEUS, 1758)	1	1	–		–		–		–		B
Anser erythropus (LINNAEUS, 1758)	1[1]	1	–		–		–		1	1	M
Anser anser (LINNAEUS, 1758)	2[2]	1	–		–		–		–		B
Anser cf. *albifrons* (SCOPOLI, 1769)	1	1	–		–		–		–		M/W
Anas platyrhynchos LINNAEUS, 1758	3	1	1	1	–		–		2	1	B
Anas cf. *strepera* LINNAEUS, 1758	–		1	1	–		–		–		B
Anas crecca LINNAEUS, 1758	2	1	–		–		–		–		B
A. querquedula LINNAEUS, 1758 aut *crecca* LINNAEUS, 1758	3	1	–		–		–		–		B
cf. *Aythya fuligula* (LINNAEUS, 1758)	1	1	–		–		–		–		B[3]
Bucephala clangula (LINNAEUS, 1758)	2	1	–		–		–		–		M/W
Mergus merganser LINNAEUS, 1758	1	1	–		–		–		–		B[4]
cf. *Circus cyaneus* (LINNAEUS, 1766)	1	1	–		–		–		–		M
Falco tinnunculus LINNAEUS, 1758	4	2	–		–		–		5[5]	3	B
Falco cf. *naumanni* FLEISCHER, 1818	1	1	–		–		–		–		b
Falco cf. *subbuteo* LINNAEUS, 1758	1	1	–		–		–		–		B
Falco sp. (small)	–		–		–		–		4	*	
Meleagris gallopavo LINNAEUS, 1758	5	1	–		–		–		–		[B]

Table I ctd.

1	2	3	4	5	6	7	8	9	10	11	12
Lagopus lagopus (LINNAEUS, 1758)	25	4	–		39	8	14	5	3	1	
Lagopus mutus (MONTIN, 1776)	4	1	–		30[6]	8	3	2	5	2	B
Lag. lagopus (LINNAEUS, 1758) aut *mutus* (MONTIN, 1776)	17	*	–		14	*	17	*	5	*	
Tetrao tetrix LINNAEUS, 1758	6	2	–		–		–		–		B
Tetrao urogallus LINNAEUS, 1758	6	1	–		–		–		–		B
Bonasa bonasia (LINNAEUS, 1758)	–		–		–		–		1	1	B
Gallus gallus LINNAEUS, 1758	246	21	2	1	–		–		7[7]	2	[B]
Perdix perdix (LINNAEUS, 1758)	6	2	5	2	–		–		–		B
Coturnix coturnix (LINNAEUS, 1758)	2	1	2	1	–		–		–		B
Galliformes indet.	10[8]	*	–		–		–		–		
cf. *Gallinula chloropus* (LINNAEUS, 1758)	–		–		–		1	1	1	1	B
Rallus aquaticus LINNAEUS, 1758	1	1	–		–		–		–		B
Crex crex (LINNAEUS, 1758)	3	1	–		2	1	–		–		B
Numenius sp.	1	1	–		–		–		–		
Scolopax rusticola LINNAEUS, 1758	1	1	1	1	–		–		1	1	B
Gallinago media (LATHAM, 1787)	1	1	–		–		–		2	1	M
Lymnocryptes minimus (BRÜNNICH, 1764)	–		–		–		–		2	1	M
Tringa sp.	–		–		–		–		1	1	
Actitis hypoleucos (LINNAEUS, 1758)	1	1	–		–		–		–		B
Columba livia LINNAEUS, 1758 (*domestica?*)	3	2	–		–		–		–		B
Columba oenas LINNAEUS, 1758	2	1	–		–		–		–		B
Nyctea scandiaca (LINNAEUS, 1758)	–		–		–		9	4	2	1	A
Athene noctua (SCOPOLI, 1769)	–		2	1	–		–		–		B
Asio flammeus (PONTOPPIDAN, 1763)	–		–		–		–		2	1	B
Asio otus (LINNAEUS, 1758)	1	1	–		–		–		–		B
Strix aluco LINNAEUS, 1758	2	1	–		–		–		–		B
Apus apus (LINNAEUS, 1758)	3	1	–		–		–		–		B

Table I ctd

1	2	3	4	5	6	7	8	9	10	11	12
Picus canus GMELIN, 1788	2	1	–		–		–		–		B
Alauda arvensis LINNAEUS, 1758	5	1	–		–		–		–		B
Eremophila alpestris (LINNAEUS, 1758)	–		–		–		–		4	1	W
Hirundo rustica LINNAEUS, 1758	3	1	–		–		–		1	1	B
Delichon urbica (LINNAEUS, 1758)	1[6]	1	–		–		–		2[6]	2	B
Anthus spinoletta (LINNAEUS, 1758)	5	2	–		–		–		–		B
Anthus cf. *pratensis* (LINNAEUS, 1758)	1	1	–		–		–		–		B
Motacilla cf. *alba* LINNAEUS, 1758	1	1	–		–		–		–		B
Lanius collurio LINNAEUS, 1758	1	1	–		–		–		–		B
Cinclus cinclus (LINNAEUS, 1758)	–		–		–		–		1	1	B
Prunella modularis (LINNAEUS, 1758)	1	1	–		–		–		–		B
Erithacus rubecula (LINNAEUS, 1758)	1	1	–		–		–		–		B
Luscinia cf. *luscinia* (LINNAEUS, 1758)	1	1	–		–		–		–		b
Phoenicurus ochruros (GMELIN, 1774)	6	2	–		–		–		2	1	B
Phoenicurus phoenicurus (LINNAEUS, 1758)	2	1	–		–		–		–		B
cf. *Oenanthe oenanthe* (LINNAEUS, 1758)	–		–		–		–		1	1	B
Turdus cf. *pilaris* LINNAEUS, 1758	1	1	–		–		–		–		B[3]
Turdus merula LINNAEUS, 1758	10	2	–		–		–		–		B
Turdus philomelos C.L.BREHM, 1831	3	2	2	1	–		–		–		B
Turdus iliacus LINNAEUS, 1766	2	1	–		–		–		–		M/W
Turdus cf. *torquatus* LINNAEUS, 1758	2	1	–		–		–		–		B
Turdus viscivorus LINNAEUS, 1758	6	2	–		–		–		–		B
Acrocephalus arundinaceus (LINNAEUS, 1758)	–		–		–		–		1	1	B
Ficedula hypoleuca (PALLAS, 1764) aut *albicollis* (TEMMINCK, 1815)	2	1	–		–		–		–		B
Parus major LINNAEUS, 1758	1	1	–		–		–		–		B
Parus palustris LINNAEUS, 1758	2	1	–		–		–		–		B
Parus cf. *montanus* CONRAD V. BALDENSTEIN, 1827	1	1	–		–		–		–		B

Table I ctd

1	2	3	4	5	6	7	8	9	10	11	12
Sitta europaea LINNAEUS, 1758	2	1	–		–		–		–		B
Emberiza citrinella LINNAEUS, 1758	1	1	–		–		–		–		B
Emberiza calandra LINNAEUS, 1758	3	2	–		–		–		–		B
Emberiza sp.	4	1	–		–		–		5	5	
Calcarius lapponicus (LINNAEUS, 1758)	2	2	–		–		–		–		A
Fringilla coelebs LINNAEUS, 1758	2	1	–		–		–		–		B
Coccothraustes coccothraustes (LINNAEUS, 1758)	2	2	–		–		–		–		B
Montifringilla nivalis (LINNAEUS, 1766)	6[2]	2	–		–		–		82	14	B
Sturnus vulgaris LINNAEUS, 1758	3	2	–		–		–		–		B
Garrulus glandarius (LINNAEUS, 1758)	7	4	–		–		–		–		B
Pica pica (LINNAEUS, 1758)	1	1	–		–		–		–		B
Nucifraga caryocatactes (LINNAEUS, 1758)	–		1	1	–		–		–		B
Pyrrhocorax graculus (LINNAEUS, 1766)	–		–		5	1	1	1	60	7	B
Pyrrhocorax pyrrhocorax (LINNAEUS, 1758)	–		–		–		–		1	1	b
Corvus corone LINNAEUS, 1758	2	1	–		–		–		–		B
Corvus corax LINNAEUS, 1758	4	1	–		–		–		–		B
Corvus monedula LINNAEUS, 1758	3	1	1	1	–		–		–		B
Passeriformes indet.	9	*	–		–		–		7	*	
Aves indet.	1[9]	1	1[10]	1	3	*	–		10	*	
Total	482	111	18	12	93	18	45	18	221	53	

1 – in the case of specimen from this cave identification of species is not absolutely sure (cf.)
2 – identifications are not absolutely sure in all cases
3 – started breeding during the last decades
4 – the nearest breeding place is in the central part of Austria
5 – two not fully ossified bones belonged to two nestlings
6 – one bone belonged to a young idividual not fully ossified
7 – small race
8 – badly preserved fragments; judging from their sizes, they most probably belonged to grouse species
9 – tarsometatarsus of a very young nestling of a big bird
10 – species bigger than other birds identified from this cave

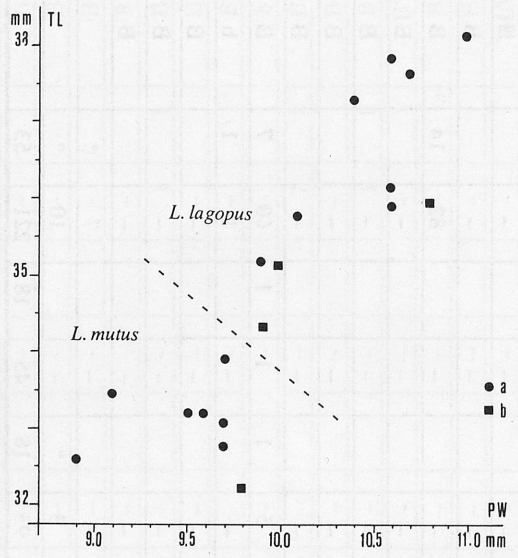

Fig. 2. The ratio of the total length of the carpometacarpus (TL) to the width of its proximal articular part (PW) in fossil *Lagopus* grouse under study: a – the bones from Hohlensteinhöhle, b – from Zwerglloch.

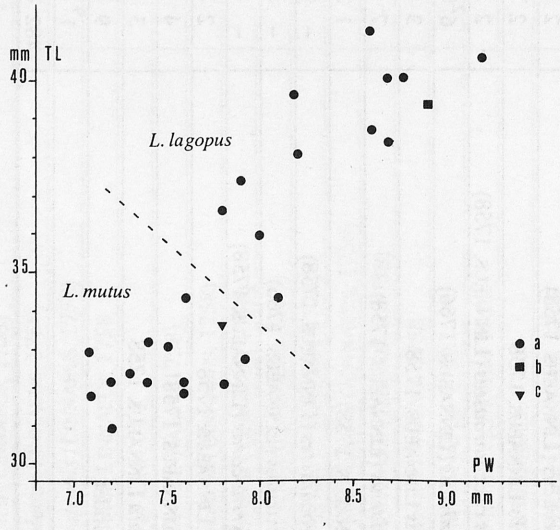

Fig. 3. The ratio of the total length of the tarsometatarsus (TL) to the width of its proximal articular part (PW) in fossil *Lagopus* grouse under study: a – bones from Hohlensteinhöhle, b – from Zwerglloch, c – from Offenbergerhöhle.

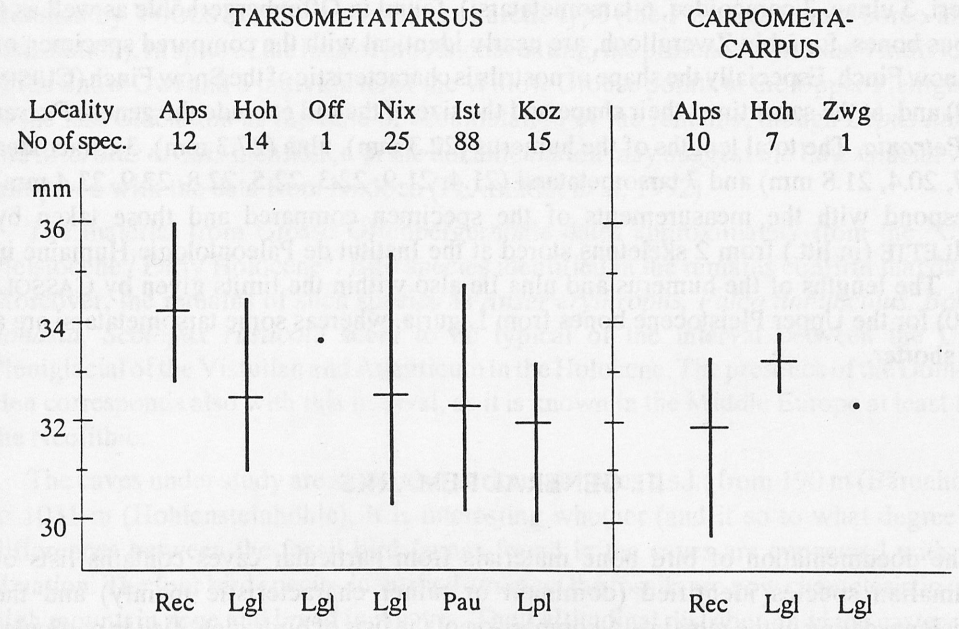

Fig. 4. Comparison of the lengths (in mm) of the tarsometatarsi and carpometacarpi and their arithmetic means in the recent *Lagopus mutus helveticus* from the Alps, fossil bones from Austrian caves under study and from some other localities. Abbreviations of the locality names: Hoh – Hohlensteinhöhle, Ist – Istállóskö Cave, Hungary (acc.to JÁNOSSY 1954), Koz – Koziarnia Cave, S Poland, layers: 11-13 (acc. to BOCHEŃSKI 1974), Nix – Nixloch (acc. to MLÍKOVSKÝ 1992), Off – Offenbergerhöhle, Zwg – Zwerglloch. Abbreviations of dating: Lgl – late glacial time of the Last Glaciation, Lpl – Late Pleniglacial of the Last Glaciation, Pau – Paudorf Interstadial, Rec – recent times.

and some measurements were taken by the authors. The results are shown in Fig. 4: the fossil carpometacarpi from Austrian caves are longer and tarsometatarsi shorter than in the recent population. This tendency is analogous to that found in the Willow Grouse (BOCHEŃSKI 1985).

Numenius sp. – A proximal part of a tarsometatarsus morphologically similar to that of the Curlew was found in Zwerglloch. It is however too small for *N.arquata* and differs a little from the compared specimen of *N. pheopus* (we cannot fix if the difference lies within the limits of individual variation of the latter species); neither was it compared with the bone of *N. tenuirostris*.

Tringa sp. – A fragment of a carpometacarpus found in Offenbergerhöhle; its size resembles that of *T. glareola – T. ochropus, totanus* and *erythropus* being too big; *T. stagnatilis* was not compared directly but its general size is like that of *T. ochropus*.

Emberiza sp. – Two tarsometatarsi from Zwerglloch resemble that of *E.cirlus*, however the lack of a longer series of some recent European buntings does not permit a more exact determination.

Montifringilla nivalis – A few dozens of various bones (among them 11 rostra, 8 humeri, 3 ulnae, 3 coracoidea, 6 tarsometatarsi), found in Offenbergerhöhle as well as 6 various bones, found in Zwerglloch, are nearly identical with the compared specimen of the Snow Finch. Especially the shape of nostrils is characteristic of the Snow Finch (CUISIN 1989) and, at the same time, their shape and the size of the bill exclude the genera *Passer* and *Petronia*. The total lengths of the humerus (22.3 mm), ulna (27.3 mm), 3 coracoidea (19.7, 20.4, 21.8 mm) and 7 tarsometatarsi (21.4, 21.9, 22.3, 22.5, 22.8, 22.9, 23.4 mm) correspond with the measurements of the specimen compared and those taken by P. VILETTE (in litt.) from 2 skeletons stored at the Institut de Paleontologie Humaine in Paris. The lengths of the humerus and ulna lie also within the limits given by CASSOLI (1980) for the Upper Pleistocene bones from Liguria, whereas some tarsometatarsi are a little shorter.

III. GENERAL REMARKS

The documentation of bird bone materials from particular caves contains lists of mammalian species identified (dominant or rather characteristic mainly) and the provisional dating of the remains. A comparison of the lists of birds identified in particular caves with well-dated materials excavated from some other Austrian caves (FLADERER et al. 1992; FLADERER 1993; MLIKOVSKY 1992) as well as with the synthetic table of the occurrence of various bird species found in many Polish localities in sediments dated to successive periods of the Late Pleistocene and Holocene (BOCHEŃSKI 1989: Table II) can help to date the sites under study more precisely.

The remains from the Zwerglloch are dated as a "mixture of Pleistocene and Holocene material" with the suggestion that they may come from the boundary of these two periods. Bird remains, which in this cave are most numerous, indicate that they accumulated until the Modern Age: the presence of the Turkey remains points to the 16th century or even later. The great number of the Domestic Hen remains confirms that conclusion.

Animal remains from Bärenhöhle, situated in the surroundings of Lake Neusiedl, are said to have accumulated in the "Early Holocene". Ten bird species identified on the basis of the remains belong to the recent breeding fauna of east Austria. The presence of the Domestic Hen and the absence of both grouse species of the genus *Lagopus* may suggest that the fauna is even younger than was determined previously.

According to the documentation of the material from Hohlensteinhöhle, its remains can be dated back to the "Early Holocene" because of the abundance of *Microtus nivalis*. The most numerous bird remains are fragments of *Lagopus lagopus*, which indicates that they accumulated during the Late Pleistocene (untill the Late Glacial). Both *Lagopus lagopus* and abundant *Microtus nivalis* were found in the Late Glacial sediments of Grosse Badlhöhle (FLADERER 1993); they were also found in the Late Glacial sediments of Nixloch whereas *L. lagopus* was absent from the Early Holocene sediments of that cave and the presence of the remains of *M. nivalis* in those sediments is not sure (FLADERER et al. 1992).

Bird remains from Knochenhöhle belong to five species only – three of them are included by VOOUS (1962) in the fauna of arctic type (the Ptarmigan has a boreo-alpine distribution). In spite of the lack of provisional dating, the presence of at least 4 individuals of the Snow Owl and 5 individuals of the Willow Grouse points to the Upper Pleniglacial of the last Glaciation as the time of accumulation of the remains, though *Lepus timidus* and *Microtus nivalis* mentioned in the documentation may suggest the Late Glacial when compared with the data from Nixloch (FLADERER et al. 1992).

The material from Grosse Offenbergerhöhle dates approximately from the "Upper Pleistocene / Early Holocene". Bird species identified in the remains confirm that dating. Moreover, the remains of such species as *Anser erythropus, Falco tinnunculus, Bonasa bonasia, Scolopax rusticola* seem to be typical of the interval between the Upper Pleniglacial of the Vistulian and Atlanticum in the Holocene. The presence of the Domestic Hen corresponds also with this interval, as it is known in the Middle Europe at least from the Neolithic.

The caves under study are situated at various altitudes a.s.l.: from 190 m (Bärenhöhle) to 1031 m (Hohlensteinhöhle). It is interesting whether (and if so to what degree) the differences between the fossil bird faunas found in the caves are connected with their situation. The four bird species identified amongst the fossils are now characteristic of the high mountain zone and breed in Austria. Their altitudinal distribution in the eastern part of the Eastern Alps is however lower than in the western part and so *Lagopus mutus* breeds above 1500 m, *Anthus spinoletta* above 960 m, *Pyrrhocorax graculus* above 1600 m and *Montifringilla nivalis* above 1600 m a.s.l. (DVORAK et al. 1993). Remains of all these species are absent from the fauna of the low-situated Bärenhöhle. On the other hand, three of these species (i.e. except *P.graculus*) were found in the fauna of Zwerglloch i.e. another low-situated cave. The comparison of the dates of those cave materials suggests that the presence of Alpine species in the low-lying deposits seems to depend rather on the time of accumulation than on the situation of the cave. It might also indicate that the Alpine species have limited their distribution to higher lying habitats since the first half of the Holocene.

A general comparison of the data on the Late Quaternary bird remains identified at Austrian localities known from the literature (BRODKORB 1963-1978; FLADERER 1993; MLÍKOVSKÝ 1992; PIECHLER 1976; SOERGEL 1966; WITTSTEIN 1938) and listed in our paper indicates that at least a total of 139 bird species are known from this country 27 taxa being identified for the first time now.

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