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The Holocene History of the European Vertebrate Fauna

Norbert Benecke (Ed.)

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The Holocene History of the European Vertebrate Fauna

Modern Aspects of Research

Workshop, 6th to 9th April 1998, Berlin

NORBERT BENECKE (ED.)

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Editorial

The papers brought together in this volume represent the outcome of the workshop "The Holocene History of the European Vertebrate Fauna – Modern Aspects of Research", held from the 6th to the 9th of April 1998 at the Natural History Museum in Berlin, Germany. The meeting was attended by 52 participants of 17 different nationalities, which demonstrates the great interest in the study of different aspects of faunal history.

A wide variety of topics were presented, including faunal changes at the time of the Pleistocene/ Holocene transition, the formation and evolution of Holocene fauna in different regions of Europe, changes in the distribution of single species and/or faunal communities in the postglacial periods, osteomorphological changes in vertebrate species and their causes as well as natural and anthropogenic factors in the evolution of European vertebrate fauna. Interdisciplinary exchange is becoming more important; this is illustrated by several papers which combine archaeozoological data with data from neighbouring disciplines like archaeology, archaeobotany, physics (radiocarbon analysis), genetics (DNA), art and history (written sources).

The organisation of the workshop was made possible thanks to funding from the Deutsche Forschungsgemeinschaft. Only by this was it possible to invite such a large number of colleagues from eastern and southeastern European countries and to support them with funding for travel, accommodation, etc.

For their help in the preparation of the workshop, I particularly want to acknowledge Michael Hochmuth, Renate Wieland and Holger Grönwald.

Mr. Hermann Parzinger, director of the Eurasien-Abteilung at the Deutsches Archäologisches Institut, kindly agreed to publish the proceedings in the series "Archäologie in Eurasien". The 29 papers assembled in this volume could be published nine months after the workshop was held. This was made possible, above all, by the authors who respected agreed deadlines and instructions, thus facilitating the swift editing of the volume. A special word of thanks on behalf of the non-anglophone authors goes to Anne-Marie Elliott (Berlin) and David Redfern (Berlin) who thoroughly checked the written English of the articles submitted.

Berlin, January 1999

Norbert Benecke

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The project "The Holocene History of the European Vertebrate Fauna"

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Abstract

Since 1995, three German institutions have been cooperating in a joint research project on the Holocene history of the European vertebrate fauna. A database system has been built up with faunal data based on archaeozoological site reports from the whole of Europe, considering the period from ca. 15,000 BC to Modern Times. At present it comprises selected data from nearly 6500 faunal assemblages. This paper describes the structure of the database system and presents some qualitative and quantitative characteristics of the collected faunal data based on the example of data from Germany. As part of the project, radiocarbon analyses are carried out on bone samples from animal species of special interest in the context of fauna history.

Keywords: Europe, vertebrate fauna, Late Pleistocene, Holocene, database system, radiocarbon analysis.

Zusammenfassung

Seit 1995 arbeiten drei deutsche Institute an einem gemeinsamen Forschungsprojekt zur Holozängeschichte der Wirbeltierfauna in Europa. Dazu wurde ein Datenbanksystem eingerichtet, in dem faunistische Angaben aus archäozoologischen Fundberichten des gesamten europäischen Raumes erfaßt werden, und zwar für den Zeitabschnitt von ca. 15,000 BC bis in die Neuzeit. Derzeit umfaßt die Datenbank etwa 6500 eingetragene Faunenkomplexe. Der vorliegende Beitrag beschreibt den Aufbau des Datenbanksystems und gibt für das Gebiet von Deutschland einen Einblick in die Datenstruktur. Als Teil des Forschungsprojektes werden Radiokarbonanalysen an faunengeschichtlich interessanten Tierknochenfunden durchgeführt.

Schlüsselwörter: Europa, Wirbeltierfauna, Spätpleistozän, Holozän, Datenbanksystem, Radiokarbon-Analysen.

INTRODUCTION

Nearly every archaeozoological report dealing with bone remains from a particular site gives some information about the wild fauna in the surroundings of that site during its existence. On the basis of such analyses various studies on the history of European vertebrate fauna in the Holocene have been carried out in the past. Most of them deal either with a certain region of Europe or with single species or animal groups. The following studies are to be mentioned as examples: the study by Paaver (1965) on the history of theriofauna in the Baltic countries, the study by Rosenlund (1976) on the occurrence and distribution of fish species in Denmark during the Holocene, the study by Piehler (1976) on the occurrence of wild bird species in Central Europe during the Mid- and Late Holocene and the study by Vörös (1981) on wild equids in the Carpathian Basin. Besides, there have also been some first attempts to collect and present faunal data from the archaeozoological record for the whole European continent, taking into consideration all animal species encountered in subfossil faunal assemblages, for example by Audoin-Rouzeau (1993). But this study is mainly restricted to the period from the Antique to Modern Times.

In 1995 three institutes – Deutsches Archäologisches Institut (Berlin), Institut für Paläoanatomie, Domestikationsforschung und Geschichte der Tiermedizin (Munich) and Institut für Haustierkunde (Kiel) – started a joint project under the title "Man and environment in prehistoric and historic times – The evolution of European vertebrate fauna from the Late Pleistocene to Medieval times." This project was established to study different aspects of the Holocene history of European vertebrate fauna. These are:

- Faunal changes at the time of the Pleistocene/ Holocene transition
- Formation and evolution of Holocene fauna in different regions of Europe
- Changes in distribution of single species and/ or faunal communities in the postglacial periods
- Osteomorphological changes in vertebrate species and their causes

- Natural and anthropogenic factors in the evolution of European vertebrate fauna

The study of these questions requires a reliable, solid framework of faunal data with good temporal and regional representation. Therefore we decided to build up a database system with faunal data on the basis of published and unpublished archaeozoological reports from the whole European continent, considering the period from ca. 15,000 BC to Modern Times. Included are all vertebrate species, wild species as well as domestic species. As a general rule only faunal reports which were published before 1997 have been analysed. This paper explains the structure of the database system and presents some qualitative and quantitative characteristics of the collected faunal data based on the example of data from Germany.

THE DATABASE SYSTEM

The database system for our project consists of four components: database "Catalogue", database "Species", database "Measurements" and database "Literature". All files of this database system are linked with each other by a reference number *(Figure 1)*.

The database "Catalogue" is arranged according to countries and contains essential information about the sites and their fauna. *Figure 2* gives an expample for the medieval site Hitzacker on the river Elbe in Lower Saxonia (Germany). The first field NUMMER contains the reference number. It consists of a country sign and a four-figure number. As a basic rule every site has its own number. If there are different chronological units on the same site, then a slash followed by a further number referring to the appropriate chronological unit is added to the reference number of the site. In the given example, the number D0375/2 refers to the layers from the 11th - 12th century of the site Hitzacker. The field FUNDORT lists the name of the locality or site whereas the field DISTRIKT contains the name of the next higher administrative unit. The chronological position of the faunal assemblage is recorded in the field DATIERUNG. Possible entries are archaeological periods (cultures) together with absolute datings and climate or pollen zones. The field DAT describes the chronology of the assemblage in an abbreviated form.

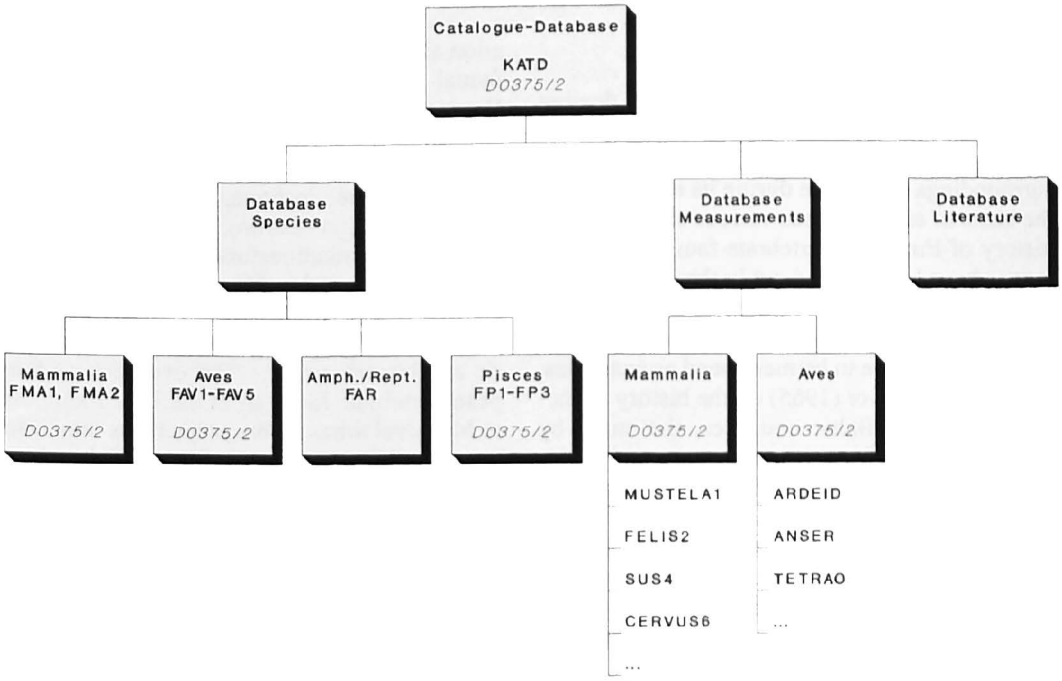

Figure 1: Structure of the database system.

NUMMER	D0375/2
FUNDORT	Hitzacker (Fst. Weinberg)
DISTRIKT	Lüchow-Dannenberg
DATIERUNG	Hochmittelalter, 11.-12. Jh.
DAT	HMA
REGION	
N_WERT	53,09
E_WERT	11,02
FUNDART	Burg
BERGUNG	Ausgrabung 1965/66 und 1970-75
BEMERKUNG	
LITERATUR	B.-M. Kocks 1978, H. F. Walcher 1978, J. Boessneck 1982, A. von den Driesch 1982
FAUNA	Pisces: Karpfen 2, Esox_luciu 258, Cyprinidae 145, Acipe_stur 80, Abram_bram 27, Perca_fluv 19, T_tinca 10, R_rutilus 8, Silur_glan 8, Leuci_ceph 7, Salmo_sala 6, Leuciscus 4, Leuci_idus 4, Gadus_morh 3, Pleur_plat 3, M_molva 2, L_leuciscu 1, V_vimba 1, Abram_ball 1, A_aspius 1. Aves: Huhn 458, W_Hgans 18, Anatidae 98, Anserinae 64, P_perdix 12, Buceph_cla 8, Lyrur_tetr 8, G_grus 8, Ardea_cine 7, Anas_penel 5, Mergus_mer 5, Anas_cr_qu 4, Haliae_alb 4, Anas_clype 3, M_milvus 3, Anas 2, Cygnus 2, Columb_pal 2, Pele_crisp 1, Anser_albi 1, Anser_ery 1, Accip_gent 1, P_pica 1. Mammalia: Schwein 8247, S_Z 2955, Rind 2455, Schaf 975, Ziege 28, Katze 23, Hund 18, Pferd 5, Cervus_ela 319, C_capreol 258, Sus_scrofa 116, Lepus_euro 69, Castor_fib 47, Ursus_arct 12, Bos_primig 10, V_vulpes 6, A_alces 6, R_rattus 1, M_martes 1.
KRITERIUM	FZ
MAMMALIA	15551
AVES	717
PISCES	590
AMPH_REPT	0
NB	0
MOLLUSCA	0

Figure 2: Example of an entry in the database "Catalogue".

This is for data selection purposes according to periods. The geographical coordinates of the sites are necessary for the mapping of faunal data from our database system. They are recorded in the fields N_WERT and E_WERT. The field FUNDART describes the type of site (settlement, grave etc.). The type and year of recovery of the faunal assemblage are noted in the field BERGUNG. The field BEMERKUNG contains, if necessary, remarks concerning particularities of recovery (selected material, sieving etc.), the state of investigation (preliminary analysis, final report etc.), critical evaluation of the species determination and of the dating of the faunal assemblage. In the field LITERATUR, all references referring to the faunal assemblage are listed. The field FAUNA presents a full description of the identified vertebrate species accompanied by their frequencies. Domestic species are listed with colloquial names and wild species with their Latin names in an abbreviated form. Theses short names are identical with the field names of the different species in the database "Species". Different taxonomic levels are recorded: species, species group, genus, family and forms (species) for which it was impossible to decide whether they are domestic or wild. The field KRITERIUM indicates the frequency parameter considered here (NISP, MNI). The last five fields describe the size of the faunal assemblage by listing the frequencies for the different vertebrate classes and the frequency of the unidentified animal remains.

The database "Species" comprises eleven files for the recording of the identified species, species groups, genera and families. These are two for mammals, five for birds, one for amphibians and reptiles and three for fish. For mammals and birds the most frequent species are grouped in file 1, while in subsequent files the species are arranged according to systematic rules. This has been done to keep the files as

small as possible and to optimise data recording. The third part of the system, the database "Measurements", contains different files for selected osteometric data from mammal and bird remains. For example, the file "Mustela1" in *Figure 1* comprises ten mandible measurements for species of the genus *Mustela* and the file "Cervus6" four metacarpus measurements for *Cervus elaphus*. The database "Literature" contains the references for the analysed faunal reports in full length.

Until December 1997, nearly 6500 Late Pleistocene and Holocene faunal assemblages from 32 European countries had been included into our database system. They represent a variety of publications from short communications over preliminary reports to papers and monographs. As a general rule during our work of data recording we included only faunal assemblages with a more or less reliable dating and taxonomic determination. A larger number of faunal reports from the end of the 19th century and the beginning of the 20th century have not been considered here for this reason. Most archaeozoological publications which have been analysed by us for this project are from the period after World War II, mainly from the last four decades *(Figure 3)*.

Table 1 shows the numbers of recorded faunal assemblages according to countries. In comparing these figures one has to take into consideration that the data recording has not yet been finished for some countries. This applies for example to France, the Ukraine, Russia and Moldavia. In addition to the absolute number an index is listed which describes the relationship between the number of faunal assemblages and the area of the countries. It gives an impression of the regional representation of faunal data in our database system. The countries with the best regional representation of faunal data are at the top of the table. These are mainly countries from Central and Western Europe like Denmark, Hungary, Switzerland etc. This is not suprising, because we have here a long tradition in palaeontological and archaeozoological research.

QUALITATIVE AND QUANTITATIVE CHARACTERISTICS OF THE COLLECTED SUBFOSSIL FAUNAL DATA

The possibilities for studying problems of the Holocene history of European vertebrate fauna on the basis of subfossil animal remains are largely determined by the quality of available faunal data, by the temporal distribution of assemblages, species composition or richness and so on. On the basis of recorded faunal assemblages from Germany, some of those qualitative

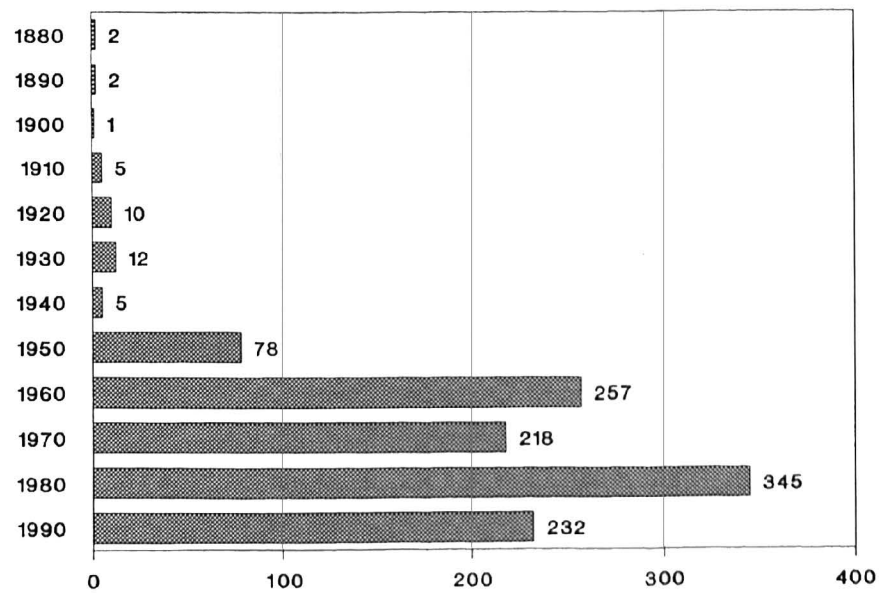

Figure 3: Faunal reports from Germany analysed for the database system according to the decade of publication.

Table 1: Numbers of recorded faunal assemblages according to countries (December 1997). Index: number/area of the country x 1000.

Country	Number	Index
Denmark	515	12,0
Hungary	422	4,5
Switzerland/Liechtenstein	182	4,4
Netherlands	173	4,2
Belgium	107	3,5
Germany	1192	3,3
Great Britain / North. Ireland	702	2,9
Slovacia	97	2,0
Poland	339	1,1
France	533	1,0
Italy	287	1,0
Sweden	418	0,9
Czech Republic	67	0,8
Austria	67	0,8
Greece	99	0,8
Moldavia	28	0,8
Luxemburg	2	0,8
Spain	285	0,6
Lithuania	38	0,6
Bulgaria	62	0,6
Ireland	38	0,5
Estonia	22	0,5
Latvia	28	0,4
Romania	76	0,3
Ukraine	195	0,3
Finland	72	0,2
Norway	66	0,2
Russia	286	0,2
Former Yugoslavia	19	0,1
Belorussia	25	0,1
Portugal	9	0,1

and quantitative characteristics will be discussed. Material from Germany has been chosen because it is quite extensive and the data recording is more or less complete for this area.

One very important aspect is the temporal distribution of the assemblages that is exhibited in *Figure 4*. It shows the distribution of recorded faunal assemblages by archaeological periods. As can be seen from this graph most of the materials belong to the Neolithic, Roman Times and to the Middle Ages. In contrast, assemblages from the Bronze Age are quite badly represented in faunal records.

If we want to compare faunal data between different regions of Europe that are chronologically more or less contemporaneous, then a classification of assemblages according to archaeological periods is not very helpful. This applies especially to the older prehistoric periods. As it is widely known, the Mesolithic/Neolithic transition took place at different times in various parts of Europe. For example, there is a time difference of more than 3000 years between Greece and Sweden for this event. A similar SE-NW orientated difference in time applies to the beginning of the Bronze Age. For this reason we have decided to group the material from our database system according to chronozones. Nine such zones have been set up *(Figure 5)*.

To gain a better insight into the temporal representation of dated faunal assemblages from Germany, the assemblages have been grouped

according to chronozones and set in relation to the length of the periods. As can be seen from the graph in *Figure 5*, the late glacial and the early periods of the Holocene are most badly represented within the faunal record from Germany. The best represented chronozones are VII and VIII, which correspond to the Roman Iron Age and to the Middle Ages.

Another interesting aspect concerning the quality of the recorded faunal data is the origin of the assemblages. *Figure 6* exhibits the distribution according to the type of site. Most assemblages come from human settlements. These are faunal remains determined mainly by anthropogenic factors. Seperately assemblages from settlement structures like wells and cess pits have

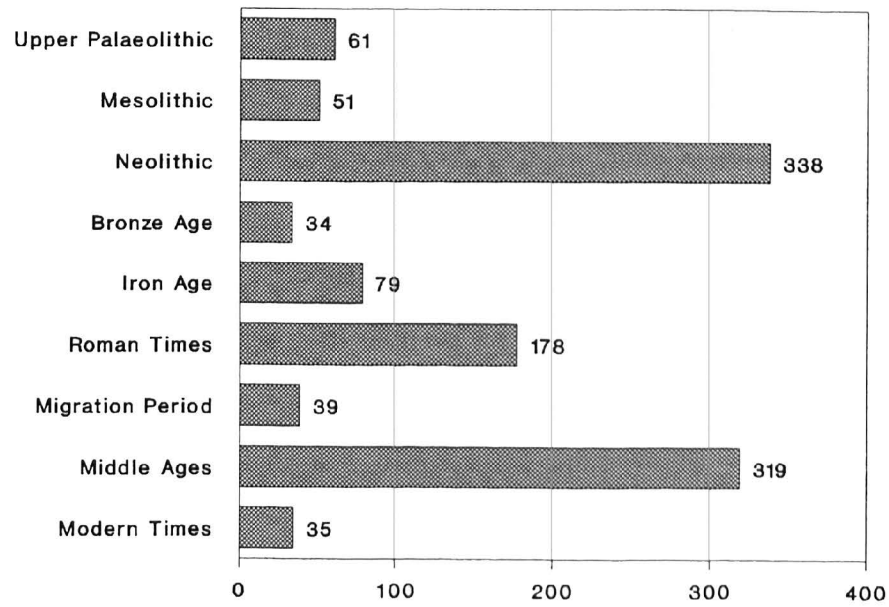

Figure 4: Distribution of recorded faunal assemblages from Germany by archaeological periods.

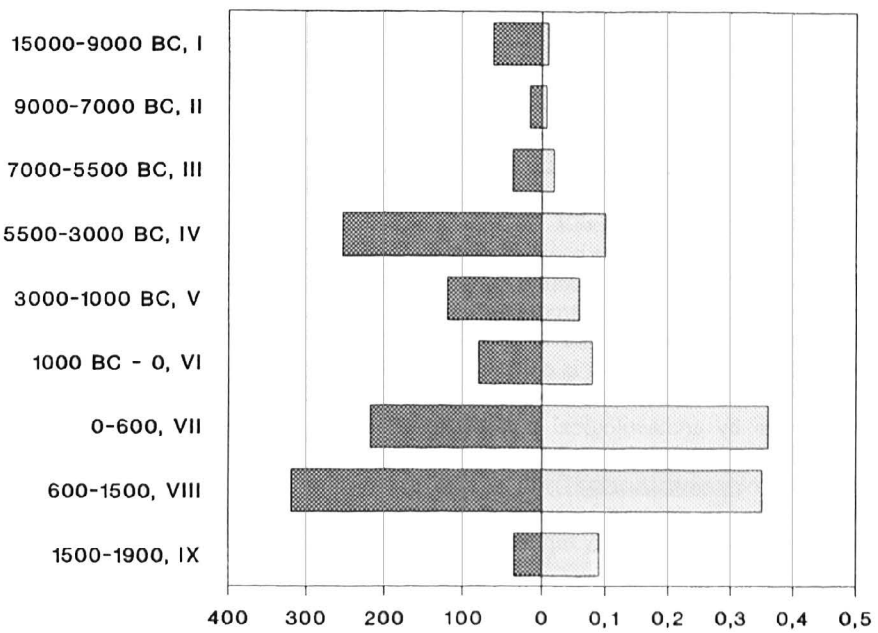

Figure 5: Distribution of recorded faunal assemblages from Germany by chronozones, in total numbers (left part of the diagram) and in relation to the length of the periods (right part of the diagram).

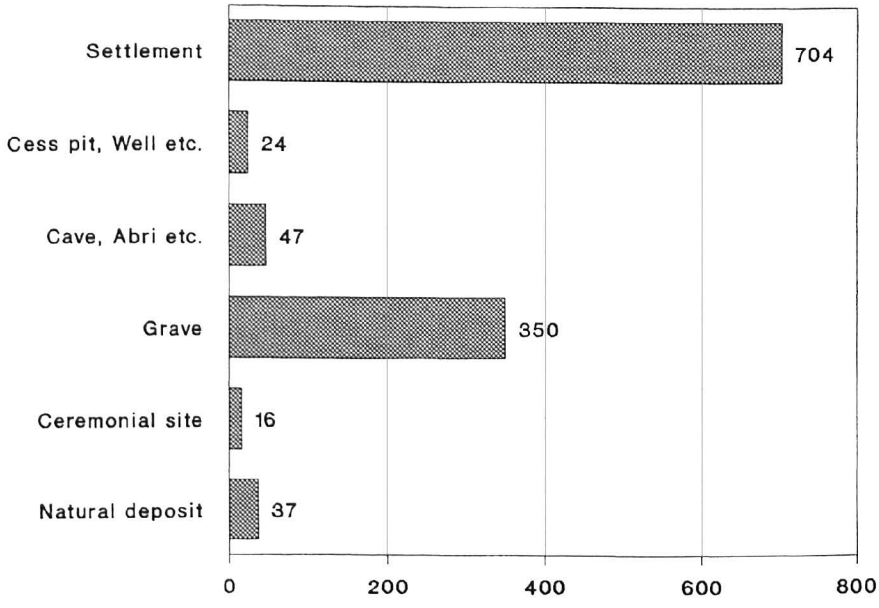

Figure 6: Distribution of recorded faunal assemblages from Germany according to the type of site.

been listed in *Figure 6*. They are often relatively rich in species from different vertebrate classes. Unfortunately their number is not very high and chronologically they are restricted to the Roman Times and to the Middle Ages. An interesting group are sites in mountainous regions like caves, grottos and rock shelters. They often contain osteological remains formed by human groups as well as by carnivorous mammal and bird species that used these places as habitats. In general, the faunal assemblages from these sites are quite large in bone numbers and rich in species. Many small mammal, bird, reptile and amphibian species have only been identified from those places. A large number, i.e. nearly a third, of faunal assemblages in Germany comes from graves. They mainly belong to the Neolithic (Funnel Beaker, Bell Beaker, Corded Ware culture), to the Migration Period and to the Middle Ages. In most cases they represent animal skeletons or parts of them, mainly from domestic mammals. But sometimes they also comprise rare wild species. For example some of the few records of wild cat (*Felis silvestris*) from the Neolithic are finds or better artefacts from graves of the Corded Ware culture in the region of the rivers Elbe and Saale (Clason, 1969: 178). The remaining group is made up of animal remains from natural deposits. These remains often represent skeletons or parts of skeletons for example in peat bogs, which have been dated by pollen and radiocarbon analysis or by archaeological materials (artefacts etc.). Their number could be much higher, because many bone finds from natural deposits have not yet been dated. For example from the territory of Mecklenburg-Vorpommern, out of 62 sites with remains of elk (*Alces alces*) only 16 are dated on the basis of archaeological finds *(Figure 7)*. A special case in natural deposits are subfossil animal burrow systems. In Germany only two such sites are known, i.e. Pisede near Malchin und Neukloster near Wismar in the northeastern part of the country (Heinrich *et al.*, 1983). Huge amounts of vertebrate remains have been recovered there. The bone material also comprises many remains from amphibians, reptiles and small mammals, that is from species which are normally missing in faunal assemblages from archaeological sites. From the Pisede site 155 vertebrate species have been identified in all, 50 belonging to mammals, 75 to birds, 15 to reptiles, 10 to amphibians and 5 to fish. Unfortunately the larger part of the faunal material from both sites cannot be precisely dated because of special conditions in sedimentation.

Finally, we shall look at the composition of vertebrate fauna within recorded faunal assemblages from Germany. *Figure 8* exhibits the absolute frequency of the five vertebrate classes. Not surprisingly mammal species occur in nearly all of the 1192 faunal assemblages from Germany. Every third assemblage contains remains of birds. Badly represented are amphibians and

reptiles. Only 9 % of all assemblages have yielded remains from these two groups. The representation of fish species in the faunal record from Germany is little better. 212 assemblages out of 1192 contain remains from this group. The general under-representation of fish, amphibian and reptile species in the faunal record especially from archaeological sites has different reasons which cannot discussed here in detail. One main reason is inadequate recovery methods on many excavations, even today. As has been demonstrated repeatedly, the application of sieving techniques leads to an enormous increase in species numbers (e.g. Quade, 1984).

Figure 9 shows the representation of Holocene mammal species within the subfossil faunal record from Germany by orders. The numbers of identified species in the subfossil record are compared with the total numbers of species for the eight orders (recent and extinct). From the orders Lagomorpha, Carnivora, Perissodactyla and Artiodactyla all recent and extinct species are documented in the Holocene faunal record from Germany. Even Rodentia and Insectivora exhibit a quite good species representation. Of bats and whales only half the number of recently occurring species has been encountered in subfossil faunal assemblages.

If we look at the average number of records per species for the eight mammal orders, then it also becomes evident that bats and whales especially are poorly represented in the subfossil faunal record from Germany *(Figure 10)*. With regard to whales this can be explained by the fact that the exploitation of this animal group by man, especially of the large species, is a relatively recent phenomenon. Many of the few subfossil whale bones probably come from animals which had run aground. The poor representation of bats in faunal assemblages is due to the special living conditions of these animals. There is only a small chance that bat bones would accumulate in the loose sediments of the Nothern German lowlands. With the exception of three small assemblages all sites with bat remains, some with large quantities of these species, lie in the south, in the mountainous regions of Germany.

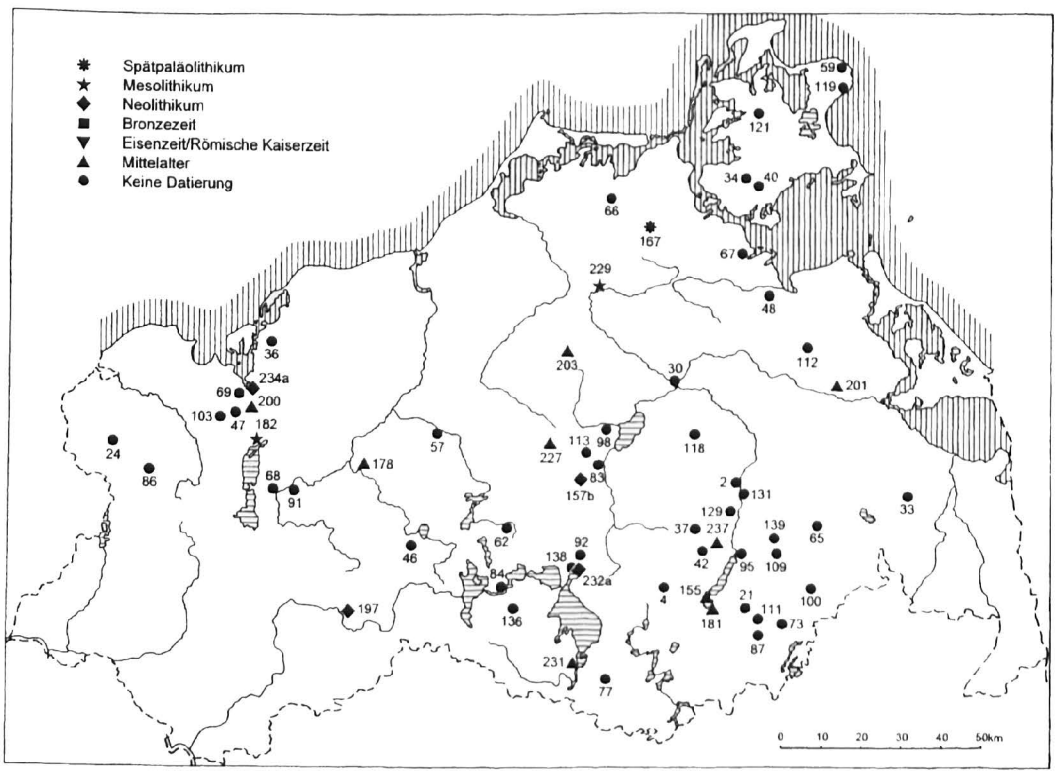

Figure 7: Bone remains of elk (*Alces alces*) from the territory of Mecklenburg-Vorpommern (Benecke, forthcoming).

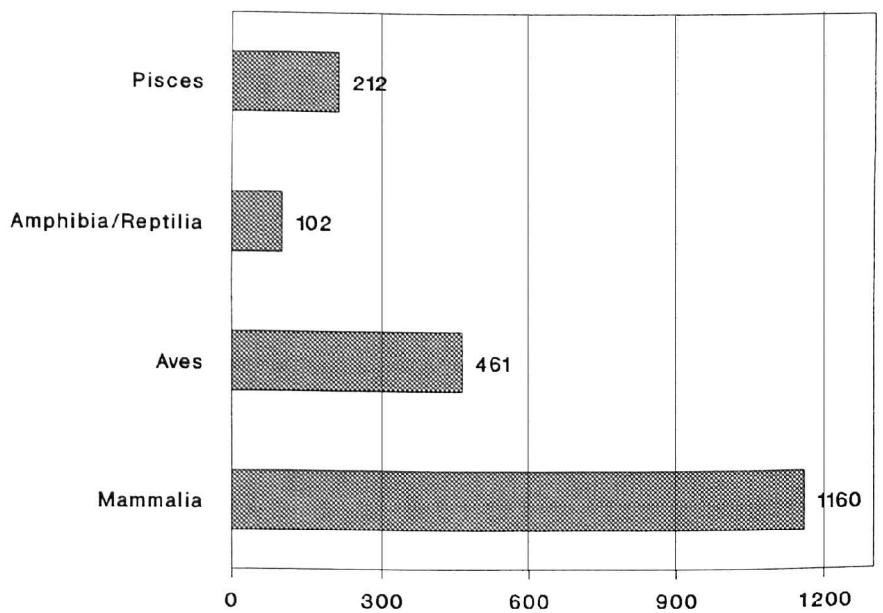

Figure 8: Absolute frequency of the five vertebrate classes in faunal assemblages from Germany.

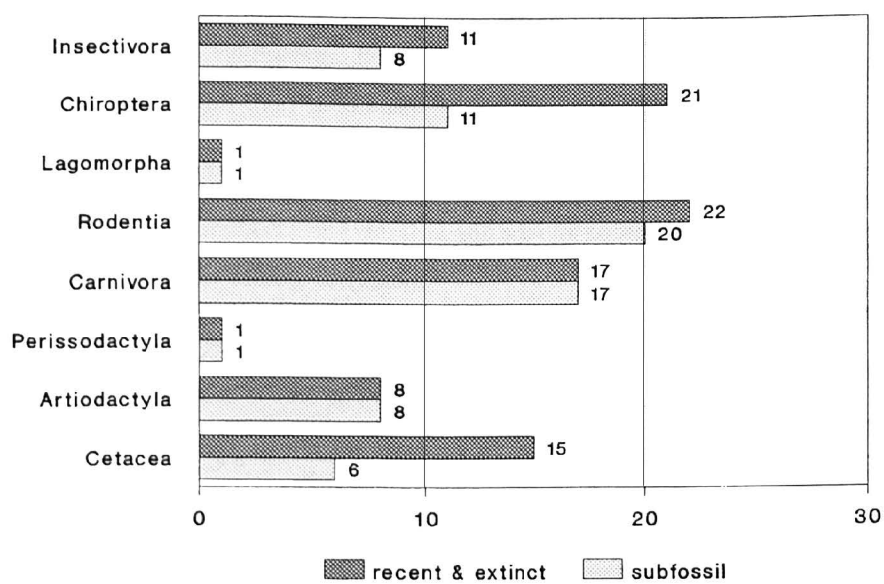

Figure 9: Representation of Holocene mammal species within the subfossil faunal record from Germany by orders.

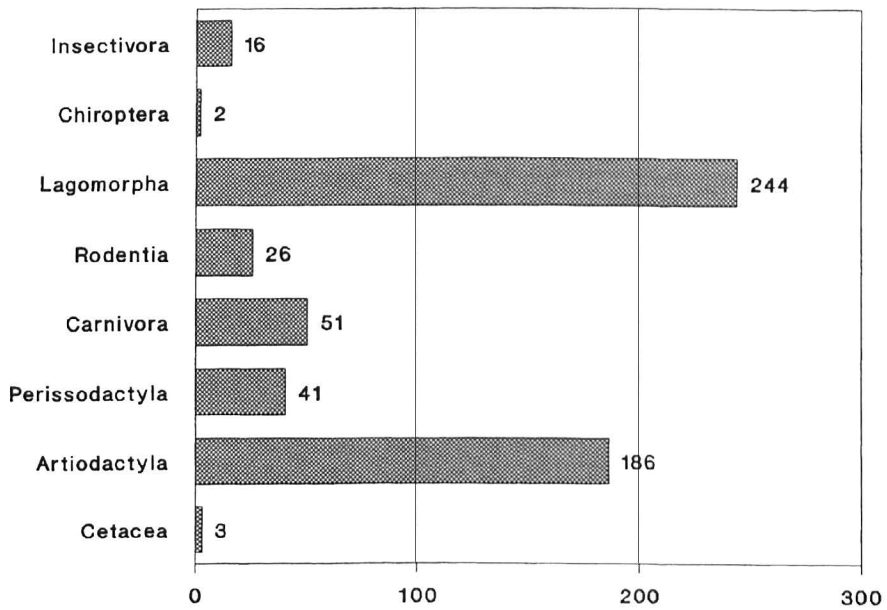

Figure 10: Average number of records per species for the eight mammal orders within the subfossil faunal record from Germany.

DATING PROGRAMME

As part of our research project on the evolution of European vertebrate fauna radiocarbon analyses (AMS ^{14}C datings) are carried out on bone samples from animal species which are of special interest in the context of fauna history. There are five groups of animals in which we are especially interested.

The first group comprises species which became extinct during the Late Pleistocene and at the time of the Pleistocene/Holocene transition respectively, like *Coelodonta antiquitatis*, *Mammuthus primigenius*, *Megaloceros giganteus* or retreated from many parts of Europe into the upper north of the continent, like *Rangifer tarandus* and *Alopex lagopus*.

An interesting period in the evolution of European vertebrate fauna is the immigration of typical Holocene species. For early immigrants like *Alces alces*, *Cervus elaphus*, *Bison bonasus* and *Bos primigenius* bone samples are dated to establish the time of their arrival in different regions of Europe. As for some parts in Western and Central Europe appropriate data is already available we are concentrating on sampling bone finds especially from Eastern Europe. This also applies for the above mentioned group of Late Pleistocene species.

During the Holocene various vertebrate species became partly or completely extinct in Europe, for example *Equus hydruntinus*, *Equus ferus*, *Panthera leo*, etc. Information regarding these extinctions has been received until now mainly from archaeologically dated faunal assemblages. Only in some cases, e.g. for *Bos primigenius* in Britain, has the period of extinction (Bronze Age) been reliably fixed on the basis of radiocarbon dates (cf. Clutton-Brock, 1986: Table 2). As some of the archaeologically dated bone finds from *Equus hydruntinus*, *Panthera leo*, and other species of this group are questionable, it is urgently necessary to check them by radiocarbon analysis.

This also applies to two other species groups of special interest in the context of fauna history, namely to species which have been deliberately or accidentally introduced by man in various parts of Europe. The first group mainly comprises domestic mammals as well as some wild species. The second group is formed by commensal species like *Rattus rattus* and *Mus musculus*. Within our dating programme some radiocarbon analyses have been carried out on the well-known Oberkassel dog, yielding data which confirms the late glacial age of this animal (see Street & Baales, this volume). From other datings currently under way, we are expecting reliable data concerning the introduction of *Hystrix cristata* in Italy and *Oryctolagus cuniculus* in Central Europe.

FURTHER PROSPECTS

One outcome of our workshop in April 1998 was learning that our database is still quite incomplete, especially for areas in Southern and Eastern Europe. During the last months we have received bulky parcels full with offprints or letters with long lists of references which have been hitherto unknown to us. We are hoping, however, to finish the recording stage of faunal data from the literature by spring 1999 at the latest. The dating programme will still run in 1999. Colleagues who can offer interesting bone finds and would like to take part in our dating programme are invited to contact us. In 1999 we will start analysing the huge bulk of data we have been collecting for the last few years. As regards publication, three volumes are planned, one about fish, amphibians and reptiles (D. Heinrich), one about birds (A. von den Driesch) and one about mammals (N. Benecke).

ACKNOWLEDGEMENTS

The project is supported by grants from the Deutsche Forschungsgemeinschaft, to whom we are much indebted. I would like to thank Angela von den Driesch (Munich) und Dirk Heinrich (Kiel) for the good cooperative work and atmosphere within the project. On behalf of both colleagues, I would like to thank, too, all persons who helped us in completing the database by sending offprints, copies or lists with references and by sending bone finds for the dating programme.

REFERENCES

Audoin-Rouzeau, F. (1993).
Hommes et animaux en Europe. Corpus de données archéozoologiques et historiques. Dossier de documentation archéologique 16. Paris: CNRS Éditions.

Clason, A. T. (1969).
Einige Bemerkungen über Viehzucht, Jagd und Knochenbearbeitung bei der mitteldeutschen Schnurkeramik. In: *Veröffentlichungen des Landesmuseums für Vorgeschichte in Halle* **24**. Berlin: Akademie-Verlag, pp. 173-195.

Clutton-Brock, J. (1986).
New dates for old animals: the reindeer, the aurochs, and the wild horse in prehistoric Britain. *Archaeozoologia* (Mélanges), 111-117.

Heinrich, W.-D., Peters, G., Jäger, K.-D. & Böhme, G. (1983).
Erdbaue von Säugetieren – zusammenfassende Kennzeichnung eines neuen Fundstättentyps im baltischen Vereisungsgebiet. *Wissenschaftliche Zeitschrift der Humboldt-Universität zu Berlin, Mathematisch-Naturwissenschaftliche Reihe* **1983** (6), 777-781.

Paaver, K. L. (1965).
Formirovanie teriofauny i izmenčivost' mlekopitajuščich Pribaltiki v golocene. Tartu.

Piehler, H.-M. (1976).
Knochenfunde von Wildvögeln aus archäologischen Ausgrabungen in Mitteleuropa (Zeitraum: Neolithikum bis Mittelalter). Dissertation, München.

Quade, V. (1984).
Die Tierknochen aus der Kloake der Lübecker Fronerei (15.-17. Jahrhundert). *Lübecker Schriften zur Archäologie und Kulturgeschichte* **8**, 105-167.

Rosenlund, K. (1976).
Catalogue of Subfossil Danish Vertebrates. Fishes. København.

Vörös, I. (1981).
Wild equids from the Early Holocene in the Carpathian basin. *Folia Archaeologica* **32**, 37-68.