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Archaeozoological investigations in North-eastern Italy: the exploitation of animals since the Neolithic

ALFREDO RIEDEL

ABSTRACT - Riedel A., 1996 - Archaeozoological investigations in North-eastern Italy: the exploitation of animals since the Neolithic. [Ricerche archeozoologiche nell'Italia nord-orientale: lo sfruttamento degli animali a partire dal Neolitico]. *Preistoria Alpina, vol. 30, pp. 43-94.*

The paper deals with the evolution of those animals which played an important role in man's economy from Neolithic to Middle Ages in North-eastern Italy. The paper relies mainly on the Author's studies of the faunal remains from archaeological sites situated in an area extending from the Alpine region of Alto Adige-Südtirol and Trentino, across the Adige Valley to the Northern Adriatic Sea. The evolution of animal economy, though slower than other more cultural aspects of a society, is none the less continuous and alternatively influenced in particular by northern or southern situations. Besides the gradual and irregular abandonment of hunting activities during the Neolithic, the most important stages in this evolution are the partial standardization of animal forms at the end of this period: the development and diversification of domestic forms in the Iron Age which culminated, in the Po Plain, in the Roman period: the partial regression which accompanied the fall of the Roman Empire in particular in the Alpine regions. The faunal composition often remained rather constant, but showed marked regional differentiations.

PAROLE CHIAVE: *archeozoologia, Mammiferi, Italia nord-orientale, Neolitico, Medioevo.*

KEY WORDS: *archaeozoology, Mammals, North-eastern Italy, Neolithic, Middle Ages.*

Alfredo Riedel, Via Diaz 19, I - 34124 Trieste.

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EXPLANATIONS AND ABBREVIATIONS OF TEXT AND FIGURES

The approximate age of the compared sites is indicated in the text by means of the following abbreviations:

MS	Mesolithic	EA	Etruscan Age
NL	Neolithic	RA	Roman Age
CA	Copper Age	MA	Middle Ages
BA	Bronze Age	E/M/L	Early-Middle-Late
IA	Iron Age		

The location map and list of the sites (Fig. 1a, Table 1) give the age, location and references which are not usually given in the text, especially if they have been studied and published by the Author.

All measurements are, if not otherwise stated, in millimetres.
Measurements have been taken according to the instructions of A.v.d. Driesch (1976).
Age determinations follow the indications of the Munich school.

Statistical abbreviations:
n. = number of measures
min. = minimum
max. = maximum
$\bar{x}$ = arithmetical average

f = fore
h = hind
+/– = erupting
\+ = tooth erupted
o–+–++–+++–++++ = increasing dental wear

NR = number of remains
MNI = minimum number of individuals
W = weight in grams
WH = withers height

1. FOREWORD

1.1. *Investigation*

This paper describes some aspects of the contribution of animals to the economy and development of the civilisations of North-eastern Italy from the Neolithic to the Middle Ages. It is based on the Author's studies of bone deposits found in several archaeological sites in South Tyrol, Trentino, Veneto, Friuli and some adjacent areas. Many of them are located in the area extending from the Alpine regions of South Tyrol and Trentino along the Adige Valley to the Upper Adriatic coast. Several studies by other authors were also helpful for this synthesis.

In most archaeozoological studies osteology is the main source of information, although archaeology, the study of land and soil characteristics and history are also helpful. Starting from a naturalistic and biological point of view we make a realistic contribution to knowledge about the life of ancient human societies as well as about the exploitation of animals and their symbiosis with man.

Economic and cultural interpretations are limited and less complete for older periods than for more recent, historical ones, owing to written documents being practically absent in the former.

A first synthesis on the area under examination, which was published some years ago (RIEDEL, 1986), followed a more naturalistic and zoomorphological approach. Many of the data presented in that paper are also included in this one, which comprises the results of several new investigations and – although still based on osteology – is more concerned with palaeoeconomy and other forms of animal use. It is an *aperçu* of the investigations made by the Author in the area.

After a list of the sites and a brief description of the area, various methodological problems focused on during previous studies and some characteristics of the faunas are treated in four sections. A last section is dedicated to the regional description.

Some general methodological problems are described more carefully for those people who are not particularly familiar with archaeozoology.

1.2. *Sites and areas investigated*

The surface of North-eastern Italy is not large but includes many different environmental aspects. The influence of various civilisations of neighbouring countries favoured the formation of differentiated cultural developments. The climate is usually temperate and humid along the coast and cold in the Alps, with transitional stages from the Adriatic Sea, through the Venetian Plain, the hills and the lower mountains up to the Alpine areas. The morphology changes from the marshy lagoonal coast to the plain intersected by rivers, to hilly areas, plateaux and mountains with deep valleys and higher terraces. Different vegetational types characterised the area: they changed with the development of human occupation mainly at the expense of forested soils and marshy environments, and favoured various forms of economic exploitation and increased trade relations. The relations were oriented northwards, beyond the Alps, to Central Europe; eastwards to Pannonia, the Balkans and the Eastern Mediterranean; southwards, beyond the Apennines, to Southern Italy and finally also to Western Italy and Europe. We studied many sites along the penetration routes which – from the watershed to the Alps along the Isarco-Adige Valley, or along Lake Garda and the Mincio – reached the River Po and the Polesine as far as the areas of Ferrara and Venice, linking the northern countries to the Adriatic Sea.

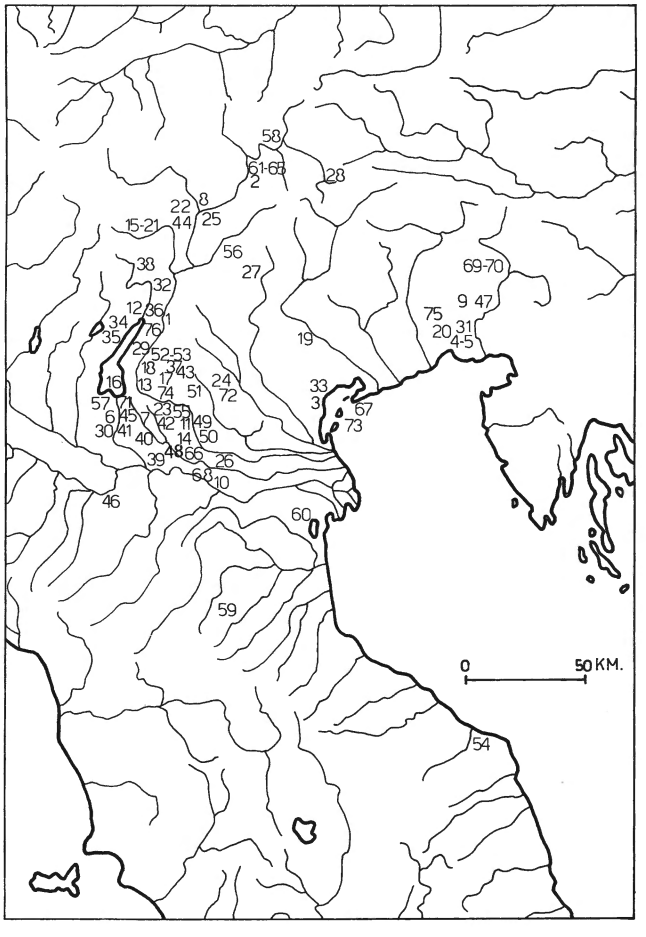

Fig. 1a - Location map of the sites (Tab. 1).
Fig. 1a - Mappa delle località esaminate (Tab. 1).

As far as the Neolithic is concerned, the influences from the east were particularly strong during the Early and Middle Neolithic – mainly those of the Dalmatian Danilo culture or the Square Mouth Pottery culture – while others from the west introduced the Chassey-Lagozza culture in the late Neolithic.

The Bronze Age Urnenfeldkultur, and later the Hallstatt and La Tène, penetrated mainly from the north, that is from the Alpine countries, the Danube Valley and Pannonia. In more recent times, after the decline of the Etruscan presence, Celtic population coming from the north and the west had a strong influence on the area. After the long Roman occupation, northern and eastern influences increased again through Lombards, Bajuvarians and other Germanic people.

The Polada lake-dwelling culture and other similar ones (Barche, Ledro, etc.) are largely autochthonous; they began in the Early Bronze Age and expanded first in the Lake Garda region and then in more extended areas. The Middle and Late Bronze Age Terramare civilisations of Emilia spread through the Po Plain (Poviglio, etc.) and had later developments. The eastern Castellieri and the northern Wallburgen were contemporaneous with some later phases of these cultures.

The Alpine Rhaetian cultural area, which lasted from the end of the Bronze Age to the end of the Iron Age, is also considered to be largely autochthonous but not homogeneous, and influenced by the surrounding countries with different cultural developments.

Finally, very important southern Iron Age cultures, the Villanovian the and Etruscans, ending with the Roman civilisation, caused fundamental improvements in the economy which decreased later – more in the Alps and less so on the plain – after the Mediaeval invasions from the north-east (Lombards) and the north (Bajuvarians) disrupted the imperial Roman and colonial order.

We must also mention the eastern Greek (Spina) and later Byzantine (Torcello, Venice) influences, coming from the sea (Aspes, 1984; Pauli, 1992; Radmilli, 1962; Riedel, 1989A; 1990A; 1992).

2. COMPOSITION OF THE FAUNAS

2.1. *Interpretation*

The first aim of the archaeozoological investigation is to understand the composition of a population. This information is only partial because the analysis of the bone deposits, which forms the basis for the interpretation of animal economies,[1] gives only percentage and not absolute data on the presence of animals. Moreover, description and calculation are difficult because they require meaningful quantitative and qualitative information to evaluate the characteristics of each species, its weight, form, age, sex, etc.

Table 2 and Figs. 2a, 2b, 2c, 2d and 2e give the composition of some of the most important faunas. The various and different data sometimes given for the same site need some explanation, and therefore we make some extended considerations on this subject.

The first usual procedure is the calculation of the number of remains. Although the relationship between the number of the entire bone originally present in a deposit and the number of fragments recovered is not known and can only be supposed, this method of calculation has the advantage of usually being uniform and consequently of making the comparison between different population easier.

The bones of certain species are more prone to breakage than others. The breakage of large bones of cattle can result in more fragments than that of small bones of sheep. Different butchery methods can also give different results (e.g. for red deer see Noe-Nygaard, 1979): for instance, the tibia splits into more parts when cut nearer both ends. Such observations can be multiplied. Small bones and fragments are more easily destroyed than larger ones, while immediate burial of waste decreases losses. Some animals, such as horses and dogs, are more rarely butchered and consequently their bones tend to be less broken.

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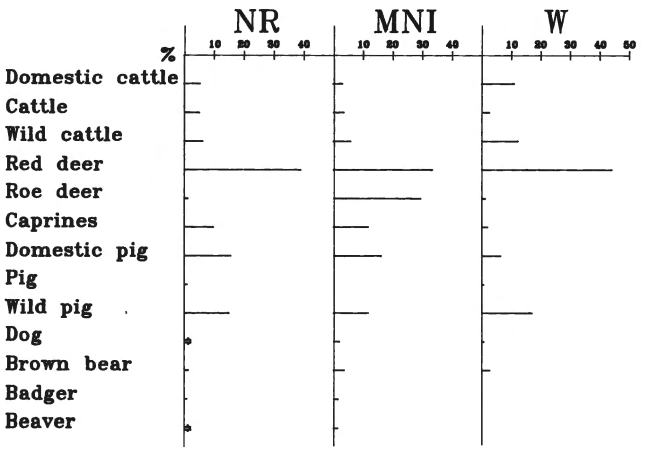
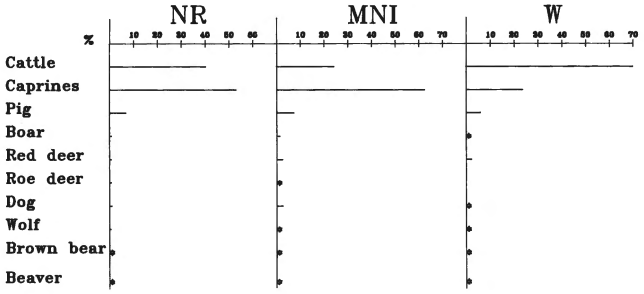
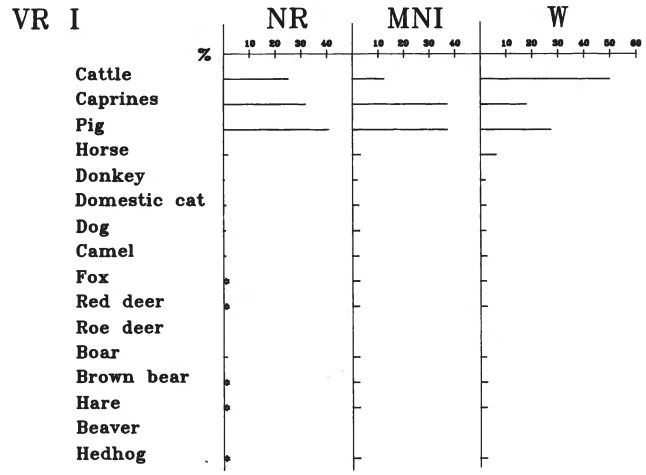
[1] This is not the place to examine in detail the numerous and difficult problems connected with the exactitude and real meaning of the quantitative data obtained from the archaeozoological investigations of bone deposits. Here we give only some information on the methods employed in our studies and the observations made to assess the limits of validity of their results and the possibilities of comparisons between sites. These problems were dealt with by Chaplin (1971), Payne (1972), Uerpmann (1973), Gautier (1984), Casteel (1977A; 1978) and others; Reichstein (1989) critically summarised some of them.







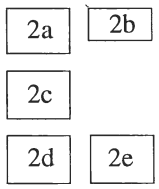
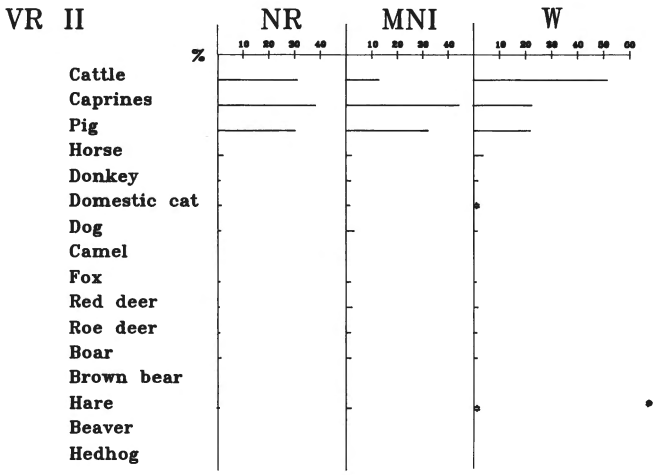
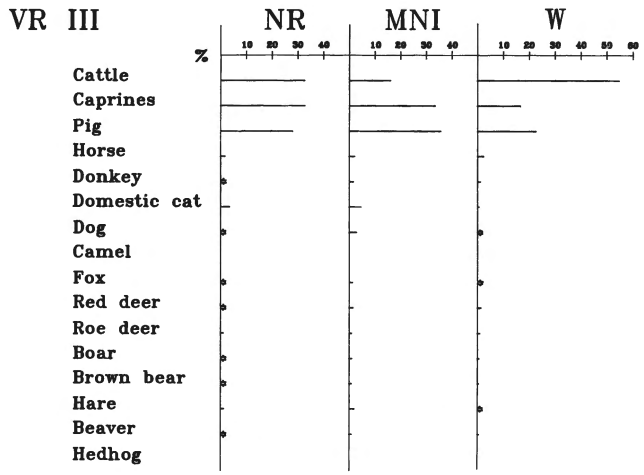


Fig. 2 - Faunal composition of sites. 2a: Cornuda - NL/L - Veneto - Composition (NR-MNI-W); 2b: Albanbühel - BA/M - South Tyrol - Composition (NR-MNI-W); 2c: Verona I (6th-7th centuries AD) - Composition (NR-MNI-W); 2d: Verona II (10th-11th centuries AD) - Composition (NR-MNI-W); 2e: Verona III (13th century AD) - Composition (NR-MNI-W).

Fig. 2 - Composizione faunistica dei siti. 2a: Cornuda - NL/L - Veneto - Composizione (NR-MNI-W); 2b: Albanbühel - BA/M - South Tyrol - Composizione (NR-MNI-W); 2c: Verona I (VI-VII sec. d.C.) - Composizione (NR-MNI-W); 2d: Verona II (X-XI sec. d.C.) - Composizione (NR-MNI-W); 2e: Verona III (XIII sec. d.C.) - Composizione (NR-MNI-W).





A second method is the calculation of the minimum number of individuals, which helps with the evaluation of the contribution of animals to the production of wool, milk, etc. and to activities such as transport, field work, hunting, war, guarding, etc.

Unfortunately, the calculation of the minimum number of individuals does not always give the same results if made by different people. Moreover, some results change if not only the jaws are counted, but all the bones, as should usually be done. The estimation of the morphological or age differences among bones which can or cannot be paired is also a personal decision. Statistical considerations are against this method (Casteel, 1977; 1977A; 1978) but the minimum number of individuals, though difficult to determine, still represents a very important piece of information on the faunas.

In addition to the rough MNI percentage we also need other information – such as animal forms, their age and, if possible, sex – in order to define

better the individuals and their utility and therefore to understand the meaning of the composition figures.

Other methods have to be devised to assess the weight of the animals. This can be calculated using the MNI and a conventional weight for each species. As prehistoric races, and also most of the more recent ones, were small, the individual weight is low but still uncertain, although it can be inferred with the help of documentary data (e.g. in the Middle Ages). With more precise calculations we can attribute different coefficients, which discriminate between younger and older animals, to each age class (VIGNE, 1988).

These and other methods are sound, but each improvement makes them complex and may add several methodological and operational errors.

KUBASIEWICZ (1956) has developed a "weight method" by weighing the bones of the major large domestic animals and assuming that in these animals the weight of their bones is proportional to the amount of meat obtainable. As we always deal with percentages and not with absolute numbers, we can only obtain the relative importance of the animals. This method also has its drawbacks: in our opinion the most important is that the total weight of the bones of a pig is probably much less (65%?) than in other animals (VIGNE, 1988).

In spite of all these methods, some forms are essentially incomparable with others: e.g. birds, the bones of which are often broken and destroyed, especially in the case of young individuals, and whose data are consequently comparable to those of mammals only with caution. Young individuals are underrepresented with respect to adults because their bones and also their deciduous teeth are smaller and more fragile. Because of the counting method, wild animals and others with few individuals are overrepresented in the minimum number of individuals tables.

The number of remains, the number of individuals and the bone weights of many sites of North-eastern Italy are given in Tab. 2 and Fig. 2. The analysis of their differences can provide some information on the importance and characteristics of a given animal species.

The basic data on age and sex distribution are also added to the faunal descriptions (see Chapters 4 and 6). Due to all these problems, it is easier to describe the general aspects and evolution of the population on comparative grounds, rather than to ascertain the detailed characteristics of each individual fauna.

Unless stated otherwise, the number of remains is used for comparisons between the faunas, although all the methods cited are useful for understanding their composition.

The meaning of the percentage of the animals is heavily dependent on their type and use. Animals which do not give the same products and are used in different ways cannot be easily compared. Meat animals are usually numerous, while transport and labour animals are fewer. Wild animals killed to defend the fields are fewer than those killed to obtain subsistence and meat. Many bones of wild animals may remain at the hunting site after the meat has been removed and consequently will not be found in the village waste deposits. Pests and pets, hunting (since the end of the Neolithic) and guard animals are few. For example, dogs are quite useful in the everyday life of a site, although usually their minimum number of individuals is low and their number of remains and their weight minimal. Therefore it is difficult not only to calculate the composition of the fauna but also to interpret the meaning that it had for the human community.

The distinction between domestic and wild forms, especially cattle v. aurochs and pigs v. boars, is another of the practical problems found in the calculation of a faunal composition. A distinction is usually possible using the size of the bones, sometimes their shape and structure or other cultural criteria, but nevertheless the conclusions can be uncertain, in particular for boars.[2]

2.2. *Faunal osteological composition and its variation*

It is important to verify if the composition calculated with a given amount of bones is reliable, in other words if we obtain similar results with other analogous bone amounts of a similar age, size and origin.

A study was possible for the Mediaeval settlement (7th-14th centuries AD) of Verona, situated in the centre of the ancient Roman town. 23 groups of remains were collected during the

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[2] These problems, and also those of sex and age determination – mostly based on HABERMEHL (1975) and on the methods of the Munich School – have already been discussed in previous works (e.g. RIEDEL, 1986). In further parts of this work we will give some other data.

excavation of an area of about 6000 m², in the old centre of Verona; about two thirds of them came from waste pits of comparable formation, while the rest were strewn over more or less wider areas. First we studied the cattle, caprines and pigs, which represent 95.4% of the total of 13634 remains (VR I = 6th-7th century, 3 groups; VR II = 10th-11th century, 2 groups; VR III = 13th century, 17 groups; VR IV = 14th century, 1 group).

The 23 bone deposits were analysed separately and gave compositions which were not identical but usually broadly similar for the three main groups of cattle, caprines and pigs (Fig. 3 of the number of remains; other data of individuals and bone weight are given in Riedel, 1994A). The similarity regards deposits which are both contemporaneous and of a different age. This is probably also due to the difficulty of quantifying the evolutionary trends from the 6th to the 14th centuries at this site.

Differences of 10% are not appreciable and the results given by faunal samples with less than 500 remains are only indicative. Larger deposits are broadly similar. The indications of most deposits are relatively consistent, though they cannot be considered to be completely similar in details.

In Verona there are no specialised deposits of cattle or other important species. Only some of the less important deposits had a composition which deviates from the normal one.

The distribution of the less important animals – other than the three large groups of cattle, caprines and pigs – is erratic, in other words some of them have a more specialised distribution. 87% of the cat remains were found in only 3 waste pits, and 61% of the horse remains in 5 pits or over small surfaces: this situation should indicate a selective disposal of the bodies.

The Verona excavations took place in the central part of a medium-sized Mediaeval town, but in more specialised localities or in sites with a different stage of development, economic activities involving animals can vary topographically according to the economic and social structure of the site: for instance, in Roman Aquileia (Riedel, 1994B) or Augs (Schibler & Schmid, 1989) (see Chapters 2.3 and 6.4).

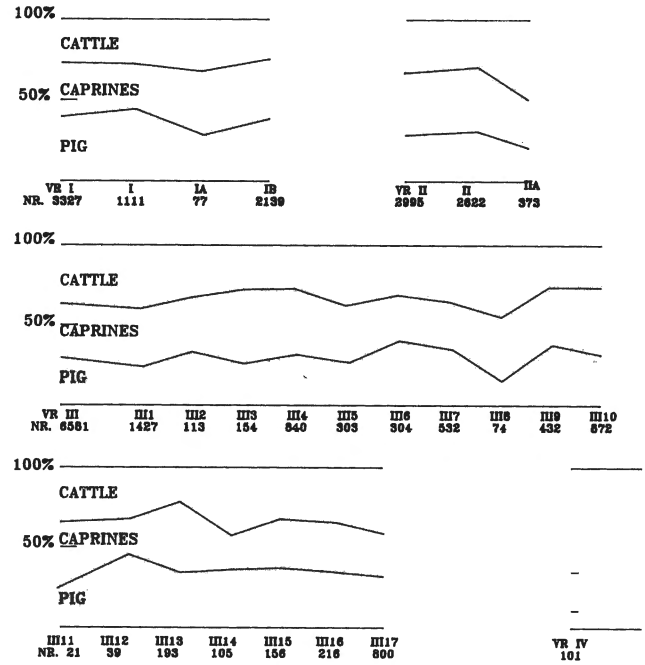


Fig. 3 - Verona - MA - (VR I - 6th-7th centuries AD; VR II - 10th/11th centuries AD; VR III - 13th century AD; 14th century AD) - Composition (NR).
Fig. 3 - Verona - MA - (VR I - VI-VII sec. d.C.; VR II - X/XI sec. d.C.; VR III - XIII sec. d.C.; XIV sec. d.C.) - Composizione (NR).

2.3. *Formation of a bone deposit and interpretation of faunal developments in both uniform and diversified sites*

In a small prehistoric village with a self-sustaining economy of only husbandry and agriculture most activities – such as butchery, meat consumption, manufacturing of animal products, etc. – usually take place at the same site. Bones may be the object of butchery, cutting, chopping and cooking processes and of eventual uses for tools and handicraft. If not buried immediately, they may be gnawed or devoured by animals, trampled upon and broken on the site surface, disturbed by the overlying formations and destroyed by acids and other agents in the soil. Later on these residues can be found in archaeological excavations.

In such cases, the distribution of the remains of the different skeletal zones (skull, jaws, vertebrae, limb bones, etc.) may be irregular but it is often the same, or similar, in different sites. The actions which break up large bones and destroy brittle and small ones are in fact more or less the same in broadly similar natural and cultural environments.

If the formation of the deposits is comparable, this facilitates the interpretation of similarities in the evolution of the faunas and animal economy.

We have pointed out the difficulty of obtaining reliable knowledge about the composition and other characteristics of the faunas from the osteological remains. Comparisons between the evolutionary trends of deposits of a similar origin seem to be on a sounder base (Gautier, 1984).

These rules apply to most prehistoric and protohistoric sites with a uniform self-sustaining

economy in the area under examination. Different problems arise in larger or otherwise socially important settlements with diversified economies, where a specialisation of areas with different economic activities may take place. In many deposits this diversification is gradual and often minimal or difficult to detect. In all these cases we must take into account not only the general rules of formation and transformation of the kitchen waste deposits, but also the special origin from specialised human activities (BARKER, 1987; CLARK, 1987).

More details will be given in Chapter 4, while here we will mention some of these characteristic sites.

Diversification in productive areas was particularly frequent in Roman settlements. The *villae rusticae* of Friuli, which were based on a slave-labour organisation, were centres of production for local consumption as well as for the export of meat. Beef was expensive but still very saleable (VERZÁR-BASS, 1986). Mainly large sized adult cattle, used for agricultural work and transportation, were kept at Volano in Southern Trentino (RIEDEL & SCARPA, 1988) (RA/L).

To take an example from the area north of the Alps, the deposit at Traismauer (Lower Austria) (Riedel, in prep.), on the Roman limes on the Danube, includes a large quantity of remains of adult animals, e.g. cattle or caprines, which – when no longer suitable for other uses – were butchered in a slaughter-house of a local village near the Roman military castrum.

These waste pits of butchery include larger bones, mainly of cattle, which were not forwarded to the kitchen as the smaller bones of other animals with meat still attached to them probably were.

At the metropolis of Aquileia (RIEDEL, 1994B), in the waste deposit of a market, bone of cattle were mixed with only a few elements of the vertebral column and ribs, which were probably discarded somewhere else. Some selection was also made of the skeletal parts, since there are few proximal parts of metapodials. Bones of sheep and pigs were less important. The remains of horses do not show any real butchery marks, and they were sawn only for handicraft use. A market place for sheep and a deposit of cattle horn cores for handicraft have also been identified in the town.

The detailed osteological study in the Mediaeval centre of Verona (RIEDEL, 1994A) (7th-11th-13th centuries AD) gives only some weak hints about a diversified use of animals and animal remains.

Mediaeval castles can either drain special meat sorts or animals required by the landlords of these centres of power (MÜLLER, 1973), or simply be farms for agricultural or husbandry purposes (e.g. Sagogn) (DRIESCH, 1973). At Castel di Drena (1200-1400 AD) in Trentino, the fauna was apparently only slightly improved upon normal village husbandry.

In the great sanctuaries, the composition of the large waste deposits depends only on religious traditions. A good example is the Heraion of Samos in Greece (BOESSNECK & DRIESCH, 1988). At Castelrotto (Verona) – IA – sacrificial food waste was not different from other kitchen waste.

Besides these deposits of mainly kitchen remains, the area we describe has several examples of small accumulations of animals and their remains which are not related to food procurement but rather to traditional rituals, specialised burials, handicraft or chance reasons (see Chapter 4.8).

2.4. *Composition of the faunas studied*

Tables 1, 2, 3 and Figs. 1, 4, 5a, 5b, 5c and the maps and lists give some of the most important

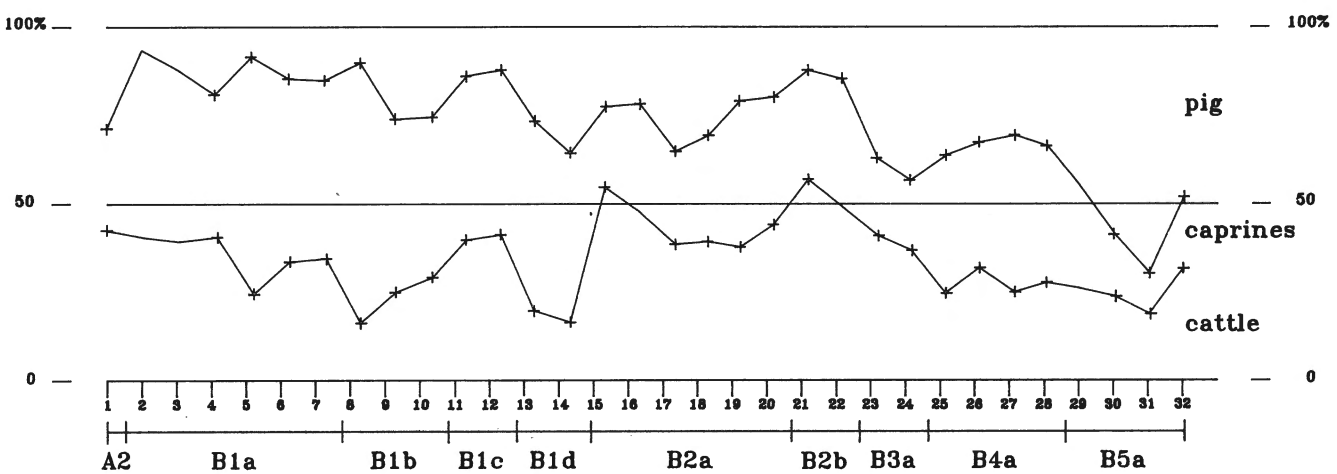
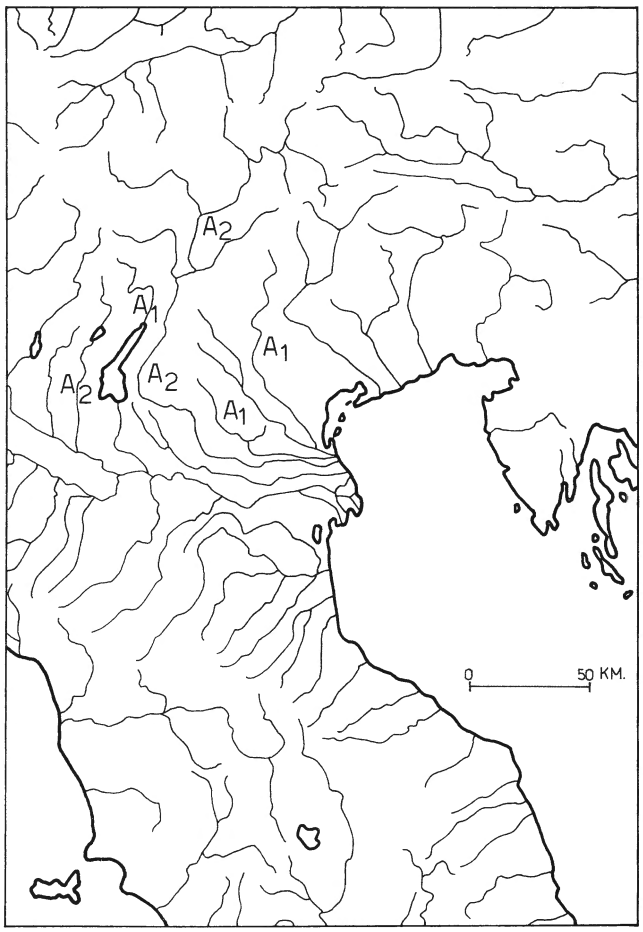
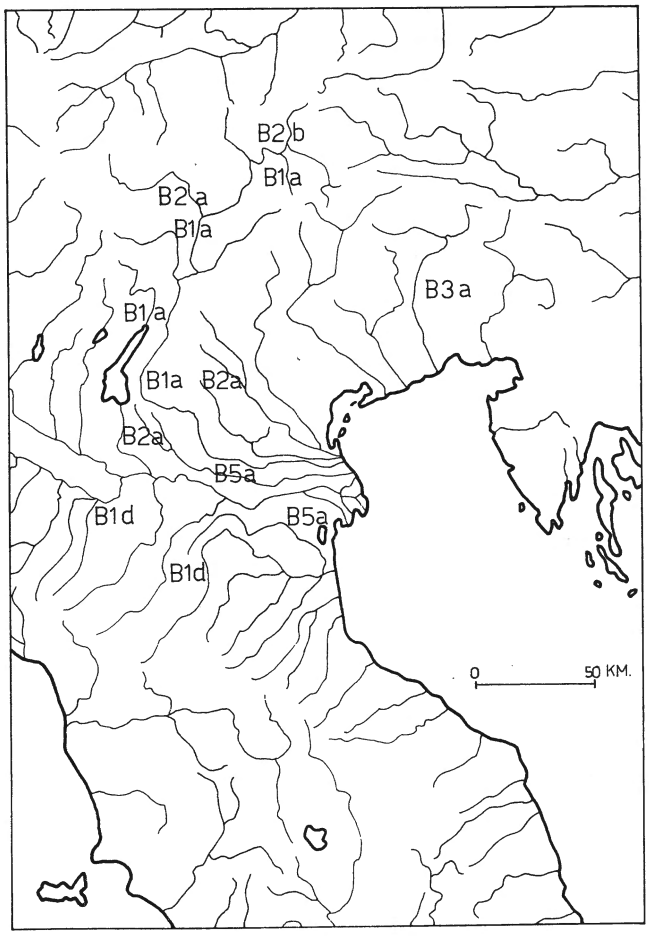
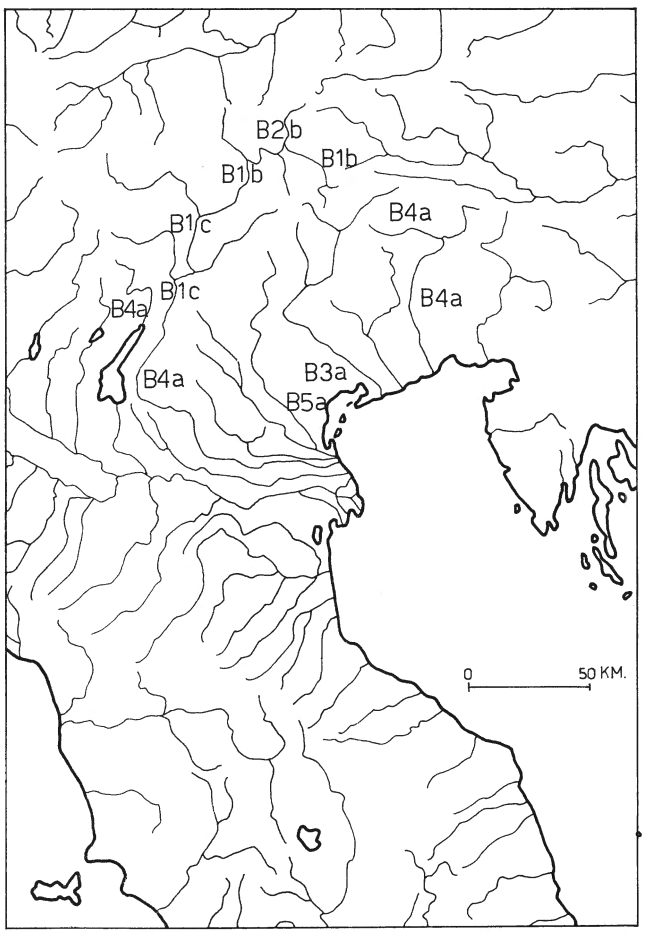


Fig. 4 - Faunal composition groups (NR) – see list of sites in Tables 1, 2, 3.
Fig. 4 - Composizione faunistica per gruppi (NR) – vedi la lista delle Tabb. 1, 2, 3.







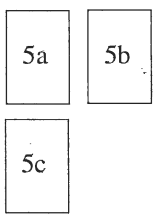


Fig. 5 - Distribution of the faunal compositions.
5a - Sketch map of the distribution of the faunal groups (NR); NL-CA; see Tables 2-3 and Fig. 4.
5b - Sketch map of the distribution of the faunal groups (NR); BA-IA-EA; see Tables 2-3 and Fig. 4.
5c - Sketch map of the distribution of the faunal groups (NR); RA-MA; see Tables 2-3 and Fig. 4.
Fig. 5 - Distribuzione delle composizioni faunistiche.
5a - Mappa schematica della distribuzione dei gruppi faunistici (NR); NL-CA; vedi Tabelle 2-3 e Fig. 4.
5b - Mappa schematica della distribuzione dei gruppi faunistici (NR); BA-IA-EA; vedi Tabelle 2-3 e Fig. 4.
5c - Mappa schematica della distribuzione dei gruppi faunistici (NR); RA-MA; vedi Tabelle 2-3 e Fig. 4.

characteristics of the composition of the faunas of different age and geographical situations. These data are included and developed in the regional descriptions in Chapter 6.

The most important trait is the percentage of the three main economic groups: cattle, caprines and pigs. It is sometimes very stable in a given area, but it is also sometimes subject to an evolution whose development is described in Chapter 6. Among cattle, caprines and pigs, cattle are usually the largest meat producers; the other two groups are of variable importance and in particular their percentages characterise the faunal assemblages.

There are few other domestic animals, such as horses, dogs, and cats; domestic fowls are exceptional, except for a certain number in Mediaeval Verona; wild animals are usually relatively few (about 5%): all of these are not considered in the diagrams.

Red deer is everywhere the most important wild animal, followed by boar, which is rare in the mountains (more details about wild animals are given in RIEDEL, 1991A).

Table 2 and Fig. 4 include only the important deposits relevant to our description.

Faunas with many wild animals cannot be compared directly with others characterised by domestic husbandry, because of their different significance in the economy. Hunting, once indispensable for food procurement, slowly gave way to a small and unnecessary exploitation of game for meat or some secondary products. The percentages of domestic animals might also be related to the wild animal species, especially if they are abundant and if some domestication process is possible (e.g. at Cornuda – NL – where there are several pigs but a secondary domestication has not been proved).

Among the bone deposits investigated, that at Cornuda (Fig. 2a) (Treviso – beginning of the Late Neolithic) has a strong prevalence of wild animals, mostly boars and red deer (NR: domestic animals 31.5%; wild animals 63%; uncertain 5.5%; domestic cattle 5.6%; wild or domestic cattle 4.8%; aurochs 6.6%; caprines 9.8%; domestic pigs 15.5%; wild or domestic pigs 0.7%; boar 14.8%; red deer 39.3%; etc.). The high percentage of large wild animals is increased and favoured by the presence of a hilly forested environment at the border of the then marshy Venetian Plain.

At Moletta Patone di Arco (Trentino), the faunal composition (calculated on the basis of the number of remains) is rather constant during the whole of the Neolithic. Domestic animals make up 63% (NR) and wild animals as much as 37%. However, only 9.6% are of the usual red and roe deer and the remaining are of small mammals (foxes, hares, etc.) which probably lived in the rock-shelter when man did not dwell there. Cattle, caprines and pigs (NR 11.1% – 29.9% – 21.8%) are all important.

Among other known faunas, those of Fimon-Molino Casarotto (Vicenza) and Razza di Campegine (Reggio Emilia), sites attributed to the Square Mouth Pottery culture, both include very few domestic animals.

At Isera – CA – in Trentino (JARMAN, 1970; Riedel & Rizzi, in preparation) the wild animal remains, which are mainly of red deer, amount to over 35%.

3. EVOLUTIONARY TRENDS IN THE FORM AND SIZE OF ANIMALS

3.1. *Animal races and their development: their identification in bone deposits*

The interpretation of the characteristics of the faunas through their osteological remains includes the identification of the animal races and the description of their development.

Skeletons cannot provide complete information about the living animals when the perishable parts of the body are not preserved. We have nearly no data on milk, meat, wool or hair production, the quality of hides, etc. The general principle already established by the Munich School (J. Boessneck, A.v.d. Driesch, various statements) is that we cannot describe races only from animal bones.

We can only deduce the characteristics which have some relationship with the skeletal structure: sex, height and sometimes sturdiness.

Some information can be obtained by making comparisons with the traditional races of the end of the 19th or the beginning of the 20th century AD, for which old descriptions are available (e.g. RIEDEL, 1993 and in preparation).

A related problem is that of verifying whether a population corresponds to only one race, using this term in its most informal meaning (breed, population). When comparing populations of several sites we must examine whether the morphological and quantitative variations are relatively low, as can be expected within one race, or very large, thus suggesting the existence of different races or mixtures of them.

Transitions from one race to another could point to an *in situ* evolution. If the change is abrupt, then the import of another race from outside can be considered to be more likely instead.

A first tentative study is therefore always done to ascertain if we can be reasonably sure that a population corresponds to one osteomorphological race or to a mixture of two or more. Although the solution of this problem is not usually easy, and in any case it is only an approximate one, we should gather such information because of its importance for the study of animals exports, trade and cultural changes.

The most important domestic animals of the area are cattle. They have considerable size variations in different epochs and also at the same epoch in different areas.

Variations in bone form is mainly due to sex differences – small slender cows, strong sturdy bulls, columnar strong castrates – but otherwise the body proportions of various races rarely have strong variations. Only in certain populations, such as the Roman ones, were they exceptionally large, sturdy and long.

Variations in the withers height may be insignificant – e.g. between the Early and Middle Bronze Age populations – and in this case the animals can be considered to be of the same race. However, variation may on the other hand be significant – such as between these populations and the small ones of the Late Bronze Age – and in this case either a new race developed *in situ* or more probably it had been imported.

The characteristics related not only to the size but also to morphological aspects, such as horn cores, are more interesting. In fact cattle can be of a similar size – such as in the Po Plain in the Early Bronze Age and in the Early Iron Age – but at the same time have horn cores with very different shapes.

Three horn core groups – more visible in oxen remains – can be distinguished during the Bronze and Iron Ages: the first in the Lower Bronze Age (large, long, thin-walled, often with a smooth surface: e.g. Barche); the second in the Late Bronze Age (small, short: e.g. Isolone); and the third in the Iron Age (middle-sized, strong, locally thick, often strongly furrowed: e.g. Pozzuolo). As a tentative hypothesis, we can suggest a successive appearance of three different races. The strong differences in the horn core groups can also point to their import from outside, replacing the former populations.

The study of a waste deposit of horn cores in Aquileia led to the hypothesis that two different races coexisted in one population. The forms of a Landrace of Iron Age type and a true Roman race with large, long, thin-walled and twisted horn cores of castrates (Riedel, 1979C) were found together. This problem could be better analysed in a Roman population at Traismauer on the Danube near Vienna (Riedel, in prep.), which also includes two forms similar to those at Aquileia. Here the presence of two races, a Celtic-Germanic smaller Landrace and a Roman one, is more likely but still hypothetical.

Another example of tentative race identification is given by the dogs of North-eastern Italy.

The Bronze Age is characterised by a rather uniform population of small dogs similar to spitz ones – with a withers height under 50 cm. A diversification in their size and form begins in the Iron Age (Pfatten-Vadena, Spina).

In Roman Hungary (Bökönyi, 1974), Traismauer – Austria (Riedel, in prep.), and Aquileia (Riedel, 1994B), and in Mediaeval Verona and Povegliano (Riedel, in preparation), the faunal spectrum varies from small pleasure dogs, sometimes with short legged forms (Teichert, 1987), to high and elongated greyhound-like animals, while 'spitz' and shepherd-like dogs are very common. Very small dogs were found in Roman Aquileia and greyhound-like ones at Lombard Povegliano.

But a distinction between these forms is always hypothetical and the body shape, the character and the activities of the dogs, if known only from their bones, are only a matter of supposition. Dogs which in recent times are considered to be separate races, such as the greyhound and the 'segugio italiano', cannot be distinguished using osteological criteria (Povegliano – Riedel, 1994A and in preparation; Quadri, 1989).

Finally, we can add that recent races have no proved biological links with presumably older ones. Some skeletal forms are constant features which appear again and again in different epochs, such as in greyhounds in ancient Egypt (Boessneck, 1988), in Roman times in Middle Europe (Bökönyi, 1974), in Lombard times at Povegliano near Verona (Riedel, in preparation) and during the Renaissance (segugio italiano, Quadri, 1989).

Another example is given by sheep. In the Bronze Age the sheep of North-eastern Italy, in contrast with Central European ones, are small, under 60 cm; they become larger in the Iron Age and especially during the Roman Age. The possible link between these changes and an improved hair-wool production is not easy to define (Driesch, 1983). In the Roman Age horn cores also change from a more oval, not so heavy form to a triangular, orally flat, very sturdy one (Riedel, 1986). Here we also observe a change in races, which were probably imported, and whose economic significance is difficult to elucidate. Detailed studies under very favourable conditions can give no more

than a very vague identification of races. Therefore special attention must be paid to documentary sources and to the study of the more recent races of the last century.

3.2. *Size trends of animals*

The withers height of the animals at several sites could be calculated with the long bones. For sheep and pigs some smaller bones can be taken into consideration. When the data of the sites are few, we cannot compare small differences between populations and analyse in detail the evolutionary trends in size. Consequently other measurements have to be added – some of the widths of bones (Fig. 2); (cattle: Astragalus GL1 – Phal. 1 f+h Glpe – sheep: Metacarpus Bp – domestic pigs: Humerus Bd) – for the three most important domestic animals which are often found in larger amounts.

Some general trends in the evolution of animal size have already been described (Riedel, 1986); here and in Chapter 6 they are summarised with the addition of data from new sites.

3.2.1. *Withers height and size trends in cattle, sheep and pigs*

According to the data of withers heights, the ancient animal races were usually small in comparison with the recent ones.

Some selected withers heights of cattle are (coefficients J. Matolcsi, 1970):

	n.	min.	max.	$\bar{x}$
Barche (BA/E)	59	1036	1037	1160
Canar (BA/E)	37	1006	1248	1128
Ledro (BA/E/M)	66	936	1288	1103
Isolone (BA/M/L)	99	924	1209	1062
Sabbionara di Veronella (BA/L)	17	981	1157	1070
Pfatten, Eppan, Stufels (BA/L, IA)	24	968	1223	1026
Pozzuolo-Colognola (IA)	42	995	1217	1126
Spina (EA)	11	1085	1250	1185
Traismauer (RA)	19	1159	1469	1288
Verona (MA)	21	1051	1362	1195

If compared with some large Neolithic forms (e.g. Colombare), these cattle are middle-sized, though with many height variations, in the first part of the Bronze Age and small-sized in the Late Bronze Age. Middle and large races begin to appear on the plains with the Early Iron Age, and only later in the Alps with the large Roman races. After the Roman period, a decrease in size takes place during the Middle Ages.

Some selected withers heights of sheep are as follows (coefficients of M. Teichert in: Driesch & Boessneck, 1973):

	n.	min.	max.	$\bar{x}$
Barche (BA/E)	82	527	671	587
Ledro (BA/E/M)	771	488	720	596
Isolone (BA/M/L)	95	490	678	570
Sabbionara di Veronella (BA/L)	21	582	686	629
Spina (EA)	26	577	701	633
South Tyrol (IA)	33	578	737	651
South Tyrol (RA)	28	605	767	695
Traismauer (RA)	14	641	793	716
Verona (MA)	40	561	748	630

The size of animals was small during the Bronze Age, and larger during the Iron Age and especially during the Roman period. A decrease follows during the Middle Ages.

Some selected withers heights of domestic pigs are (coefficients of M. Teichert, 1969):

	n.	min.	max.	$\bar{x}$
Barche (BA/E)	41	591	876	733
Ledro (BA/E/M)	44	523	798	728
Spina (EA)	101	559	826	706
Verona (MA)	69	632	877	763

The pigs height is more stable but also slightly irregular and increases locally during the Middle Ages.

Other measurements are often available in large numbers and allow more detailed studies than those based on the withers height (Figs. 6a, 6b, 6c, 6d). With these and other measurements, it is sometimes possible to analyse the size variations within the same area and civilisations (see Chapter 6).

3.2.2. *Withers height and size trends in other species*

The horses found in archaeological excavations are usually smaller than average recent ones. The Iron Age small horses of western type are about 123 cm high (Riedel, 1986). The slender Palaeovenetian (Riedel, 1984A) forms of the same epoch are high, such as at Le Brustolade (n. 97 min. 1188 max. 1471 $\bar{x}$ 1345). They are similar to Etruscan (Azzaroli, 1972) and eastern European forms (Bökönyi, 1974).

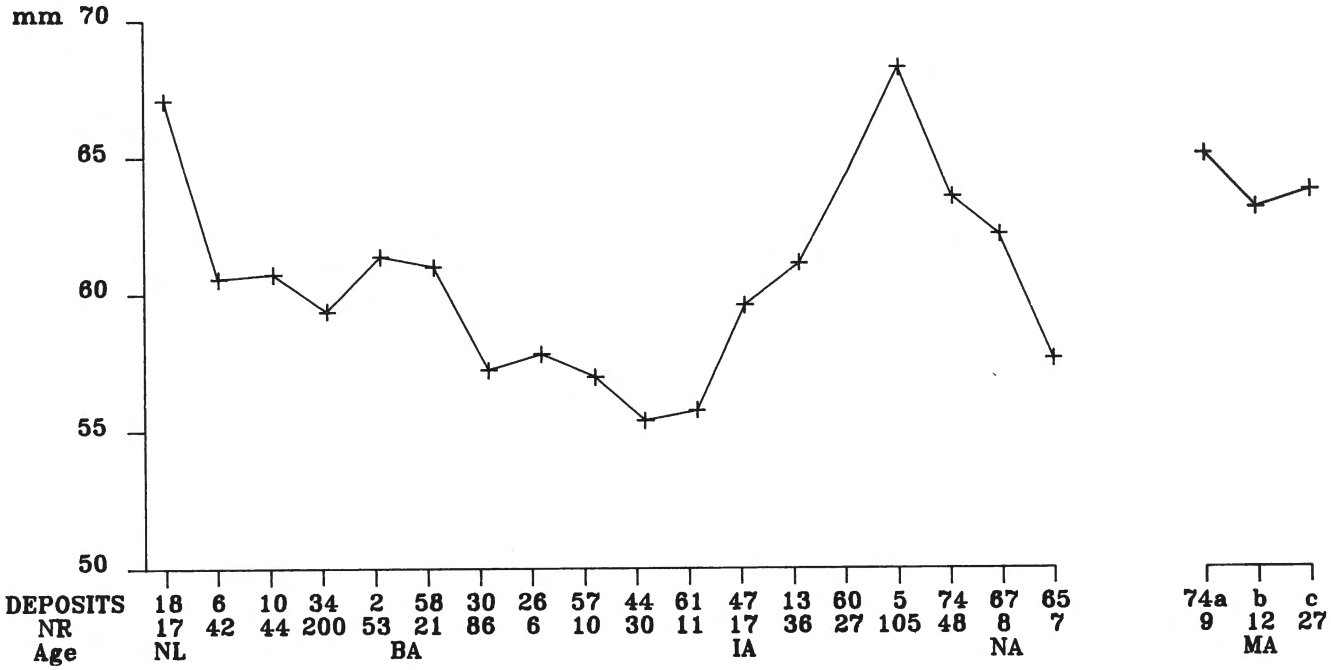


Fig. 6a - Size evolution of animals. Cattle: Astragalus GL1 (greatest length of the lateral part) $\bar{x}$; size trends; see Table 1 and Fig. 1a; 74 (Verona) a: 6th-7th century AD; b: 10th-11th century AD; c: 13th century AD.

Fig. 6a - Evoluzione delle dimensioni degli animali. Bovini: Astragalus GL1 (lunghezza maggiore della parte laterale) $\bar{x}$; tendenze dimensionali; vedi Tab. 1 e Fig. 1a; 74 (Verona) a: VI-VII sec. d.C.; b: X-XI sec. d.C.; c: XIII sec. d.C.

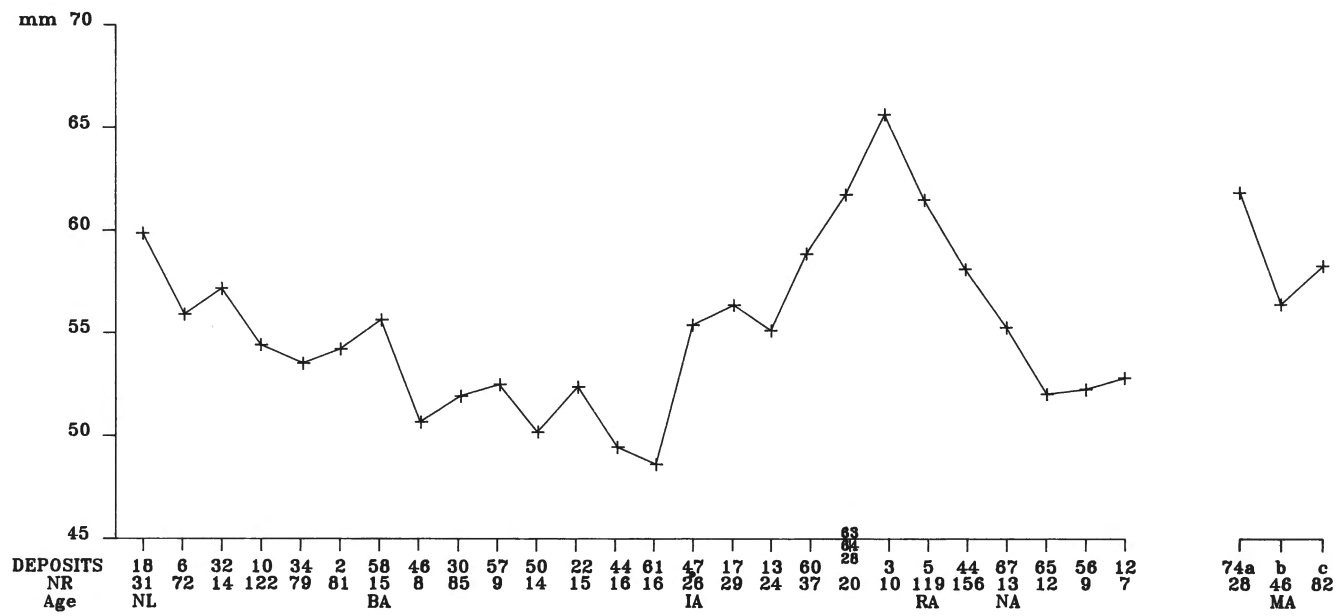


Fig. 6b - Size evolution of animals. Cattle: Phalanx 1 f.h. Glpe (greatest length of the peripheral half) $\bar{x}$; size trends; see Table 1 and Fig. 1a; 74 (Verona) a: 6th-7th century AD; b: 10th-11th century AD; c: 13th century AD.

Fig. 6b - Evoluzione delle dimensioni degli animali. Bovini: Falange 1 ant.post. Glpe (lunghezza maggiore della metà periferica) $\bar{x}$; tendenze dimensionali; vedi Tab. 1 e Fig. 1a; 74 (Verona) a: VI-VII sec. d.C.; b: X-XI sec. d.C.; c: XIII sec. d.C.

The Roman and Mediaeval horses are slightly higher and sometimes very strong (Middle Age Stremitzer in South Tyrol and Castel di Drena in Trentino).

The best known dog population dates to the Bronze Age. It is small-sized with spitz-like forms of uniform characteristics (coefficients of HARCOURT, 1974: Barche and Ledro WH n 42 min. 414 max. 601 $\bar{x}$ 470). Since the Iron Age the withers heights may be variable and high (e.g. hunting and slightly greyhound-like dogs of the Lombard Povegliano WH 64 cm) but also very small (e.g. see a companion animal found in Roman Aquileia, RA) (RIEDEL, 1994B). But the average height of the population increases.

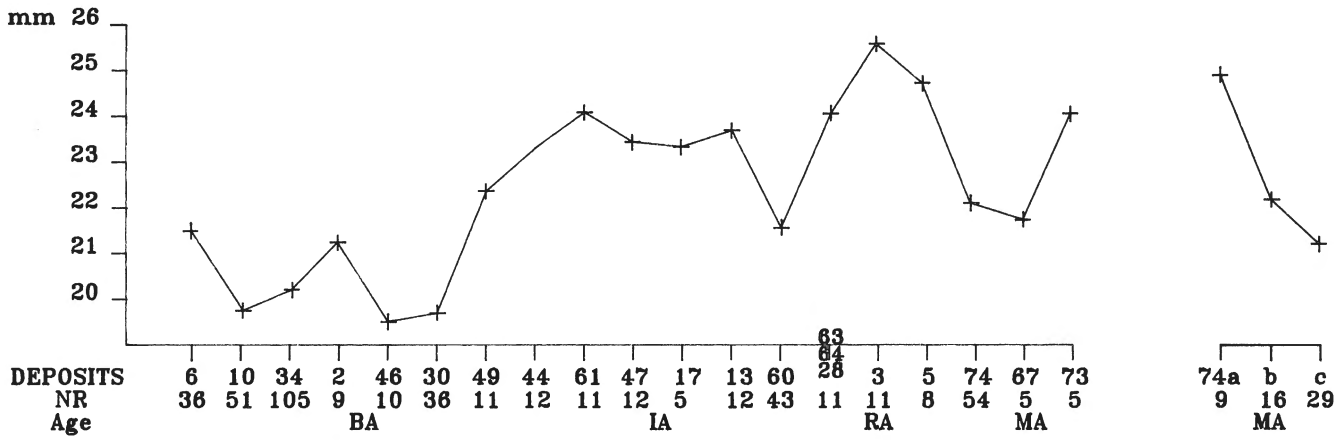


Fig. 6c - Size evolution of animals. Sheep: Metacarpus Bp (breadth of the proximal end) $\bar{x}$; size trends; see Table 1 and Fig. 1a; 74 (Verona) a: 6th-7th century AD; b: 10th-11th century AD; c: 13th century AD.

6c - Evoluzione delle dimensioni degli animali. Ovini: Metacarpus Bp (larghezza della estremità prossimale) $\bar{x}$; tendenze dimensionali; vedi Tab. 1 e Fig. 1a; 74 (Verona) a: VI-VII sec. d.C.; b: X-XI sec. d.C.; c: XIII sec. d.C.

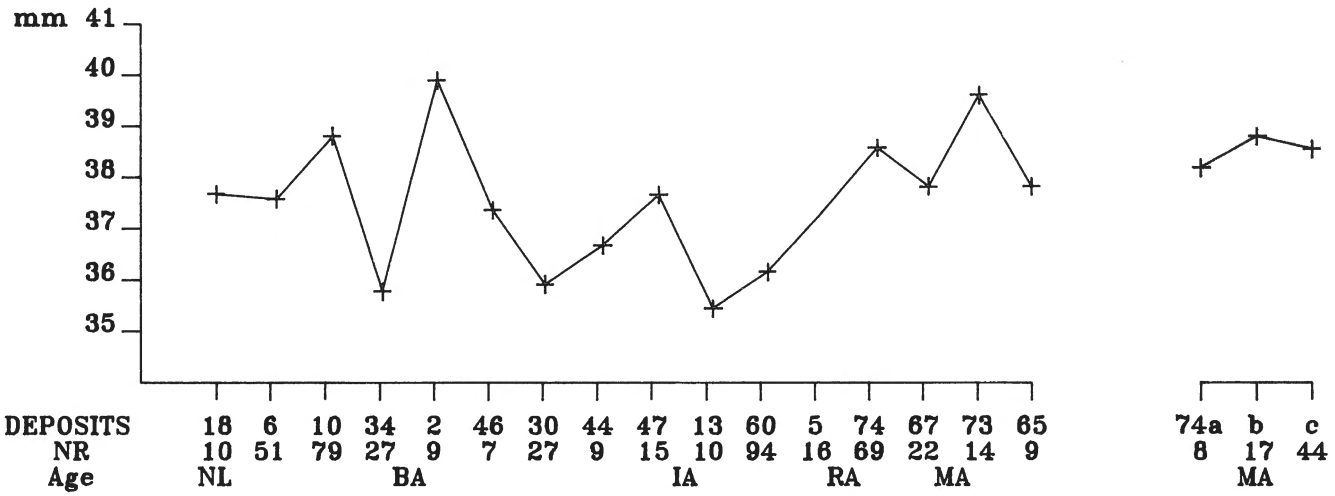


Fig. 6d - Size evolution of animals. Pig: Humerus Bd (breadth of the distal end) $\bar{x}$; size trends; see Table 1 and Fig. 1a; 74 (Verona) a: 6th-7th century AD; b: 10th-11th century AD; c: 13th century AD.

6d - Evoluzione delle dimensioni degli animali. Maiali: Humerus Bd (larghezza della estremità distale) $\bar{x}$; tendenze dimensionali; vedi Tab. 1 e Fig. 1a; 74 (Verona) a: VI-VII sec. d.C.; b: X-XI sec. d.C.; c: XIII sec. d.C.

Goats are much less frequent than sheep, usually slightly higher, and follow the same evolutionary trends.

Many cats have been found in Mediaeval Verona where they represent a small breed, smaller than the recent populations.

There are only a few remains of donkeys and mules.

Domestic fowls (Thesing, 1977) are small in the Celtic period (Casalandri, Valeggio, Santa Maria di Zevio) and as large as those of Roman Imperial times in Mediaeval Verona.

Wild animals are similar to recent species, and not smaller as most domestic populations are. Boars are nearly one meter high (Barche, Spina, Canar: no. 72 min. 859 max. 1064 $\bar{x}$ 982) and red deer are also middle-sized, less than 1.2 m (Barche, Ledro, Canar, Spina: no. 33 min. 107 max. 127 $\bar{x}$ 116) (Riedel, 1986) and smaller than eastern European populations (Pietschmann, 1977).

4. SOME ASPECTS OF THE EXPLOITATION OF ANIMALS

4.1. *The origins of domestication*

Animals are useful in many different ways in the life of human groups.

Before and during the Mesolithic animals were still a prey for hunters. Because they and their products were an important part of the diet and moreover supplied commodities such as leather, bone artifacts, etc., hunting influenced the mobility of man who had to adapt himself to the behaviour of the preys and to their seasonal migrations (for Veneto and Trentino see e.g. Broglio & Lanzinger, 1990).

Besides hunting, there is an incipient man/animal individual relationship which does not necessarily lead to domestication (see Mechin, 1989 for the Vosges region in France) and which may include keeping herds of animals in enclosures (such as the fallow deer at Sappada-Pladen in Veneto) (Riedel, pers. obs.; Hemmer, 1983).

Some cases of domestication could be the recent exploitation of the reindeer in Lapland or the supposed domestication – or rather taming – of red deer in Veneto in the North Italian Neolithic (Jarman, 1972; Forni, 1989). Human influences of various intensity are also present in successful cases of domestication (Bökönyi, 1986) but there is always a difference between mere familiarity with man and strong behavioural changes after domestication, when some hereditary skills for survival in natural conditions are eliminated by selection (Hemmer, 1983).

The economy changed radically during the Neolithic in North-eastern Italy. At the beginning animals were killed for food, their remains were used for several purposes and the life of wild animals was certainly only partially disturbed or controlled by man. Later on domesticated animals were reared, culled and managed in order to provide a constant source of food, handicraft products, transport, traction, company, etc.

Hunting for meat was gradually restricted. Finally wild animals were captured for domestication – but this, though possible (for instance in Cornuda [Province of Treviso, Veneto] – Riedel, 1988), is not definitely proved in our area where only the importation of already domesticated animals is demonstrated. They were hunted when they damaged the new agricultural fields in the sparsely inhabited landscape (Uerpmann, 1973), and at the end of the Neolithic they were occasionally killed for pride or as a supplementary source of food. Wild animals were still important only locally: e.g. in the Alps at Isera (Trentino) – CA – where they represent more than 35% of the total fauna (Riedel & Rizzi, in preparation).

In the Neolithic at Razza di Campegine (Emilia) and Fimon-Molino Casarotto (Veneto), there are examples of faunas consisting nearly totally of wild animals; Cornuda (Veneto) has a mixed economy; Isera and Moletta (Trentino) have less wild animals and mainly domestic animals respectively; at Colombare (Veneto) the percentage of wild animals is very low.

It is difficult to establish why a given species has been domesticated. It is possible that the economically important groups, selected among animals because of their submissive nature, were captured principally for meat production (Bökönyi, pers. com.), and only later was their potential utility for other purposes discovered (eggs, milk, wool). The exploitation of these by-products could have developed slowly, through the domestication and selection of useful mutations (the Bronze Age revolution of Sherrat, 1981; see also Morales Muñiz, 1990). More strictly psychological reasons were certainly required for cats, dogs, horses and similar animals, and their acceptance of the needs, leading role and organisation of man was a necessary prerequisite.

4.2. *Pastoralism*

When hunting and gathering died out, a new economic model gradually replaced them which was characterised by agriculture – also in unfavourable areas – with informal animal keeping.

Several forms of pastoralism – which is a more extensive management of animals, often not strictly localised and with less strong ties than agricultural cultivation – are largely intermixed with a more strictly controlled husbandry. In fact all primitive forms of animal keeping have a tendency towards pastoralism and not to intensive exploitation (Maton, 1993 and others).

Pastoralism of caprines spread largely on the plains (e.g. in Emilia, Poviglio BA), and certainly with an intense production of milk, later, wool, etc. Pastoralism can also represent a way of exploiting poor soils of low productivity in the mountains, near rivers or on slopes near villages (Ledro BA, Stufels BA-IA, Pfatten BA-IA).

High altitude pastoralism (e.g. in the North Tyrol at Birgits, 834 m, IA, Guem, 1956) indicates the exploitation of high fields with less profitable agriculture; caprines also grazed in the forests, thus enlarging the pastoral areas.

In prehistoric times, pastoralism of caprines and other animals could have been an answer to the necessity of improving the economy of small sites when soils or climatic conditions deteriorated or population density increased. More sophisticated social structures can include groups needing marginal resources, such as goats, or the disposition to pastoral activities.

Until recently a limited transhumance to Alpine pastures was very common in Trentino-South Tyrol and was adopted to increase the fodder supply for the winter or to graze during the summer, when the animals – sheep and others – were taken to the pastures at higher altitudes. Specific products, such as cheese, can be increased by this practice which presumably started only in the Iron Age (Gleirscher, 1985) or perhaps before, in favourable local conditions.

Transhumance in a horizontal direction may also have taken place in our region but is not really proven or common. Some forms do exist, such as at the Vinschgau in South Tyrol and elsewhere (Gleirscher, 1985; Migliavacca, 1991). Since the 13th century, during the summer sheep (in recent times 3000 individuals) have been conducted from the Schnalstal in South Tyrol to the Ötztal in North Tyrol passing over mountains 2,000 meters high (Benedikt, 1990). True transhumance is a large movement of animals guided by specialised people of particular social categories; the resulting important increase in yield reminds one of capitalistic methods and hints at increasing needs connected with an increasing population (Barker *et al.*, 1990).

Osteology gives little support to identify pastoralism, while documentary research on regional economy and archaeology are the first sources.

4.3. *Primitive and advanced economies*

Sudden or slow changes in cultures and economies also have consequences on animal exploitation, which are usually revealed – though sometimes only approximately – by archaeozoological methods (Morales Muñiz, 1990; Riedel, 1993). This is also true for the area under examination.

The changes in animal population and economy are mostly slow and not so impressive as cultural changes, to which they are not always well correlated.

Three important revolutions can be mentioned. One is the change from the Mesolithic hunting and gathering economy to the agricultural one, with husbandry and some forms of pastoralism. This change is well documented in some Neolithic bone deposits in North-eastern Italy.

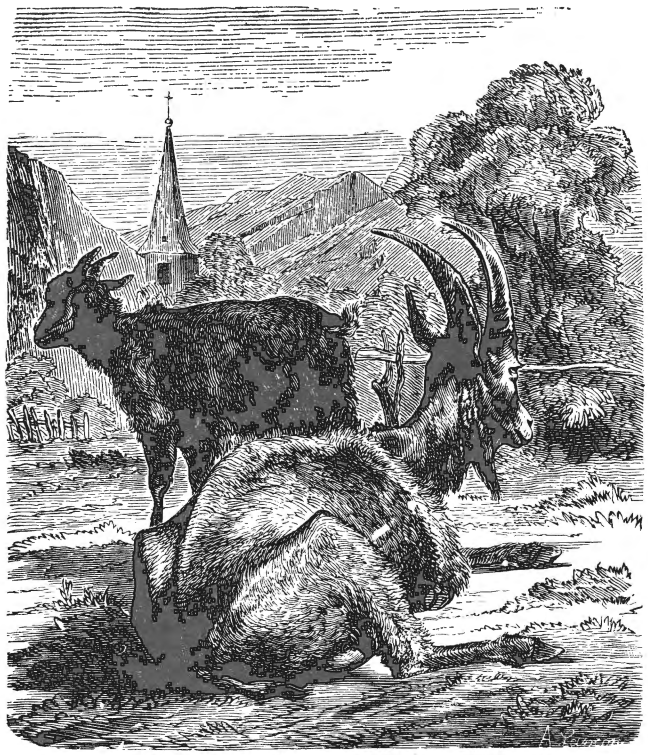


Fig. 7 - Goats (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 7 - Capre (da: I Mammiferi, *Luigi Figuier, 1892).*

Prehistorians suppose that at the beginning of the Bronze Age a "secondary products revolution" (Sherrat, 1981) started a more complex and systematic exploitation of secondary products from domestic mammals, through a change in the nature of stock-breeding strategies. Domestic animals, originally used only as meat providers, also became a source of secondary products (milk, transport, wool, etc.). No important influence of wild animals is observed on the economy. This change corresponds to the spread in the Eneolithic and Bronze Age of small villages throughout North-eastern Italy. But osteological methods are not suitable, or at least do not always constitute the most appropriate methods, for discovering the rise of this type of economy (Morales Muñiz, 1990).

A third revolution took place during the Iron Age when developed economies (Palaeovenetian, Etruscan and Roman) based on trade and the maximisation of resources, led to changes in the breeds and diversification of their performances. The changes are confirmed by bone deposits and archaeological analyses.

This evolution is perceptible in the Iron Age, e.g. in Veneto and Emilia, through the development of improved animal populations and changes in the age and sometimes sex composition patterns. At the same time the self-sufficient economy of small villages changed, with the development of diversified activities taking place in specialised areas

of the settlements or the cities. Aquileia and the *villae rusticae* of Friuli are good examples of this evolution in the Roman period.

4.4. *Environment and economic activities*

4.4.1. *Environment and vegetation were transformed by human activity*

Setting fire to grasslands for hunting or clearing forested grounds for agricultural purposes (Uerpmann, 1977) were common practises.

The summer exploitation of the highlands in the central Alps by Alpine pastoralism, through the overgrazing of more or less horizontal surfaces, transforms Alpine and subalpine grasslands into a stable degraded vegetation (Pignatti Wikus, 1987). Moreover, the natural vegetation around the treeline descends to lower habitats which are degraded by grazing, trampling and human impact.

Alpine valleys also underwent important transformations. The flat bottom of the valleys was usually marshy, a humid environment and often unsuitable for both agriculture and pastoralism; communications could also be more difficult and the routes had to be displaced onto the hanging slopes, such as the Mediaeval imperial road through the "Salurner Klause" between South Tyrol and Trentino. The draining of the flat bottom of Alpine valleys was undertaken mostly in the last century (Dal Rì, pers. com.). From the Neolithic – e.g. Fingerhof, South Tyrol (Bagolini, oral com.) – to Mediaeval times the agricultural fields, like the more important communication roads, were often on slopes or on lower reliefs.

Since the Neolithic the North Italian Plain has been slowly transformed from marshes and forests adapted for hunting, pig husbandry, etc., through later deforestation and cultivation into land suitable for agriculture and husbandry, with fringes of less favourable areas for pasture near rivers or on slopes (Bagolini *et al.*, 1973).

Coastal marshy lands were filled and consolidated; rivers were naturally or, in more recent times, artificially deviated; harbours were often placed on rivers or lagoons, not immediately on the coast, and were protected from the sea (Aquileia, Altino, Venice, Spina) (Uggeri & Uggeri Patitucci, 1974; Patitucci Uggeri, 1987).

4.4.2. *The influence of environmental and geographical conditions varies with the cultural development of the area through time*

Hunting, agriculture, husbandry and pastoralism all have a different optimal habitat. Communication routes are necessary for the trade of both small objects – amber, salt, flint, etc. – transported by man, and large and different wares such as tiles, amphorae, cattle and cereals, transported with carts; therefore the roads can be of different size and accessibility. Harbours can be used by both ships or smaller boats.

The geographical situation which leads to large movements of populations in a given direction for trade or war was always of great and steady importance.

The local topographical conditions may instead be considered optimal or unfavourable according to the cultural pattern of the populations. Therefore lake-dwellings are usually on shores or wetlands, typical *Castellieri* or *Wallburgen* are on hills, and harbours need accessibility as well as protection and roads need special consistency of soils. Villages may prefer either optimal soil quality and water supply or instead better defence conditions.

The interaction between environment and human activity depends on the economic model and technical conditions of the times.

4.5. *Butchery patterns*

The butchery of animals is also a cultural characteristic with traditional patterns; its methods can be partially reconstructed from the shape of the cut marks and breakage marks and the surfaces of the bone fragments.

Bone breakage may also be due to many natural causes; for instance, the lack of recognisable human intervention on the bones found in a rock shelter with anthropic remains may be proof of an independent occupation of the same site by man and animals, such as at Grotta di Ernesto (Trentino – MS/E) (Riedel, 1994). But in archaeological contexts skeletons are usually heavily dismembered and broken either directly or indirectly by man.

In prehistoric sites (e.g. Canar BA/E), man employed axes but also small tools made of flint blades which leave fine marks; metal knives of the Bronze and Iron Ages did not cut the individual bones deeply and their marks are sometimes rare and not always easily visible. Later on, but also already in prehistoric times, heavy chopping tools, axes, etc., cut through strong articulations and shafts, such as at Stufels (South Tyrol – RA) and Aquileia (Friuli – RA), causing not only fine marks but wide flat surfaces as well.

From a careful extraction of the bone man passed to a rough dismembering of the body parts with a high meat value. The heavy butchering marks

Fig. 8 - Sheep (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 8 - Mandra di Pecore della Brie (da: I Mammiferi, *Luigi Figuier, 1892).*

on the bones are impressive, especially in sites such as Roman Aquileia and Mediaeval Verona. For example, at Aquileia the radius, like the other long bones, was cut longitudinally on both the lateral and medial sides, with the proeminences cut away. Small splinters were removed parallel to the surface from the shaft of the femur and from other bones (Riedel, 1994B).

In earlier times some religious or traditional rites (Swegat, 1976) might also have influenced butchery, although it is quite difficult to infer this influence from osteological remains. Therefore, if we leave them to one side, we can say that butchery starts as a family affair and later becomes a handicraft and a profession; consequently the methods becoming increasingly more systematic along some defined rational patterns.

The faunas of North-eastern Italy allow specific remarks to be made about the butchery methods.

The killing method itself rarely leaves visible marks. In some cases the separation of the skull from the vertebral column is visible: for instance, a Bronze Age bull at Pfatten BA/L (like the caprines at Albanbühel BA/M) was cut through the *epistrophaeus* and a horse of the Lombard grave at Povegliano was decapitated. This procedure seems to be a secondary treatment and dismembering of the carcass, not a killing action. Whole skeletons (e.g. the Palaeovenetian horses at Le Brustolade) do not show killing marks; the animals were perhaps strangled.

A prominent method of dismembering is the extraction of the vertebral column and subsequent disconnection of the limbs and skull. It already existed in the Bronze Age and developed irregularly. In modern butchery the animal is hung up and the vertebral column halved and sawn dorsoventrally through its centre in a longitudinal direction. In ancient times (e.g. in ancient Egypt, Schüssler, 1989, photo page 80) animals were butchered lying on the ground.

The usual prehistoric method, which survived locally until quite recent times, consisted of the extraction of the spine cutting it on both sides with the articular ends of the ribs. The *processus spinosus* on the dorsal side was also sectioned away. The carcass was cut transversally. Canar (BA/E) is an example of this method.

At the Rhaetian site of Pfatten-Vadena, South Tyrol (BA/L; IA/E/M) the more recent method of halving the spine was already employed for

butchering caprines, pigs and probably cattle. In contrast, the same procedure was not applied at Stufels, a site of the same age and region. In Europe the old methods were still used during the Roman Age, but we have noticed that the Pfatten procedure was applied especially on the caprines at Roman Stufels.

From the 7th century the Mediaeval animals of Verona were treated with this method. The carcasses of cattle, caprines and pigs were halved and split longitudinally and dorso-ventrally through the centre of the vertebral body, sometimes laterally, but in this case only on one side, and sometimes completely out of it. At the same time at Venice-San Pietro the old method was still applied to pigs.

Several vertebrae were split transversally to the long axis. In Verona, there are few transversal splitting surfaces because large meat pieces were butchered instead of chops. It is difficult to establish from the vertebral fragments whether the longitudinal halving of the spine was antecedent to the transversal cutting or whether it followed it.

At all the sites the *processus spinosus* of the dorsal vertebrae usually appears to be cut at its base. The ribs themselves were cut near their articulation and also in many sections in an irregular way.

In other countries – such as France, Austria, etc. – these butchery methods are similar but their evolution could have taken place in different epochs. So, for example, in Roman and Mediaeval Central Europe at Künzing Quintana (Germany RA, Swegat, 1976), at Traismauer (Austria RA, Riedel, in preparation), at Sagogn (Switzerland MA, Driesch, 1973) and in South-eastern France (RA, Olive, 1987) the cranio-caudal halving of the vertebral spine was not a necessary procedure. In England (Maltby, 1979) longitudinal spine splitting has taken place only since the 16th century AD onwards. In France, Audoin & Marinval-Vigne (1987) observed that this splitting has taken place at Orléans and in Châtité-sur-Loire since the 13th century AD for cattle and sheep and later for pigs. However Meniel (in Audoin & Marinval-Vigne, 1987) recognised the application of this method on pigs already in the Early Hallstatt period in France at Choisy-au-Bac, Compiègne.

Butchery methods can vary according to geographical areas and epochs and need careful investigation in order to be identified.

The dismembering affects all the bones and more seriously the upper limbs between the scapula and the body and between the femur and the pelvis. All the articulations, or bone proeminences, may be heavily affected by butchering especially in historical times (e.g. at Roman Aquileia), but also before that age (e.g. at Castelrotto, IA, and at other sites), though to a lesser degree.

Small bones of the feet and more rarely the ends of the metapodials can be detached from the body and remain in the hides.

In Aquileia, nearly only the distal ends of cattle metapodials are preserved in a market place. Small bones, which are certainly often not carefully collected such as the *astragali* of caprines, and fragments are destroyed in large quantities more easily than other bones, for instance by dogs; but if they are very hard and medium-sized, as in cattle, they are usually preserved entire and thus collected.

Many bones, especially the hard metapodials of cattle, are split mainly through the shaft and often also longitudinally because they have been subject to the action of frost, to humidity and to fluctuating temperatures, hit, broken and trodden on uneven ground or, perhaps more frequently, steadily pressed on in archaeological waste deposits. Many parts of these bones are also devoured by carnivores.

Cattle bones are often more fractured also because their meat is originally attached in large portions; the bones of animals such as pigs and caprines are instead less fractured because both they and the meat portions they give are smaller (see for example Mediaeval Verona).

The great demand for bones for handicraft also favours their destruction.

The bones of other animals give fewer opportunities to study the butchery methods.

Dogs usually have no butchery marks although some people (e.g. the Celts in France) used the body of these as well as of other animals (Yvinec, 1987): for instance, a femur from Verona (13th century AD) was cut proximally and burnt and cut marks have also been observed at Albanbühel (BA/M) and at a few other sites. In the Alps the tradition of dog eating lasted until recent times (Riedel & Rizzi, 1995).

Horses also have a less prized meat – in Mediaeval Germany their consumption was sometimes forbidden by the church because of their use in pagan rituals (Schreiber, 1984) – and their bones and vertebrae are less likely to be affected by butchery marks than those of cattle; for instance, these marks are quite scarce on the bones found in Roman Aquileia and in Mediaeval Verona.

Other animals with fewer remains give less information; some important species, such as red deer and wild boar, have less butchery marks than the main domestic animals. Wild animals were probably treated differently and perhaps partly butchered outside the village in order to reduce transport costs.

4.6. *Age distribution*

The age distribution charts of a few typical sites with a reasonable minimum number of individuals and a good collecting record have been analysed in order to obtain information on local economies (Figs. 9a, 9b, 9c).

As no important Roman bone deposits have been studied in North-eastern Italy, we also selected Traismauer, a market and military *vicus* on the Danube in Lower Austria, as a comparative site.

Besides Roman Traismauer and Mediaeval Verona, two other bone deposits from sites with improved husbandry or from markets with selected old individuals, whose data could not easily be put on the diagrams, are:

Aquileia (Friuli) – supposed market – 2nd-5th centuries AD (Riedel in: Verzár-Bass, 1991; Riedel, 1994B) – mostly cattle bones and nearly only adult animals;

Torcello (Venice) – monastery and possessions of the church – 5th-12th centuries AD (Riedel, 1979B):

cattle:	adult	80%	M3 +/- 20%
caprines:	adult	80%	M3 +/- and juv. 20%
pigs:	adult	37%	M3 +/- 29% juv. 34%

The procurement of meat is considered to have been the main purpose of the initial domestication of animals. The importance of secondary products was discovered only later (Sherrat, 1981). But many populations with primitive economies (Allen in: Noddle, 1989) eat meat only on special occasions such as marriages, sacrifices and funerals; therefore it is difficult to define the real influence that a good husbandry and a well organised economy might have had on the age of butchery. No general rule can be applied and modern technical and economic interpretations are only tentative.

The many young cattle slaughtered at Canar are a good example of the culling of the herd to avoid foraging during the winter. At the contemporaneous site of Albanbühel half of the individuals are very young calves, nearly foetal, because the community required only labour and meat – and perhaps milk wasted by the young animals – and did not have a reasonable amount of winter forage at its disposal. At other sites (e.g. Lasino BA/E; Riedel & Tecchiati, in prep.) the culling of cattle was scarce (35.3% of cattle were young); at still others (Poviglio, Pfatten, Pozzuolo – BA, IA) the animals were slaughtered whenever necessary, either disregarding their age or else preferentially when adult.

Traismauer, Verona and still more Aquileia – RA – and Torcello – MA – have age distribution curves which are more typical of markets with imported animals or of economic systems encouraging a thorough exploitation of animals for all purposes (labour, milk, etc.) until maturity. Since the Roman Age onwards, but sometimes even before, some young individuals could have been slaughtered either in traditional rites or to satisfy culinary tastes.

On average, caprines were slaughtered at an older age than cattle. Near markets (Traismauer – RA, Verona – MA) adult animals were very numerous, like cattle. But already in prehistoric times (Canar – BA, Albanbühel – BA) they were often exploited for secondary products and mostly slaughtered when adult; their meat could have been eaten on occasions when it was not necessary to slaughter larger animals. At Pfatten, Poviglio and Pozzuolo they were often slaughtered when young; at Lasino BA/E – this happened very often (67.5% of cases). Beyond general trends, each site or culturally homogeneous region must be the object of an interpretation which is mostly only of local validity.

Pigs were slaughtered at a younger age because they were used only for their meat and consequently killed when further feeding was no longer economic.

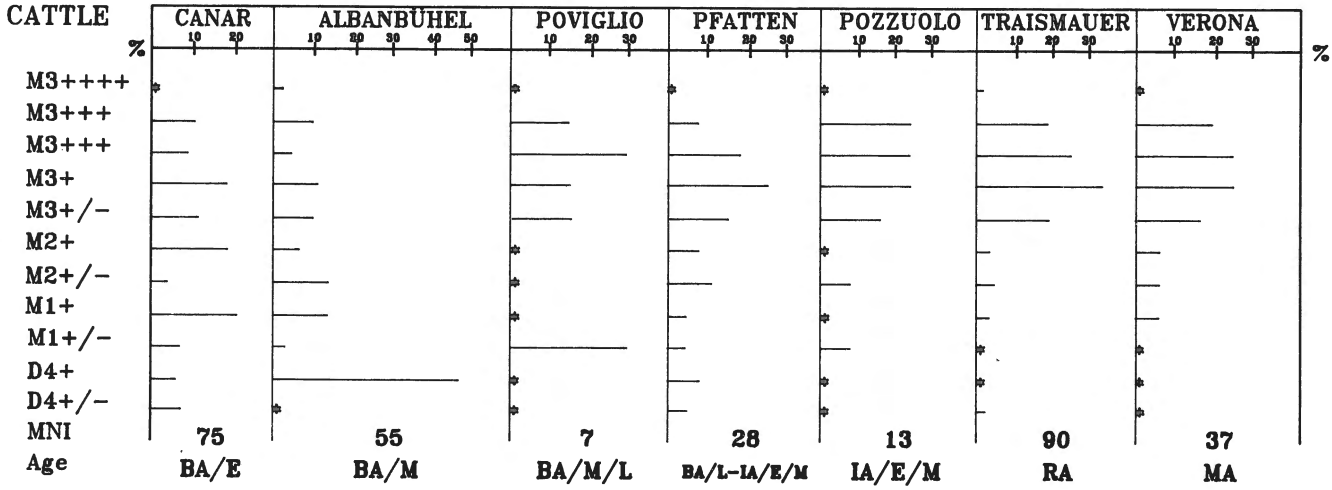
Besides cattle, caprines and pigs, other animals – such as dogs, horses, cats and red deer – usually do not give interesting and reliable age distribution data, because the individuals determined are fewer. Adults usually predominate.

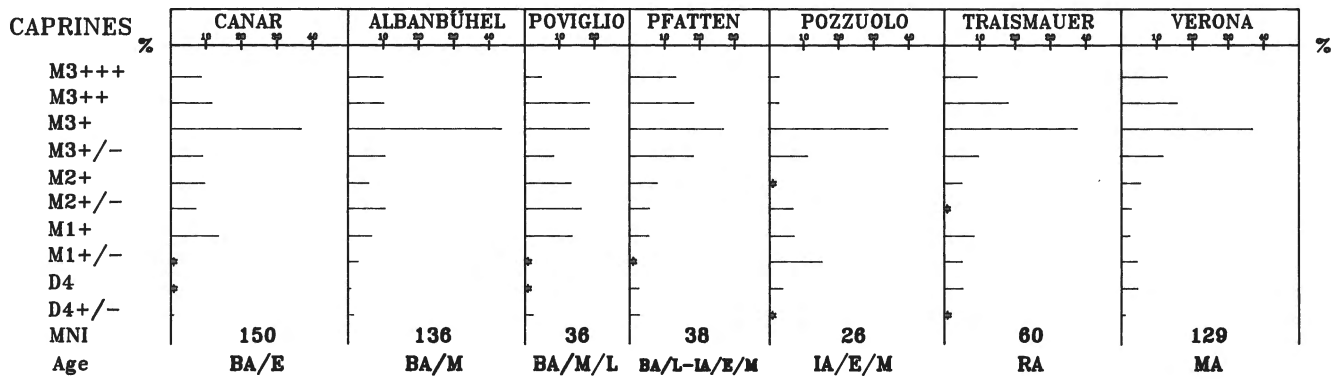
The death age of horses varies, with individuals in all age spans (at Pfatten – BA-IA – from 2 to 20 years; at Stufels – IA – from 3½ to 6). There are very few young individuals. Red deer are also prevalently, but not always, adult. There were however exceptions: at Canar, for instance, 40% of the deer were young.

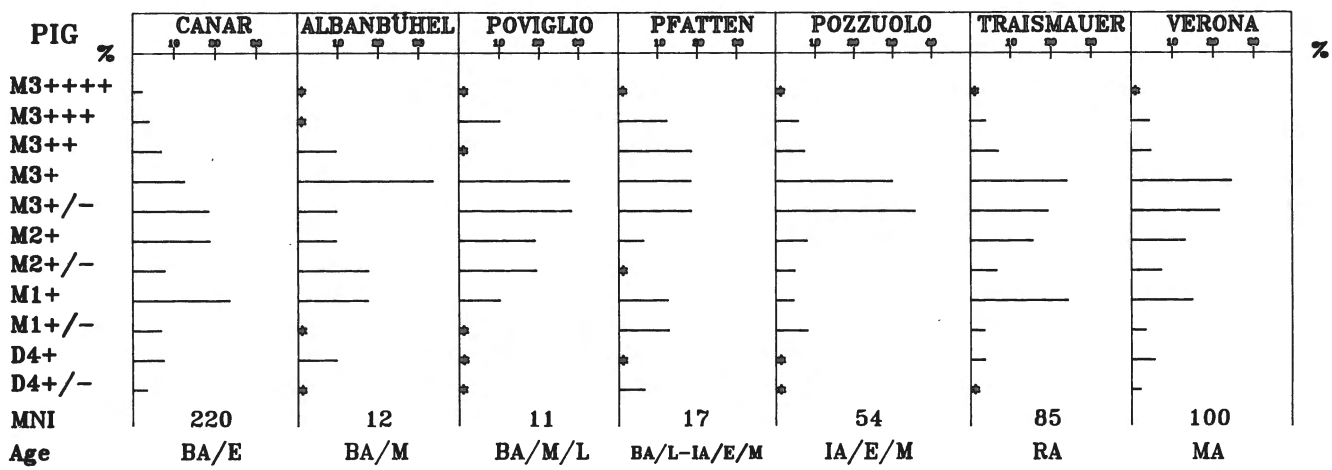
4.7. *Sex distribution*

Reliable sex determination and percentage calculations can be done with the pelvises of cattle and caprines and the jaws of pigs. Horn cores are also useful for this purpose, but they are often destroyed or otherwise selected when used for handicraft. The metapodials of cattle give only some sex indications and those of caprines very few. Very young individuals can only sometimes be identified (Riedel, 1986).

The percentages of both cows and male cattle are often evenly distributed. Caprines include







9a

9b

9c

Fig. 9 - Age distribution of animals: 9a - Cattle (Table 1, Figure 1); 9b - Caprines (Table 1, Figure 1); 9c - Pigs (Table 1, Figure 1).
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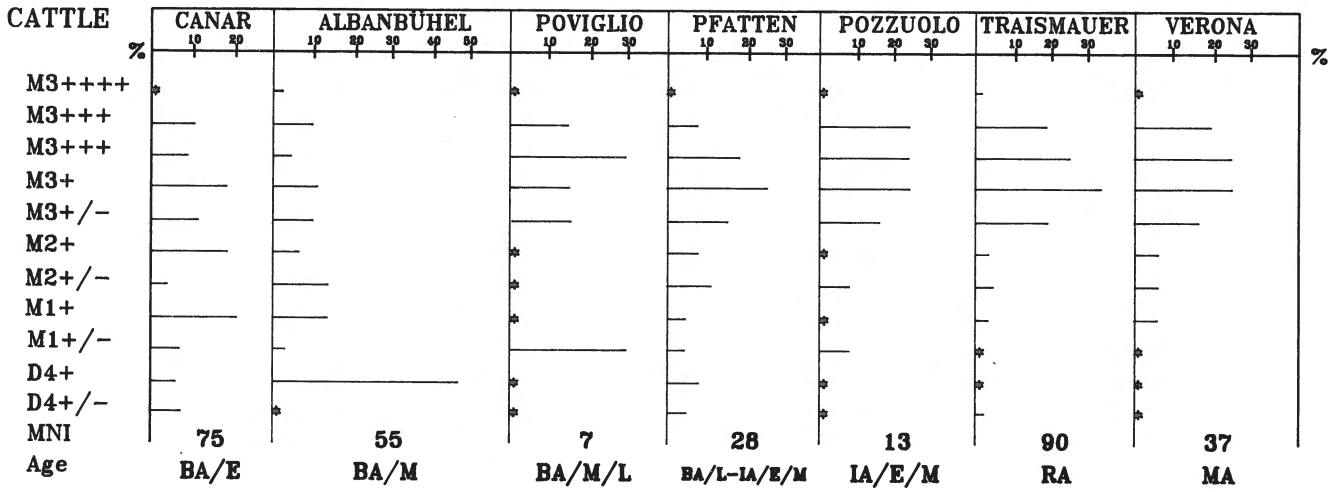

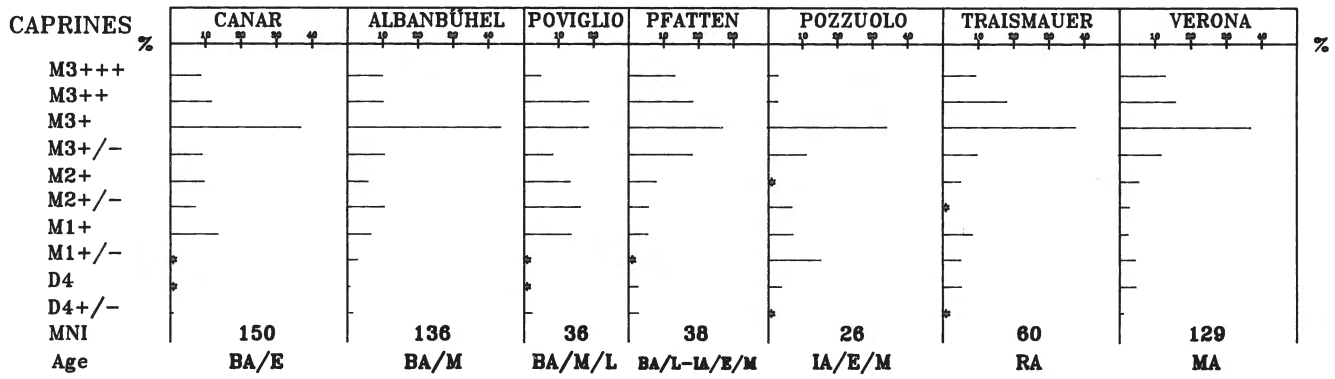

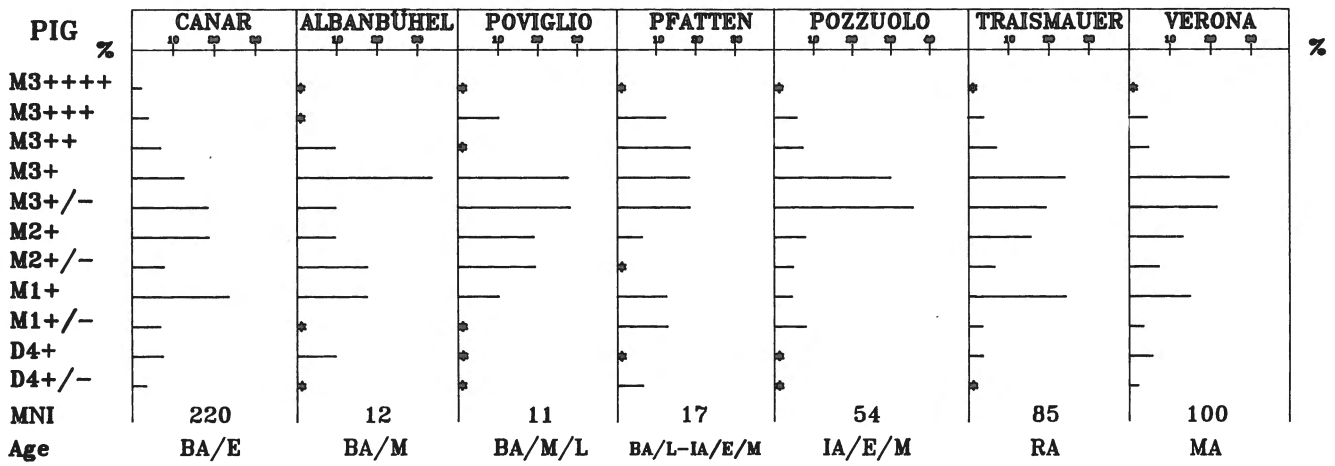

9a

9b

9c

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more females, which were kept for their milk, than males, which were slaughtered when very young. The variation in the sex percentages of pigs can be explained as reflecting culinary preferences – castration could be taken into account; but the necessity of females for reproduction in rearing places and the majority of males in markets, where animals were usually transported on the hoof to be slaughtered, could also be a reasonable explanation.

4.8. *Special deposits: handicraft and ritual exploitation of animals*

Several bone deposits are not the usual kitchen waste but are the result of a differential exploitation of the animals. Some ritual offerings or sacrificed animals are connected with human graves and whole skeletons or groups of remains can be the result of sacrificial acts.

Dismembering and breakage for ritual meals is sometimes very intensive (Castelrotto – IA) or sometimes the operation can be restricted to the killing of animals without any dismemberment (Le Brustolade – EA) or with only a partial one (Celtic cemeteries at Casalandri, Valeggio, Santa Maria di Zevio; cattle at Pfatten-Vadena – BA/L).

Some deposits result from the waste of handicraft activities; some are connected with specialised markets and butchery places; others are the remains of draught animals, etc. Several deposits are of uncertain interpretation.

Many kitchen waste accumulations also include more of less significant amounts of bone remains of animals employed for special purposes.

Remains connected with human graves come from three localities in the Province of Verona – Casalandri, Valeggio and Santa Maria di Zevio – in a Roman occupied territory where animal bones were found in Celtic graveyards of the 1st century AD as ritual offerings contained in bowls near the corpses.

The most frequent animals are pigs and domestic fowls of both sexes, usually young. Sheep are mostly adult and fish are rare. Other species of the local fauna were never or only rarely offered. Either limited parts of the animal bodies or perhaps entire skeletons were sacrificed: they include bones and flesh because small and brittle bones, certainly in anatomical connection, are also often preserved. The domestic fowls belong to the small Celtic race.

These offerings are typical of the late La Tène traditions (Ambros, 1985).

The Celts displaced the previous Palaeovenetian populations from this area, at least culturally, and later on were slowly conquered and assimilated by the Romans.

At Montereale – Friuli – ceremonies of the Roman Age along field boundaries were discovered by studying ditches with the remains of pigs and fowls (Petrucci & Vitri, 1995).

Two skeletons of horses were buried near the Palaeovenetian cemetery of Franchine di Oppeano (6th-9th centuries AD). The horses were lying on their right side with bent legs, in oval ditches. The first, a stallion, was 17-18 years old, the second two and a half and of unknown sex. The height of their withers was about 130 cm. They were sacrificed but did not show marks of killing or of flesh having been taken off and they were not related to individual human graves.

Another case of a Palaeovenetian horse grave is that of Piovego (Padova), described by Azzaroli (1980).

27 skeletons of horses were found at the Palaeovenetian site of Le Brustolade near Altino (450-350 BC): nearly all of them are adult and male, with an average withers height of 135 cm and an age ranging between four and a half and 16 years. Very few tools were found.

Until now they have only been studied from a zoological point of view and not within the broad context of Palaeovenetian traditions.

The horses were buried quite irregularly, sometimes one on top of the other. They were usually lying down on their sides with the body and legs in a normal and more or less slightly bent posture or, in one case, with the fore ends and hind clogs joined together.

One horse is supine on its back and another prone on its stomach. Two are distinctly paired one on top of the other. The head of only one horse is upright. The anomalous position of some skeletons is due to the shape and dimensions of the pits in which they were buried, probably dug into the clay.

The entire skeletons and the selective choice of the animals facilitate the interpretation of the ritual.

According to Titus Livius, Palaeovenetians sacrificed horses (Tombolani in: Riedel, 1984A).

The Lombard animal grave of Povegliano (7th century BC) is placed at the centre of a cemetery, and is not connected with any individual human grave. It includes an adult slender horse, about 140 cm high, and two young adult dogs, apparently of a greyhound type, about 64 cm high.

The horse lies on its left side, with the legs in a normal posture, the cervical spine curved upwards and the skull cut off probably at the level of the axis, which is the last partially preserved vertebra. Locally the spine has a *spondylosis chronica*

deformans and *ancylopoetica*, which causes pathological rigidity and prevents a normal use of the adult. The dogs are placed on the fore and hind legs of the horse, as if leaping onto it.

This burial ritual is very common during the first centuries of the migrations period north of the Alps. Sometimes the skull was found in another area of the cemetery; the beheading of horses was common but remained a minor phenomenon (for horses see e.g. AMBERGER & KOKABI, 1985; for dogs see e.g. MÜLLER, 1973). The ritual at Povegliano is highly symbolic and was adopted by the Lombard upper class of warriors and hunters.

Another burial of a Lombard horse was discovered in the graveyard of Bovolone (Riedel, in preparation). The animal was lying on its left side, with the fore limbs bent and the hind ones more straight, an image of a raised jumping horse.

Other ritual burials are of ruminants.

At Pfatten-Vadena a round hole with a diameter of about 80 cm – dug in deposits of the Final Bronze Age perhaps in connection with a slightly more recent habitation – was filled with the skeletal bones of a young bull, about 30 months old. Only the ribs are lacking while all the other remains, including small detached epiphyses or friable articular parts, are preserved.

The axis is cut transversally because the body was beheaded, the atlas is lacking and there are no marks of butchery or of flesh having been taken off. Only a few lateral articulations of the vertebrae are slightly cut. Some bones are in anatomical connection – such as the metapodials with phalanxes and the vertebrae of a long section of the spine – while others are not in their normal anatomical position.

The carcass had been dismembered in large sections, the ribs were taken away with the bowels and all – except the ribs, which were carefully detached from the vertebrae, and in a few cases with slight cuts – put together into a hole. A ritual meaning is very probable.

Two skeletons of full grown oxen (that is with all the sutures of the long bones fused or fusing) of the very end of the Bronze Age at Nogara d'Olmo (Verona) were placed in oval ditches, lying on their right side in specular position; they were entire and undisturbed, without cuts or marks. The site is adjacent to a Late Bronze Age cemetery but very slightly younger than it (end of the Bronze Age).

A bone deposit of the Late Bronze Age (13th-12th century BC – late Peschiera lake-dwelling culture) was discovered at Sabbionara di Veronella. A wide shallow ditch is filled with many bones of various animal species, besides other archaeological remains; one photo shows a skeleton, probably of a cow, lying on the ground. Many other bones are young and fragile but well preserved, thus suggesting the existence of abundant entire skeletons or of parts of them. They belong to at least 14 animals: 11 young and 1 adult cattle, and 2 adult sheep. There are also many other remains of a normal waste site, but with rare butchery marks. Cattle remains constitute 64.6% of the fauna, MNI 35% and bone weight 75.2%.

The interpretation of this deposit is uncertain because many data are lacking but the more or less connected skeletons and limbs are certainly of intentional origin. Ritual causes are more likely than diseases.

At Castelrotto – IA – a stone chest, about one square metre wide, was filled with bone and pottery fragments and covered with a conical accumulation of pebbles. There are 57 remains of cattle, caprines, pigs and red deer, and 145 splinters. Although the bones are broken like those found in kitchen waste deposits, their position in a stone chest suggests that they could be the remains of a ritual meal.

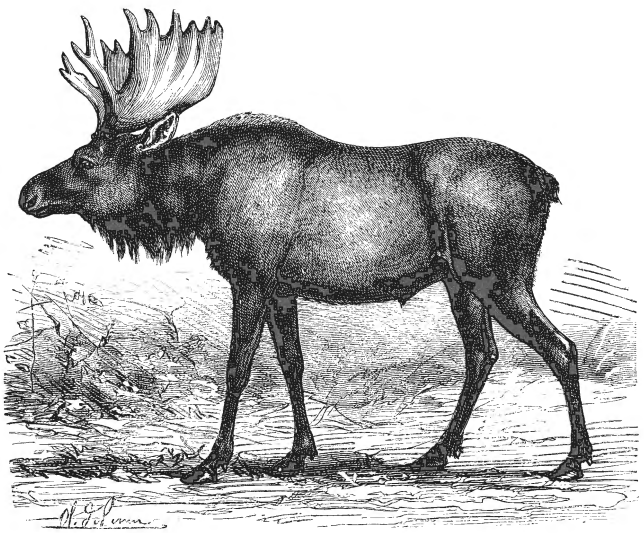

Fig. 10 - Elk (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 10 - Alce (da: I Mammiferi, *Luigi Figuier, 1892).*

Another example of ritual treatment of skeletons is given by the discovery at Monte Ozol, studied by CHAIX (1984). The deposit (700-600 BC, Laugen-Luco culture, Trentino) is composed only of goats (40 individuals); their horn cores were systematically cut away, and the animals were cut into two pieces along a longitudinal section across the skull and the vertebrae. The *astragali* were not found there but rather with others of cattle (600 in all) elsewhere, and were also used for ritual inscriptions. These are all remains from sacrifices and ritual uses.

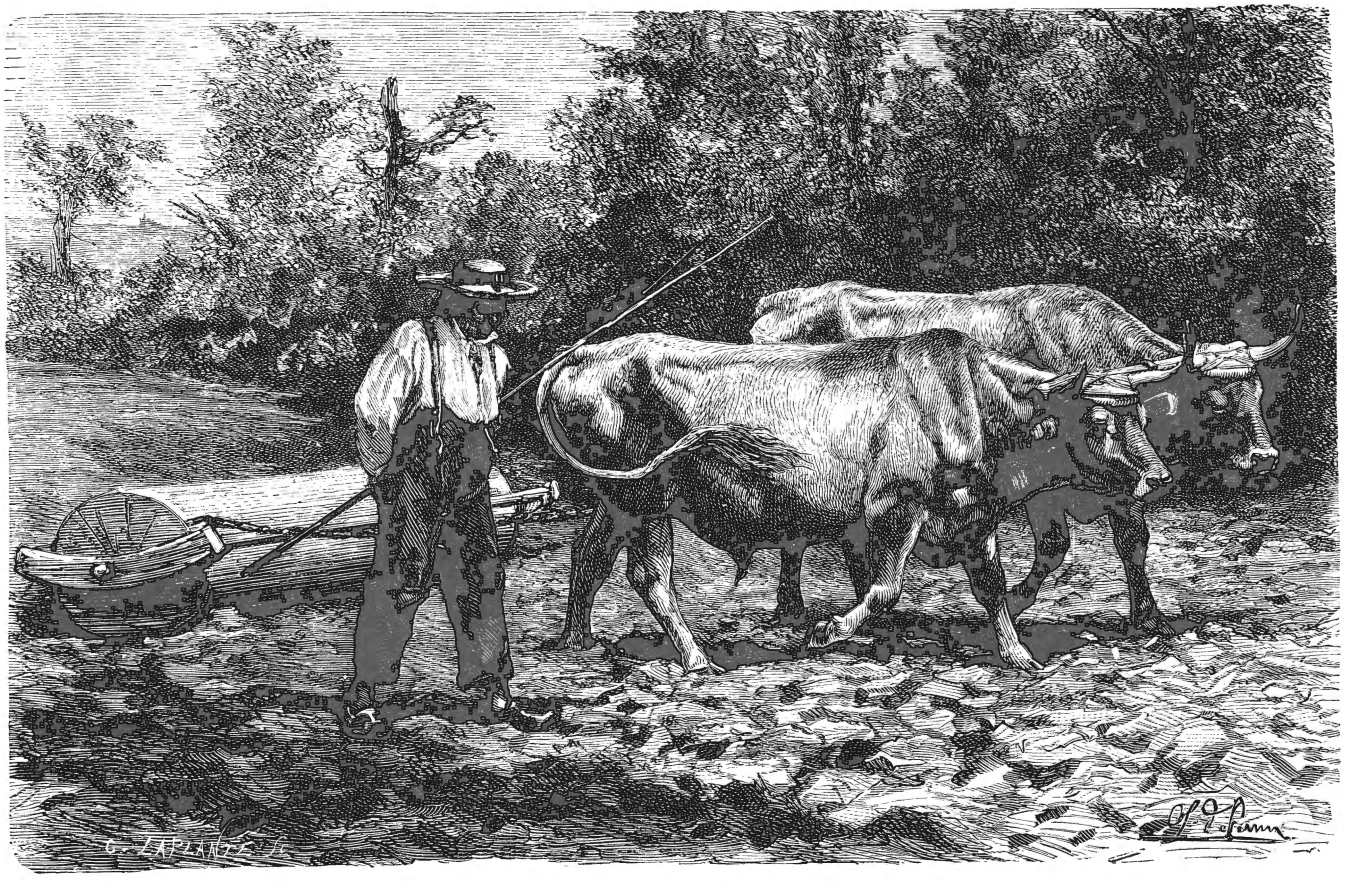

Fig. 11 - Cattle (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 11 - Buoi al lavoro (da: I Mammiferi, *Luigi Figuier, 1892).*

At this point we can point out that at Pfatten-Vadena, in the Early Iron Age levels (1000-600 BC), the minimum number of caprines is 39 although the *astragali* – which are small bones and therefore not easily recoverable – belong to 78 individuals. Here these bones were also certainly used for ornamental objects, games and ritual needs.

Bones also have many economic uses. Horn cores and horn sheaths are particularly useful for handicrafts. Cattle horn sheaths are very useful, and female goat horn cores and sometimes hard ram horn cores are also utilised.

An interesting deposit of two cubic metres in Roman Aquileia (first half of the 1st century AD) is filled for the most part with 601 remains of cattle horn cores, 374 of which are large and measurable. A further six fragments were of male ibex and rams.

The horn cores were chopped away from the skull, still retaining part of the latter. Some were sawn near the tips, some near the base, and sections were sawn at both sides and at one side. The tips are often 15-20 cm long and sections 10 cm long. The sawing of the cores was probably done with the sheaths still attached and flat sheets of horn were thus obtained.

The deposit is certainly related to a horner's workshop. Horns are in fact used as raw material for handicrafts. From Plinius Secundus (see e.g. 1844 edition) we know that horns were used by northern people for drinking and cutting arrow points, and that Roman cattle horns were sectioned into blades for lanterns, other ornamental objects and for inlay works. An interesting outline of horn handicraft is given by Wenham (1964) in his description of the craft of the horners in York from the 14th century AD until modern times. The uses of horn which he cites include combs, pins, braids, shoe-horns, potter's horns and drinking scoops.

In many sites we find the remains of cattle, sheep and goat horn cores and red deer antlers which were used either as the cattle of Aquileia or, if hard and thick, for preparing handles or other implements. An important site is that of San Giorgio in Valpolicella (14th-11th centuries BC); less important are Colognola ai Colli (4th-2nd centuries BC) and the castle of Udine (RA-MA), where rams' horn cores were used.

Another different type of deposit with particular economic characteristics is Volano (Late Roman Age), where mainly adult and male cattle were found which were certainly farm labour animals.

Specialised production sites – such as *villae rusticae* or, in large towns, topographically separated deposits or differentiated activities – are

common in Roman times. At Aquileia, besides the horn core deposit, both a sheep market and a market with a butchery place have been identified; cattle predominate at the latter, followed by horses. The remains of horses are only slightly butchered. Cattle have many butchery marks; few vertebrae, costae and proximal parts of metapodials are preserved and there are few teeth.

The identification of special deposits is not always easy: see, for instance, the one at Grotta d'Ernesto, of the early the Mesolithic, at 1,130 metres a.s.l. in the Upper Valsugana on the western slope of the Asiago Plateau.

The animal remains include 9 ibex and 6 red deer, which are usually male and young adults, especially the ibex. The bones are fairly well preserved: as they were found near a Mesolithic fireplace, they could belong to hunted animals which were not heavily butchered.

However, as marks and cuts produced by man were nearly absent on the bones while many bite marks of carnivores were observed, a non-contemporaneous presence of man and animals was finally hypothesised. It was supposed that the animals penetrated accidentally into the cave and that their bones were partially gnawed or taken away by carnivores.

At the bottom of the cave there was a skeleton of a young-adult male brown bear, which died during hibernation (Riedel, 1994; butchery was also studied by Giacobini, in preparation).

The interpretation of other deposits is uncertain. At Pieve di Colognola (NI), for instance, a group of bones of large-sized cattle and other domestic animals was found on and under the living surface. Perhaps they can be considered to be the remains of a sacrificial meal.

A special discovery is that of the small Roman Age vase at Castelrotto (Verona) with the remains of a serpent, *Malpolon monspessulanus* Hermann, 1804. The Romans kept snakes as tamed animals (Bodson, 1990).

Bones of less common and special animals are always mixed with kitchen waste: for instance, dogs and cats which were not necessarily eaten. In Mediaeval Verona, cats' carcasses were not only put in selected pits but also sometimes mixed with other waste.

Most common are the bones used for handicrafts, which are cut, sawn (e.g. at Altino and in Aquileia – RA) or polished (the horse long bones at Pozzuolo and Pfatten-Vadena – IA – are polished on their flat side), and the cattle ribs are polished into spatulas at Albanbühel – BA, etc.

Bones were intensely exploited for many uses after taking the flesh off.

5. OTHER REMARKS ON FAUNAL INTERPRETATION

5.1. *Remarks on other methods of investigation*

Archaeozoology integrates data of various origin.

Although the basic document of these studies is indeed the bone deposit, archaeology also contributes with knowledge about the settlements, buildings, all sorts of implements and, finally, the general aspects of the civilisation and its history. In more recent times we also have documentary contributions on the improvement of husbandry and its economic efficiency (see e.g. White, 1970), such as the more general and theoretical texts of Roman authors (Columella, Pliny, etc.), or the detailed and analytical descriptions of Mediaeval origin which also record all the changes in property, taxes, inheritances, etc.

Paintings are also important if they are at least partly copied from nature, such as those of the "Seasons" of the 15th century AD in the Torre dell'Aquila in Trento (Castelnuovo, 1987).

Finally, populations of the recent past, which are well known, can give helpful indications (for cattle in the Austrian Alps see Riedel, in prep.).

Geological, pedological, climatological and botanical studies and all data improving the study of the environment are also a necessary contribution.

Many problems remain mostly outside osteology, such as pastoralism which has to be studied through the integration of various methods such as traditional archaeology, environmental, sociological and economic studies. Trade is also only weakly reflected in the characteristics of bone deposits: sometimes it can be revealed by the distribution of bones in specialised sites, the age of the animals, the butchery methods and the preservation of the bones.

The historical developments of human populations are the principal cause of all the observed changes in the economy and also in the human-animal symbiosis. The environment is only a secondary cause which modifies some developments. Therefore history is the key to all interpretations of the economy.

5.2. *Conclusion: economy and cultural methods of animal exploitation*

A model highlights and synthesises the relationships between the data, observations and interpretations which we have obtained through the

analysis of the characteristics of the faunas. The study of bone deposits and of the natural and historical environments of the sites is the main means to build it.

Economic models are only a vague approximation of the reality of economies and cultural methods of animal exploitation, but they do help to interpret some trends and developments. The first chapters of this paper gave some tentative interpretations, while Chapter 6 – including regional descriptions – will provide information about these models.

The models mainly reflect our ideas on recent or historic economical organisation. However, NODDLE (1989), for instance, correctly observed that animals were not always important as a food source in all ages and cultures. Meat has never represented a major part of a normal human diet. Anthropologists working amongst African tribes reveal that animals are always getting slaughtered for particular occasions although everybody gets his share of the meat (Allen in: NODDLE, 1989) (see also Chapter 4.6).

The milk of cows was not always particularly appreciated: Romans and Greeks (BODSON, 1983) preferred that of sheep and goats. The same is also true for North-eastern Italy in the 15th-16th centuries AD (D'ANGELA, 1993). In some economies the lifetime of cattle depended upon many factors, including meat and milk production; but cattle may also be a symbol of richness or religious belief, and in these cases the butchery age and methods follow traditional rules.

Besides the uses of animals at traditional sites, many other uses – such as purveyors of handicraft products; for labour, transport or agricultural uses; for contributions to the human social life, such as hunting, war, guard, companionship – are in part easily seen or only tentatively inferred. Therefore many facts, not provided by osteology but proved otherwise, can change the interpretation of the bone deposits and the economic models we use to explain them.

The archaeozoological interpretations of a standard bone deposit are usually strictly economic, but traditional, religious or other factors can have a great importance on the way that animal populations were kept and exploited.

The first and most obvious explanations are therefore only mere theories which need to be verified and improved in the future.

6. REGIONAL DESCRIPTION

6.1. *The Mesolithic and the neolithisation*

In the area under examination there was a gradual neolithisation of the economy (Figs. 2a-5a; Table 2; Chapter 2.4). A decrease in the importance of hunting and an increase in husbandry, first limited to only some regions, were completed at the end of the Neolithic or locally (e.g. Isera in Trentino) in the Chalcolithic.

In this area, after the Epigravettian and the Mesolithic, the Neolithic begins with cultural groups such as Gaban, Fiorano, etc. (ca. 6200 BP), then develops during the long period of the Square Mouth Pottery culture (6000 BP), and ends with the Late Neolithic (4750 BP) and the beginning of the Chalcolithic (4250 BP) (ASPES, 1984).

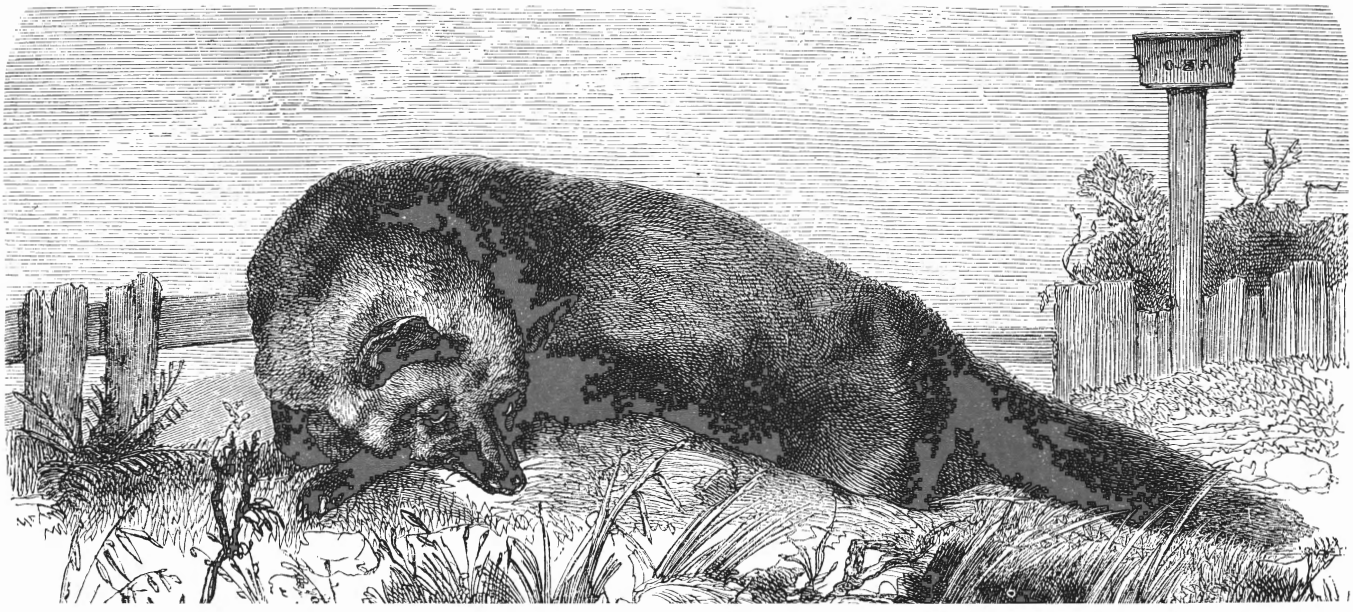

Fig. 12 - Fox (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 12 - Volpe (da: I Mammiferi, *Luigi Figuier, 1892).*

Three important sites have been examined: Grotta d'Ernesto, dated to the Early Mesolithic; the shelter of Moletta Patone, with deposits extending through the whole of the Neolithic (both in Trentino); and Cornuda, of the Late Square Mouth Pottery Culture in central Veneto.

All these sites are important from a methodological point of view: the first for problems of interpretation of animal skeletons in a shelter used by hunters; the second for knowledge about the faunal types in a rockshelter inhabited from the Early Neolithic onwards; and the third for the study of the relations between domestic and wild faunas.

Some other smaller deposits provide supplementary information on the local faunas of the Early and Middle Neolithic and their evolution; the lower layers of Fingerhof, Acquaviva, Spilamberto San Cesario, Pieve di Colognola, Riccione-Santa Monica and the sites of the Trieste karst.

Other sites – such as Fingerhof (Late Neolithic), Monte Mezzana, Colombare, Ronchetrin, etc. (Late Neolithic and Chalcolithic) show closer similarities with Bronze Age sites. Exceptions to this result from local situations or history: e.g. Isera (Chalcolithic), Trentino, with more than 35% of wild animals (Jarman, 1970; Riedel & Rizzi, in prep.), certainly a biotope especially adapted to hunting.

Other authors have studied some faunal deposits of the area (e.g. Molino Casarotto, Jarman in: Bagolini *et al.*, 1973; Razza di Campegine, Sala in: Cazzella *et al.*, 1975, and others): some of their results are taken into consideration in this description.

The Grotta d'Ernesto has already been described in the previuos Chapter 4.8. The presence of animals and hunters was not contemporaneous and the deposit is mainly of a naturalistic and ethological interest.

The prehistoric site of Moletta Patone (see also Chapter 2.4) is situated at a height of 100 metres above sea-level in a wide valley near the Sarca River, two kilometres north of Arco, on the left side of the Valle dei Laghi and near a former small lake. The climate of this region north of the Garda lake tends to be mild, and in fact olive trees grow there.

The stratigraphy of the deposit is quite complex, but detailed studies (Bagolini *et al.*, 1984) proved that, besides some Mesolithic traces, the site was occupied from the Early Neolithic (Gaban group), through the Square Mouth Pottery period, and into the Late Neolithic. The rather small sample of fauna analysed, which has been subdivided into three successive age groups – Late

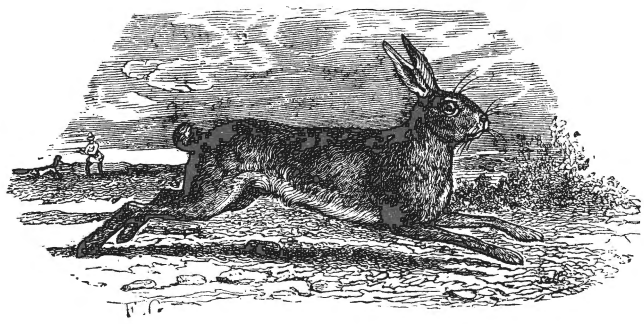

Fig. 13 - Hare (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 13 - Lepre (da: I Mammiferi, *Luigi Figuier, 1892).*

Mesolithic-Early Neolithic; Early Neolithic; Middle-Late Neolithic – shows the same composition throughout the period of occupation of the rockshelter.

Two thirds of the animals are large mammals. About 30% are small wild animals (foxes, hares, cats, etc.) and many of them certainly date to periods when man did not live in the shelter.

The animal economy of the site is based on middle-sized animals, which were mostly domestic; it started very early in the Neolithic, and shows no significant changes through the whole period.

Only the economy of the very beginning of the Neolithic is uncertain, because of the scarcity of securely dated bone remains recovered from the base of the formation, and consequently further research is necessary.

The site of Cornuda (see also Chapter 2.4) dates to the Late Square Mouth Pottery period (ca. 5000 BP).

The remains have been collected on the first hills of the northern part of the Province of Treviso, not far from the Piave River, north of the humid plain which at that time was probably forested and uncultivated.

The composition (NR and MNI) (see also Chapter 2.4) includes one third of domesticated and two thirds of wild animals (20% and 80% of the weight of the bones). According to the remains, red deer are the most numerous species (39%) while cattle represent 17% (about half wild and half domestic) and pigs 31% of the fauna (also half wild and half domestic). The fauna also includes caprines, dogs, brown bears, badgers and beavers.

Although the faunas of Moletta and Cornuda are contemporaneous, Cornuda has less domesticated animals than wild ones: these are mainly red deer and to a lesser extent wild boars and aurochs. This is proof of the wide variation in the composition of the Mesolithic populations of North-eastern Italy.

It is always difficult to prove a local domestication in addition to the importation of animals, and at Cornuda there is no real proof of it (see the end of this chapter).

Nearly only wild animals lived in the two other important sites of North-eastern Italy, while at the same time at Moletta and Cornuda domestic animals played an important role.

The deposit of Molino Casarotto (Jarman, in: Bagolini *et al.*, 1973) – situated amid the Berici hills (Vicenza) on the shore of a former small lake and dating to ca. 5800 BP, at the beginning of the Square Mouth Pottery culture – includes nearly only wild animals. Boars and red deer predominate within a Mesolithic-like economy dominated by hunting and gathering. In Northern Italy at Razza di Campegine (Reggio Emilia; beginning of the Late Neolithic) there are also very few domestic animals (Sala, in: Cazzella *et al.*, 1975).

The fauna of the small site of La Vela (Trentino – Sala, 1977) has more wild animals in the Early Neolithic while more domestic ones in the Square Mouth Pottery culture. An important fauna, mostly composed of domestic animals, is that of Rivoli (Jarman, 1976A), located at the top of a hill in the Adige Valley (Province of Verona). Here the Neolithic economy begins rather early in the middle phase of the Square Mouth Pottery culture.

All these sites as well as others give some information on the development of the regional economy. A particularly good example is provided by the habitat of the Adige Valley and its surrounding areas (Broglio & Lanzinger, 1990; Boscato & Sala, 1980) in the north Italian Plain, where since the Mesolithic marshy soils predominated and these were replaced by forests which were more or less burnt out by hunters, who in the better season occupied temporary locations in the valleys and lower mountains, following the movements of the ibex in particular.

During the Mesolithic the milder climate favoured the occupation by ibex and chamois of the higher plateaux and mountainous areas, where red deer were also present.

The local Neolithic settlements were the result of the development of the already existing Mesolithic sites under the influence of the Neolithic economy which spread out on the plain (Broglio & Lanzinger, 1990).

This local view of the neolithisation makes us consider the problem of acculturation or the introduction of new cultural models, with or without population displacements or the elimination of pre-existent cultures; it is a very broad debate, with several possible theoretical solutions (Gallay, 1990) which mainly the prehistorians, strictly speaking, should solve.

In the area we examined there is no primary – nor probably secondary – local domestication (Riedel, 1990A); instead it originated and evolved in other countries and was then introduced into Northern Italy. It looks as if population with domesticated animals (Rivoli, Moletta, etc.) lived near others with nearly no husbandry (Fimon-Molino Casarotto, Razza di Campegine) and this may have persuaded the hunters to accumulate experience, change their habits and finally adopt the techniques of keeping domesticated animals.

The neolithisation was introduced very slowly from the Balkans as well as from peninsular Italy and western countries. This may have favoured local differentiations in subsistence behaviour.

A variety of local conditions and biotopes on the plain and in the hills and mountains, as well as the existence of special immigration routes (such as in the lake Garda and Adige areas in a north-south direction, or in Friuli from eastern countries in an east-west direction), may have caused a differentiation between the human populations during the neolithisation process.

Fig. 14 - Boars (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 14 - Cinghiali (da: I Mammiferi, *Luigi Figuier, 1892).*

Site analyses shows that between the Mesolithic and the end of the Neolithic, when faunas were usually domestic, their composition varied. The ratio of game was irregular both through time and at different sites of the same epoch.

There is in fact a total lack of uniformity in the faunas of the Neolithic in North-eastern Italy. The size of the animals, at least in the case of cattle, also has an irregular variability. This variety of form was favoured by natural geographical and climatic situations but also had its roots in historical reasons, that is in the cultural developments of the populations.

The process of domestication and the spread of its products may also have been a long one for the best known animals, such as cattle and pigs. An example of different and successive methods of introduction of husbandry is provided by Hungary (Bökönyi, 1974): after the first introduction of relatively small animals in the Early Neolithic, domestic animals spread out and increased in size with the domestication of local wild animals such as boars and aurochs. This is mainly typical of the Middle Neolithic and sometimes of the Late Neolithic, when we observe a gradual and continuous transition from wild to domestic animals and consequently the presence of domestic populations of large-sized animals.

There is no sure indication that in Northern Italy a domestication process took place out of the local wild species, such as for instance boars and aurochs. The problem is also difficult to solve by using bone deposits alone; if both domestic and wild populations are present and important and their minimum and maximum sizes overlap, it is not always evident whether there is a continuous transition from one to the other or rather only occasional crossings.

This problem could be dealt with at the site of Cornuda (Late Neolithic, Square Mouth Pottery culture – Riedel, 1988) where wild animals prevail but domesticated ones are numerous.

The pigs at Cornuda, which are numerous (31%) and roughly equally divided between domestic and wild forms, were analysed to study this problem. Although some remains are not easily identifiable, on the whole there is no large overlap between the two forms.

The scarce remains of aurochs at Cornuda, though sometimes very typical, are not always clearly separated from domestic cattle. Therefore in the area studied local domestication has not been established for pigs and it is improbable on a large scale for cattle.

6.2. *The Late Neolithic and the development of the Bronze Age*

Several settlements of the Late Neolithic and Early and Middle Bronze Ages have been analysed; some of the older periods still have a scarcely advanced economy, with some hunting and gathering (Moletta, Cornuda, etc.); others of the very end of this period, with rare exceptions (Isera, CA), are already akin to the new, nearly exclusive pastoral and agricultural economies of the Chalcolithic and Bronze Age (Monte Covolo – Barker, 1979 – Fingerhof, Colombare, Monte Mezzana, etc.).

A stabilisation of the faunal assemblages and their exploitation gave a homogeneous look to the peasant economies of small villages during the Early and Middle Bronze Age. A central role was played by the Polada lake-dwelling culture with its various aspects; from its centre in the Garda lake region it expanded and influenced nearby areas and was followed by the "Cultura della Terramare" and the Peschiera lake-dwelling cultures. Northern and eastern regions were more intensely influenced from outside.

The deposits examined sometimes include many bone remains (Ledro, Canar, Albanbühel, etc.) which provide information on the faunal composition, animal forms and economic models and which display some local differentiations within the general regional characteristics.

Animal keeping changed during the second half of the Bronze Age. New races were introduced: first of all small cattle breeds were introduced on the plain and in the Alps and then, towards the end of this period, large-sized caprine races. During the Iron Age new developed cattle breeds were introduced which spread to Northern Italy with the Venetian, Etruscan and Roman penetration.

Some of the interesting deposits of the Early and Middle Bronze Ages are Sonnenburg, Albanbühel (Riedel & Rizzi, in preparation), Fingerhof, Ledro, Lasino (Riedel & Tecchiati, in preparation) and Fiavé (Jarman, 1975) in Trentino-South Tyrol; Barche, Canar, Cisano, Nogarole, Mozzecane and Monte Covolo (Barker, 1979) in the Berici hills (Jarman, 1976; Riedel, 1948), in the area between lake Garda, Verona, Vicenza and the Po River; Poviglio and Tabina di Magreta (Modena) (De Grossi Mazzorin, 1987) in western Emilia. Our knowledge of this period is not good in Friuli and in the Trieste karst.

Composition of the faunas

In the Bronze Age the faunas are composed of domestic animals with some wild ones, which

were mainly killed to protect the cultivated fields or for accidental reasons. Red deer, and occasionally boars (Canar, Barche) and rare other animals (brown bear at Ledro) are sometimes numerous, but usually no more than 5%, and may be considered to be the result of an adaptation to local environments rather than a revival of ancient economies.

The composition of the domestic faunas, with their three main groups of cattle, caprines and pigs, varies and depends on both the local environment and the imported practices of the new populations. Local traditions were created very soon, and these had a remarkable tendency to last for a long time. Cattle are nearly always prevalent, if their large size and weight is taken into account. The greater or lesser presence of caprines or pigs is a main characteristic which differentiates many domestic populations. The composition of the populations fluctuates strongly but some main types can be identified (Table 2; Figs. 4, 5b).

In western Emilia at Poviglio, a typical terramare, Modena-Tabina di Magreta (De Grossi Mazzorin, 1987) and Monte Leoni Parma (Scarpa in: Bonardi & Scarpa, 1982), caprines and especially sheep are important; this points to a pastoral economy, perhaps with flock mobility, and perhaps to the importance of wool handicrafts (Fig. 4; composition B1d).

In the central Alpine mountainous region of the Garda lake area and Trentino-South Tyrol, caprines still tend to be numerous – Cisano, Ledro, Lasino (Riedel & Tecchiati, in prep.), Fiavé (Jarman, 1975), Albanbühel (Riedel & Rizzi, 1995) – with exceptions such as Sonnenburg. We presume that in this area the reason for this prevalence could be the better and easier adaptation of caprines to all environmental conditions, even to poor soils near rivers or to slopes at high altitude, when all the possibilities given by the area surrounding the settlements must be utilised (Fig. 4; composition B1a).

In the mountainous area pigs are usually the least important group. A partial explanation of this could be that these domestic animals, as well as their wild form, do not tolerate the rough mountainous climate well, although human intervention could have created a more favourable environment through stabling and better fodder. Moreover, in analogous areas north of the Alps – Northern Tyrol: Kelchalp (Amschler, 1937); Salzburg: Bachsfall (Pucher, 1994) – pigs were in fact numerous at some sites, quite certainly as a consequence of another local cultural tradition.

On the Polesine Plain and towards the Adriatic Sea, caprines decrease and the population instead is characterised by an increasing amount of pigs, such as at Canar. This composition will be found again in Etruscan (Spina) and Mediaeval times (Torcello) in humid, often marshy and lagoonal, and partially forested regions (Fig. 4; composition 5).

North of the Po, on the plain and towards the Alps, the percentage of pigs and caprines is more balanced and cattle are important (Fig. 4; composition 2).

Animal forms

During the whole of the Neolithic, cattle show large size variations which were presumably due to the importation of new populations from other areas and not to the age of the site or to the local environmental characteristics.

The cattle at Colombare (very end of the Neolithic) are large-sized while those at Moletta (ca. the whole Neolithic) and Monte Covolo (NL/L) are middle-sized, if we consider a withers height of circa 112-118 cm as being indicative of middle-sized, circa 100-106 cm as small-sized and circa 125 cm or more as large-sized. Some larger-sized cattle were also found in the small bone samples at Pieve di Colognola and Riccione, as well as at other sites.

At the beginning of the Bronze Age, all the cattle populations show an average middle size and these were then replaced by small forms in the Late Bronze Age.

The cattle of the Early and Middle Bronze Age were slender, as is usual in prehistoric times, and not sturdy like most recent ones. The horn cores were large, long and thin-walled, with slight differences between bulls and oxen. No bull forms as short and strong as the Roman and recent ones have been found. The horn cores were large – Barche, Lasino (Riedel & Tecchiati, in prep.) – or locally smaller – Ledro, Albanbühel (Riedel & Rizzi, 1995).

Many measurable remains are necessary in order to calculate comparable average size values and some deposits of this kind were found in this area. It could also be established that populations of the same age vary slightly as a result of the characteristics of the environment or of imports in periods of slight economic or cultural changes.

In the mountains of the Trentino, cattle are smaller at Ledro – which is situated quite high up in the mountains – but are larger at the nearby site of Lasino. They are middle-sized at Barche, in the hilly morenic lower area south of lake Garda, and at Nogarole, on the plain south of Verona, while they are slightly smaller at Canar, a very humid

biotope on the plain towards the Adriatic coast. In South Tyrol, in the high Eisack Valley, the cattle at Sonnenburg and Albanbühel are once again middle-sized.

Since the end of the Middle Bronze Age, very small forms of cattle are found in all of the areas studied (e.g. Isolone) and these became the normal cattle form in Northern Italy. These new forms also have peculiar morphological characteristics, such as their very small horn cores. They are the result of the introduction of new races as well as of a change in the economy: strong labour animals were in fact gradually replaced by animals useful for all other needs.

Caprines show the standard forms of prehistoric and protohistoric times in Northern Italy. Ewes were hornless or had small, sometimes goat-like horns. Empty, middle-sized horn cores which are supposed to belong to wethers (HATTING, 1975) are rarely found. Rams have horn cores which are curved outside and have an elliptical section.

The Neolithic races are rather small and are known less well than those of the Bronze Age, which are of very uniform small forms (less than 60 cm – Barche, Ledro, Isolone). North of the Alps and in the Pannonian area, caprines are quite large (BÖKÖNYI, 1974), whilst in the transitional area of South Tyrol (Sonnenburg, Albanbühel) they tend to be small or middle-sized.

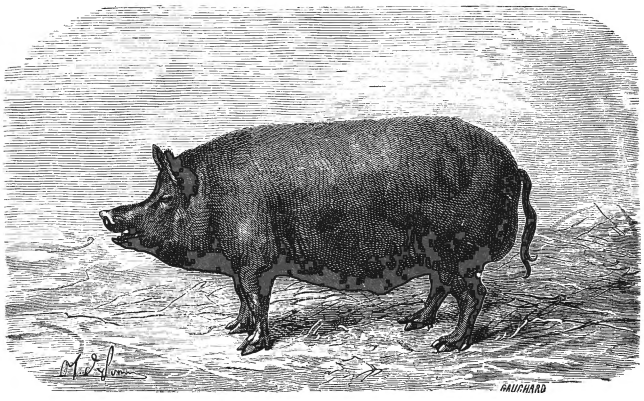

Fig. 15 - Pig (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 15 - Maiale (da: I Mammiferi, *Luigi Figuier, 1892).*

We do not know exactly the quality of their fleece and whether it was more or less mixed with hair. The small sizes are of undeveloped races, different for example from the large Roman wool-bearing sheep which are well known from the descriptions of the Roman authors. Large-sized races were introduced only towards the end of the Bronze Age (e.g. at Sabbionara di Veronella).

Goat horn cores have the same form as those of recent races and their size evolution is similar to that of sheep.

Pigs have slightly primitive, boar-like shapes (e.g. Barche, Ledro) with an elongated skull and a straight profile of the upper part. Their average sizes are usually small (e.g. Barche: 73.3 cm) and vary according to random fluctuations with no obvious explanation.

The evolution of the other animals is less evident. The dogs are all small spitz forms (average withers height: slightly less than 50 cm). Domestic horses are still rare and small (Sonnenburg, Barche, Isolone, Nogarole, the terramare of Poviglio and Gorzano [AZZAROLI, 1972]). They were probably a prestige object of chiefs and ranked people.

Economy

The economic models of this epoch are represented by small villages with husbandry and extended pastoral activities, few wild animals and agricultural output. The composition analyses have already displayed the broad outlines of the economy. The age and sex percentages provide some supplementary information, and this has already been partially given in Chapter 4.6.

In the whole area, the economy preserves an ancient prehistoric aspect. The age distribution of butchery is often typical of primitive husbandry, with early culling of herds. But the presence – besides young and subadult meat animals – of many adults also employable for labour, milk and wool, testifies to a reasonable development.

The culling of animals (for these problems see also Chapter 4.6) when new-born or very young was frequent, certainly because of hard winter conditions and foraging problems. Early selection has been observed in the cattle at Canar on the Venetian Plain and at Albanbühel in South Tyrol; at the latter site, half of the butchered animals are young calves or individuals of no more than a few months of age. The less young and adult animals were kept for meat and labour.

The caprines of these two sites were culled later, certainly because they were employed intensively for the needs of individual families: perhaps milk, wool and their meat yield given in smaller units.

At Albanbühel for instance, among the not too young animals, the female caprines prevailed over the males since their milk was highly requested, while the two sexes were balanced in cattle because the milk was used less and labour was indispensable.

Other sites had different butchery age structures. For instance, at Lasino (Trentino) adult cattle and young sheep were numerous – cattle: 35.3% young individuals (MNI 17); caprines: 67.5% young individuals (MNI 29) – because the economic needs and the cultural traditions of the populations were different. Foraging probably did not represent a problem because of the better climate.

Pigs were kept only for meat and tended to be slaughtered at a young age everywhere.

The culling of very young animals, the butchery of young and subadults for meat, and the variable exploitation of subadults and adults are all evidence of economies well adapted to different environments and human needs.

A large presence of sheep in an extended area is a sign of pastoral activities with some territorial movements of flocks, as well as of local exploitation of poorer soils.

As we know only the percentages and not the absolute figures of the composition, it is obviously difficult in dubious cases to distinguish between the presence of large sheep flocks and eventually of pastoralism, or of keeping only a restricted number of caprines for local family use instead.

The predominance of pigs in south-eastern Veneto and Emilia suggests a low incidence of pastoralism, a stability of animal herds, a disposal by the animals of agricultural waste and a vicinity of forests with tubers and other suitable food.

6.3. *The Late Bronze Age and the Iron Age*

A complex and large group of civilisations developed during the Late Bronze Age with the younger stages of the lake-dwelling, terramare and other northern and eastern cultures (Wallburgen, Castellieri, etc.). From Trentino-South Tyrol down to the Lessini hills, various so-called Rhaetian cultures developed until Roman times. The last developments of the protohistoric populations on the plain began with the Iron Age, through a Veneto-Etruscan and later a generalised Celtic predominance, and ended under the Roman influence, occupation and conquest of the whole north-eastern Italian area.

The analysis of several sites and their bone deposits offers preliminary knowledge about the local animal population and its economic exploitation.

The Rhaetian area is known mainly through the bone deposits of Stufels, Eppan and Pfatten in South Tyrol and the small deposits of Ciaslir del Monte Ozol and Doss Grum in Trentino.

During the Iron Age, on the southern limit of this area in the mountainous part of the Province of Verona, Colognola ai Colli, Castelrotto, San Giorgio in Valpolicella, San Briccio di Lavagno and Santorso (Cassoli & Tagliacozzo, 1991) all show transitional aspects towards the Venetian, Etruscan or other developed civilisation of the end of the millennium.

On the plain a group of faunas of the second half of the Bronze Age (Isolone della Prevaldesca, Sabbionara di Veronella, Cavalzara, Fondo Paviani, Braida Roggia, Peschiera-Setteponti, Feniletto) is partially similar to the contemporaneous Early Rhaetian populations.

The Iron Age deposits of the eastern and southern North Italian Plain are known from the sites of Pozzuolo del Friuli, Terranegra (Verona) and the important Greek-Etruscan town of Spina – Etruscan Bagnolo San Vito (Scarpa, 1986) (Mantova) is also as important as Spina – which are characterised by a marked presence of pigs.

Other small Late Bronze Age and Iron Age deposits were studied in Friuli by other authors (Gradisca sul Cosa, Porpetto, Castions di Strada, Udine-Piazza Venerio – Petrucci, 1992).

Composition

Cattle are important in the faunas of most sites – as was already observed in the Early and Middle Bronze Ages – especially if their bone weight is taken into account. The percentage of caprines and pigs fluctuates strongly (Tabs. 2-3; Fig. 4) while the incidence of other domestic animals and the wild ones is low.

The Late Bronze Age populations of the central plain (e.g. of the Verona area) tend to have a quite balanced composition, although cattle are more important than caprines and caprines are more important than pigs (Tabs. 2-3; Figs. 4-5b; composition 2a).

At the end of the Bronze Age and during the Iron Age in South Tyrol, cattle and caprines are both numerous while there are fewer pigs (Stufels, Pfatten) (Tabs. 2-3; Figs. 4-5b; composition 1a); only at Eppan is the number of caprines lower. On the southern limit of the Rhaetian area, at the Iron Age sites of Colognola, Castelrotto, San Giorgio in Valpolicella and Santorso (Cassoli & Tagliacozzo, 1991), there are usually fewer caprines and slightly more cattle and pigs (Tabs. 2-3; Figs. 4-5b; composition 2a).

In some sites on the plain, which has been examined especially in its south-eastern and eastern areas, such as at Etruscan Spina and Bagnolo San Vito (Scarpa, 1986), Pozzuolo del Friuli and

Terranegra, pigs are very numerous and cattle less so (Tabs. 2-3; Figs. 4-5b; compositions 3a and 5). In other areas the composition is more fluctuating.

The territorial distribution of the faunal composition is not very different from that prevailing in the Early and Middle Bronze Ages. In those periods we also observe a higher incidence of caprines and pastoral activities in the north-western and western areas, of pigs in the south-eastern one and a more balanced composition on the Verona Plain.

Animal forms

During the Late Bronze Age a small-sized cattle race, slightly taller than one metre and with very small horn cores, lived in the whole area from the North Italian Plain to South Tyrol. Its size is analogous to that of populations beyond the Alps (e.g. Manching, Bavaria, Boessneck *et al.*, 1971).

At the beginning of the Iron Age on the plain, but only in the Roman Age in South Tyrol, these small breeds were replaced by larger and different ones.

The Iron Age forms of horn cores at the plain sites are often flat, strong, furrowed, and middle-sized with many morphological variations. Etruscan and Roman cattle horn cores are much larger, slender, elongated or rather twisted in females; long, twisted, light and large in oxen; and short and sturdy in bulls.

A second characteristic of this period is the appearance of the large-sized caprines at the very end of the Bronze Age both in the mountains (Pfatten-Vadena) and on the plain (Sabbionara di Veronella) which then developed during the Iron Age.

The shape of pigs are not well known and their size is subject to local and irregular conditions.

The other domestic animals also develop rapidly. Since the beginning of the Iron Age dogs, previously belonging to a uniform small race (WH $\bar{x}$ 48 cm), started to show a large variation everywhere, including middle-sized and strong animals (Pfatten, Spina). Horses are of various forms and mostly middle-sized or small during the Bronze Age; during the Iron Age they can be very small, the so-called Celtic horses (Škocjan-Slovenia, at the outer limits of our area; withers height $\bar{x}$ 123 cm, Riedel, 1977), middle sized in the Alps or larger on the eastern North Italian Plain (Palaeovenetian forms at Le Brustolade: withers height $\bar{x}$ 135 cm). Small and large animals correspond with the western and eastern forms described by Bökönyi (1974): here there is the boundary of their European extension.

We must also mention the appearance of donkeys (Spina) and of small domesticated fowls (Valeggio, Casalandri, Santa Maria di Zevio, Santorso – Cassoli & Tagliacozzo, 1991).

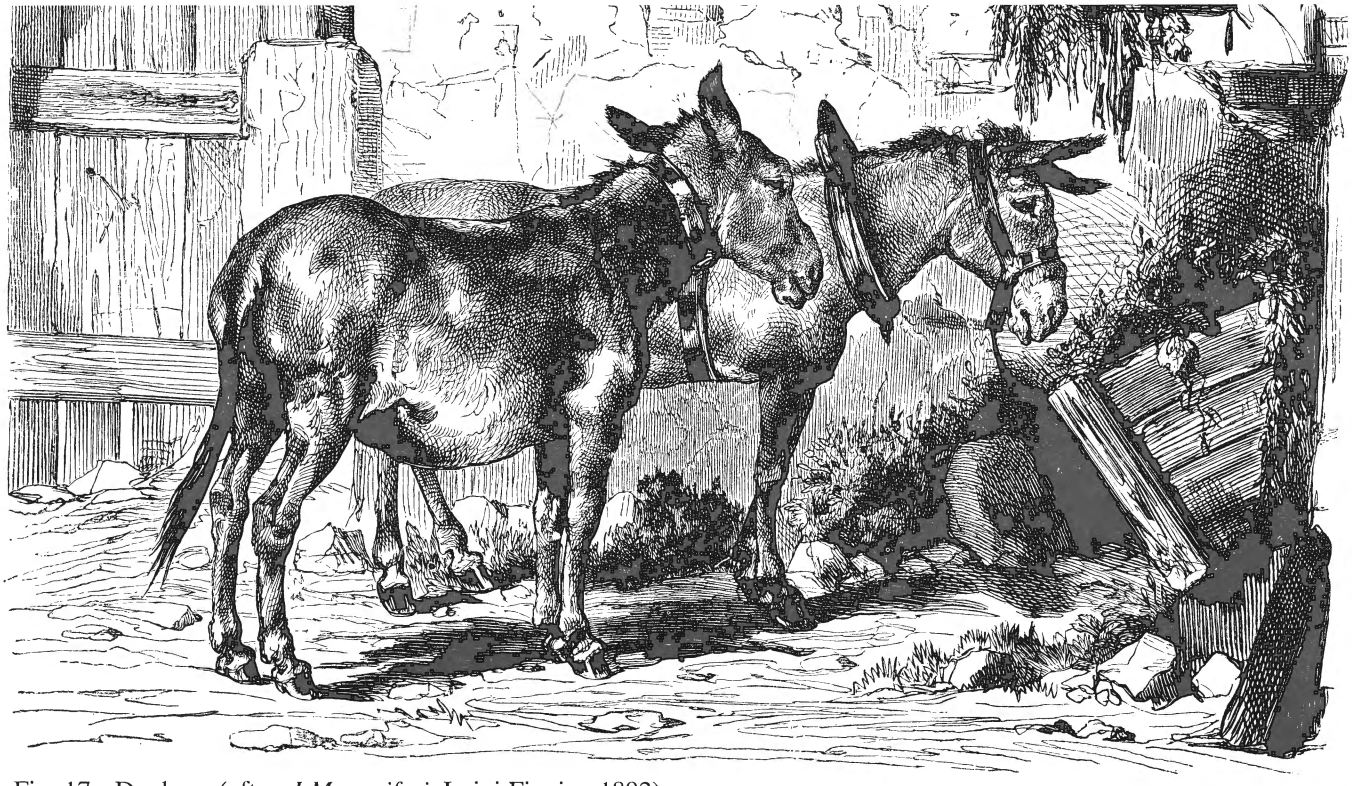

Fig. 17 - Donkeys (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 17 - Asini domestici (da: I Mammiferi, *Luigi Figuier, 1892).*

Economy

The epoch is one of profound changes, especially if compared with the more homogeneous Early and Middle Bronze Ages; the civilisations are variable and show some differences in the economic patterns.

However we must always consider that the patterns of animal exploitation are more constant than other aspects in the different cultures. Economic forms probably encompass many human cultures and have widespread developments. They may show local adaptations which improve their potential for expansion that reaches its acme in Roman times. In addition, especially in the faunal composition of this area, there is also a sort of fundamental traditional opposition to changes.

The first husbandry change is given by the import of a small race of cattle in the whole area. It is difficult to understand why this happened because small cattle do not necessarily mean a decreased importance of this species; such races can be useful for fertilising the fields and, if numerous, as milk and meat producers. At the end of the Bronze Age the appearance in the Alps of large caprines, suitable for wool and meat exploitation, can be seen as a compensation for the small size of cattle.

Since the beginning of the Iron Age several cattle races, characterised by different horn core shapes and size increases, developed irregularly and variably according to the areas where they lived. The small cattle races (Pfatten, Stufels), the larger ones in the Lessini mountains (Colognola, etc.) and Friuli (Pozzuolo) and the Etruscan ones have various sizes and sturdiness and also various horn core shapes: they are different though being more or less contemporaneous and well developed since the middle of the Iron Age.

The Etruscan races are large and similar to the Roman populations which followed them into this region. At the end of the Iron Age, in Roman times, the races were more standardised or at least the conditions of economic interdependency had been settled.

The imported large sheep probably had good wool and were related to wider handicraft activities. Pastoral activities involving the displacement of flocks may have taken place. Pigs were linked to agricultural development. Horses increased their size, dogs diversified their forms and these animals were employed for many uses. Since La Tène times onwards, poultry were a new product which were mainly exploited for family use. New species are known, such as the donkey in Greek-Etruscan Spina. The diversification of the economy was enriched.

The age distribution curves, and especially those of cattle, are skewed towards more adult animals because of an improved exploitation of them before butchery (see Pfatten, Pozzuolo, Spina).

Special deposits for rituals, cemetery places, etc. are frequent (Chapter 4.8).

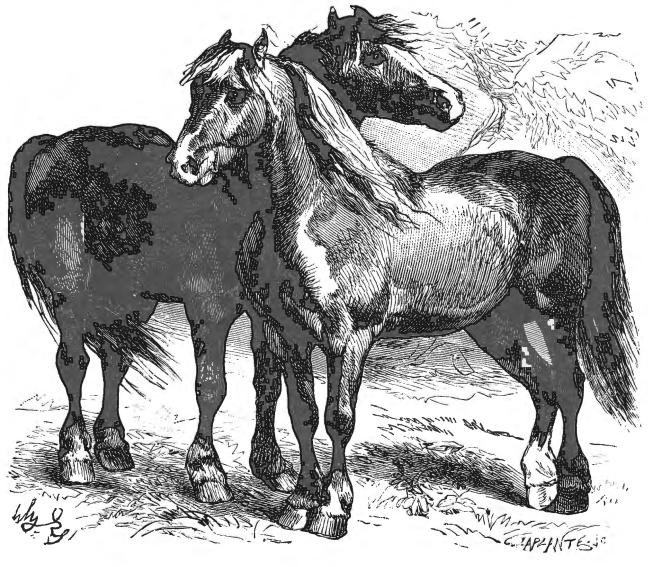

Fig. 16 - Horses (after: I Mammiferi, Luigi Figuier, 1892).
Fig. 16 - Cavalli (da: I Mammiferi, Luigi Figuier, 1892).

6.4. *The Roman Age*

During Roman times, husbandry was so developed that it resulted in an increase in the size of the animals due to some aspects of a unified and very extended empire: a flourishing trade, important military installations, wide and diversified city agglomerations. The organisation was sustained by a capitalistic economy, with an unequal distribution of wealth inside cities and between the cities and the countryside. It required a strict organisation of human labour.

The irregular composition of the domestic animal populations also depended on the extended trade of animals which were not reared only for local self-consumption. Many farms or *villae rusticae* were spread throughout the Roman territory and were part of a capitalistic economy based on slave labour, within which animals were reared mainly for trade exchange. For instance, salted pork could be favourably sold (research in "Venetia et Histria" of Verzár-Bass, 1986) and be more appreciated than beef; sheep tenure could be intensified for wool production, such as at Altino (Veneto – Verzár-Bass, 1987).

The relationship between the development of agriculture and husbandry must be discussed for each site. It is not necessarily a positive connection because agriculture is labour-intensive while husbandry is not so (Audoin-Rouzeau, 1991) and it can also be developed if there is a shortage of manpower and an impoverished agriculture.

Characteristics of the Roman deposits

The bone deposits can provide information on the butchered animals and mainly consist of market remains or kitchen waste. They are not always an exact image of the animals reared in the surrounding countryside, since in military installations or large towns animals could come from far away on the hoof or be otherwise imported according to the tastes of the buyers or the most favourable prices.

Finally the deposits may not be a representative sample of a locality, but only of one section of it, e.g. the rich quarters of a large town, or special sites like shops, specialised markets etc. (for these problems see for example Schibler & Schmid, 1989).

At Aquileia (Riedel, 1994B – see also Chapters 2.3, 4.5, 4.8), besides a sheep market there was one with mainly heavily butchered cattle and some horses, apparently unbutchered or only very slightly so; in the same place other animals were of much lower meat weight. A waste deposit of a local handicraft site of cattle horn cores with a few rams and ibex was found in another quarter of the town.

The Roman archaeozoology of North-eastern Italy is still in its infancy but some bone deposits give the first clues about the animal economy of the area and its problems.

A group of three faunas from similar sites in South Tyrol (Stufels Hotel Dominik and Senoner, Innichen) shows some characteristics of this central Alpine region.

A kitchen waste deposit was found at Altino, a large Roman city near Venice. The study of Aquileia, the fourth largest city in Roman Italy, has started; Udine, at that time a small site on the castle hill (Riedel, in preparation), and Invillino-Ibligo, a large deposit of a military installation in Upper Friuli (Stork & Driesch, 1987), are of mixed Late Roman and Germanic origin and have also been researched.

Some other small deposits have been discovered: the *villae rusticae* in Friuli (Joannis, Coseano, Vidulis), some remains at Elleri (Trieste) and Torcello (Venice) and a special deposit of labour animals at Volano (Trentino) (Riedel & Scarpa, 1988).

Composition

The Roman conquest did not cause a complete standardisation of the domestic faunas in the occupied regions, where each area could be complementary to the others through the developed trade network. The composition patterns in the different areas are broadly similar to those of the Bronze and Iron Ages (Tables 2-3; Figs. 5b, 5c).

Caprines are more frequent in the Central Alps (South Tyrol), while pigs are a little less frequent (composition B1b). On the plain at Altino, opposite Venice, cattle are prevalent and pigs are important while caprines are less significant (composition B3a). In the north-eastern area (composition B4a) (Udine, Invillino-Ibligo), caprines are strongly represented while pigs are also numerous and cattle slightly less so. A similar composition was observed on the other side of the Alpine watershed at Magdalensberg in Carinthia (Hornberger, 1970).

At Aquileia, a typical large Roman city, the faunal composition differs according to the specialised use of the excavated areas.

We do not know the exact differences between the faunas or rural districts and those of cities. Aquileia and South Tyrol provide some information on cities and countryside respectively, although the differences may be due more to geographical location than to economy. Moreover, the economy of small sites may be that of either *villae rusticae* – from where animals and meat were exported according to market conditions – or self-sufficient villages.

In some *villae rusticae*, such as Vidulis and Coseano, the composition is known only through small bone deposits. At Vidulis cattle are well represented together with caprines followed by pigs. At Coseano caprines are numerous, followed by pigs and then by cattle. Many pig remains were found at Joannis (Riedel in: Verzár-Bass, 1987 and *in litteris*).

Animal forms

The size of the animals tends to increase already in the Iron Age (Chapter 6.3). On the plain cattle, dogs and caprines developed under the influence of Venetian, Etruscan and finally Roman civilisations; in the Alps a sudden change from small to large cattle took place only at the beginning of the Roman conquest. The Roman conquest and the changes in animal husbandry are not always contemporaneous. For instance, old cattle Landraces can still be found in Roman times (such as at Traismauer in Lower Austria and Aquileia in Friuli [Riedel, 1994B]), and small domestic fowls of

pre-Roman tradition are found in Celtic cemeteries in the Roman occupied territory around Verona (Casalandri, Valleggio, Santa Maria di Zevio).

The Roman forms of cattle are similar to the Etruscan ones and develop large, long, twisted and light horn cores in oxen which are often elongated and round, as well as twisted horn cores in cows. Some forms of cattle similar to those of the Iron Age (i.e. at Colognola, San Briccio, Pozzuolo) are still found in Roman Aquileia, as well as beyond the Alps. In the Middle Ages some forms approximately similar to pre-Roman ones were again observed (Verona – Riedel, 1994A).

During the Roman Age itself many oscillations and structural changes (Verzár-Bass, 1986) characterised the economy, but we do not know whether variations in cattle forms also took place in the areas we have studied. The Altino animals are strong and developed and rather similar to the Aquileia cattle. Those of the Eisack-Isarco Valley at Stufels and of the Pustertal Valley at Innichen-San Candido are very similar to some well developed faunas beyond the Alps (e.g. Traismauer on the Danube – Riedel, in preparation). At Stufels large individuals are mixed with more middle-sized ones and are perhaps an import of southern Roman races to improve local populations (Riedel, 1986).

The Magdalensberg cattle of Carinthia (Hornsberger, 1970) are smaller than those of Aquileia and Traismauer, perhaps because of the Alpine location and the persistence of the Celtic tradition. We can consider them to be not completely Romanised forms of the first period of the Roman trade influence and conquest. They look smaller than the South Tyrol populations, which are probably similar to the usual Roman forms.

The end of the Roman period implied many changes. On the plain (Verona) and in Friuli (Invillino-Ibligo), a decrease in the size of cattle took place slowly and irregularly, and also continued after the Lombard Age; in the central Alps this change was more abrupt (San Valier in Val di Fiemme, Stufels-Stremitzer, Bozen-Waltherplaz in South Tyrol) because northern races were imported and the Germans colonised the country. Lombard Verona was instead conquered only by a small class of warriors while land farming remained in the hands of the Romanised population.

Among the other important animals sheep were also very large-sized, especially on the plain (Altino, Aquileia). Ram horn cores were strong and twisted, flat and rough surfaced frontally. In Mediaeval times the size was usually smaller but the horn cores still preserved a Roman aspect, at least on the plain.

The development of pigs is always difficult to recognise: their size is irregular and the typical changes in the profile of the skull, from straight to notched, are not easy to judge when only fragments are left. Roman pigs are not of a particularly large size although Mediaeval ones show such a tendency.

Horses change from those of the Iron Age. At Aquileia they are slightly larger (WH 140 cm) than the Palaeovenetian ones, which were considered to have a high withers height for their epoch (135 cm); the small western so-called Celtic horses (123 cm) disappear. These dimensions are preserved also in later periods because this species has always been intensively used and exploited not only for labour but also for hunting, war, etc. during the migration period and Mediaeval times.

Dogs are less known: very small-sized (at Aquileia perhaps of 30-35 cm WH) and middle-sized animals (some a little less and some a little more than 50 cm high) have been found. Roman dogs – such as those at Traismauer (Austria – Riedel, in preparation) or in Hungary (Bökönyi, 1974) – are normally of various races, sometimes very small, often strong and large-sized and also of the slender greyhound form. Small dogs, suited as companion animals, are considered to be typical of urban areas; middle-sized and strong ones are suitable for guarding and hunting, and also for peasant populations (Reichstein, 1991); greyhound forms are specialised for hunting. There are few wild animal remains.

Economy

In Roman times the age distribution curves are often skewed towards adults. Animals were exploited for secondary uses – such as wool and milk production, agricultural work and transport – besides meat production.

Deposits connected with special purposes are those containing remains of working animals (Volano) or handicraft activities (cattle horn cores at Aquileia) (see Chapter 4.6).

Animal exploitation in the Roman period shows many characteristics of a complex economy. The faunal deposits may be different, but they all belong to an economic network of mutually dependent sites. To understand the differences due to various economic functions, traditions or trade is an important aim of the study of bone deposits.

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Fig. 18 - Pigs (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 18 - Maiali (da: I Mammiferi*, Luigi Figuier, 1892).*

6.5. *The Middle Ages*

A group of deposits gives a first insight into animal exploitation in Mediaeval times.

Some interesting sites are Brixen (MA/E) and Bozen-Bolzano (MA/L) in South Tyrol, and San Valier (MA/E) and Castel di Drena (MA/L) in Trentino.

The main deposits known are those in the centre of Verona, of the 6th-7th, 10th-11th and 13th centuries respectively. South of Verona, at Povegliano, the skeletons of two dogs and one horse date to the Lombard Age, while another horse skeleton of the same age was buried at Bovolone. Further south, at the boundary of the Province of Rovigo, Torretta is a small 14th-16th century military site.

The deposit at Torcello on the coast, in the Venice lagoon (5th-15th centuries), and that of San Pietro in Venice itself provide some information on animal exploitation in the littoral area.

A small deposit of mixed Late Roman and Early Migrations period was studied in the eastern area, in the Castle at Udine (Friuli). A large Late Roman and Lombard deposit north of Udine, in the Alpine region of Carnia, Invillino-Ibligo studied by Stork & Driesch (1987), is similar to that of Udine.

Composition

The faunal composition of the deposits is broadly similar, though with several variations, to the one established before or during the Roman Age (Tables 2-3; Figs. 4, 5c).

Along the Adriatic coast, in the Venice lagoon (Torcello, San Pietro), pigs are prevalent and cattle or caprines are less important, as in the Etruscan South-eastern Po Plain (Spina, Bagnolo-San Vito – Scarpa, 1986) or since the Bronze Age in the Polesine (Canar) (composition B5a). In Friuli and Carnia pigs have some importance but less than caprines, which are abundant (composition B4a).

In western Veneto (Verona), the composition of the fauna confirms the tendency previously observed in the central northern part of the Po Plain: caprines and pigs are all important and cattle even more so (composition B4a similar to B2a). Since the Bronze Age the Alpine regions of Trentino-South Tyrol have few pigs and sometimes more caprines (composition B1c and B2b).

Animal forms

The forms of the animals are difficult to recognise because of the scarce osteological documentation.

Horn cores are a good characteristic of cattle forms. Those of the western plain (Verona) show some regressive tendency from the large and long Roman horn cores to smaller, rougher, shorter and heavier ones which are more similar to the Landraces which lived in the Iron Age. Oxen horn cores of Roman forms (large, long, oval-round section, thin walls, more or less smooth) are nevertheless found in Verona. At least until the Lombard Age at Invillino-Ibligo (Friuli), horn cores were long and large like the Roman ones at Magdalensberg (Carinthia – Stork & Driesch 1987). In the Alps (South Tyrol and Trentino) both horn cores and body size are small.

On the plain rams maintained the Roman form of horn cores, i.e. long, heavy, with a triangular section, rough with a sharp medial edge and a flat fore surface. Animals with the oval, less strong shaped horn cores of prehistoric times still lived in South Tyrol (Stufels-Stremitzer).

The shape of the skull of domestic pigs is not well known because only fragments are usually left in the deposits. It was perhaps more similar to the elongated old forms than to the shorter recent ones.

Faunal evolution

At the end of the Roman Empire, the living standards decreased and trade difficulties caused the collapse of the global and more or less interconnected economy of the Roman Imperial Age.

The size of animals of great economic importance, such as cattle, usually decreased rapidly in the Alps and less so on the plain.

In an important deposit of Lombard age, in the centre of Verona, cattle were smaller than the typical large Roman races on the plain but were still strong and similar to some smaller-sized Roman populations (e.g. Magdalensberg, Carinthia – Hornberger, 1970). Later on, towards the 11th century, the size decreased in Verona and then increased again in the 13th century.

In the Mediaeval faunas of South Tyrol (Stufels-Stremitzer, Bozen-Waltherplatz) and Trentino (San Valier) cattle were small.

We do not know much about the variations of caprines during the Middle Ages. Sheep were mostly middle-sized, that is with an average withers height of 60 cm, smaller than the typical forms of Roman times and similar to those of the Iron Age (Pfatten, Colognola, Pozzuolo).

Pigs show some variations in their average size. Articulations are wide at San Pietro near the Adriatic coast, and thinner at other sites. The general trend is towards larger sizes.

But on the whole, size changes during the Mediaeval period are still largely unknown. They are usually small and in fact detectable only when bone deposits are important. It has not yet been verified, for instance, whether the slight decrease in cattle size in Verona towards the 11th-12th centuries followed by an increase, as well as the variations in the size of pigs, are widespread phenomena.

The reasons for the changes in size in Mediaeval times may be quite different: the relations between husbandry and the more or less competing agriculture, the existence of markets with selected imports, the environmental conditions, the political situation – such as the permanence or not of Romanised populations, or the difficulties around the end of the millennium – the developments of communications and trade, and so on.

Animal size probably increased towards the end of Mediaeval times, but good osteological studies are still lacking.

The more recent and very small deposits at Castel di Drena in Trentino (12th-14th centuries) have small to middle-sized cattle (1.1 m WH?) while those at Torretta on the Po Plain (14th-16th centuries) look larger (1.2 m WH ?). These changes may be due to differences in the geographical situation rather than in the period.

While the major domestic animals – cattle, caprines and pigs – display some decrease in size and importance, the less numerous horses, dogs, domestic fowls, donkeys, cats, etc. steadily become more diffuse and diversified because they are well suited to other needs of the society – such as war, hunting, rapid communication, luxury, refined eating – or, in the case of smaller animals such as fowls also to marginal situations.

Donkeys were used in Verona and some remains at Torcello and Stufels could belong to mules.

Horses of a different size, usually of 135-140 cm WH, are well developed in the area. Sometimes they are very strong and large (Castel di Drena, Stufels) and suitable for heavy labour.

Dogs are not well known although tall and slender animals similar to greyhounds were found at Povegliano (7th century) while others are of a medium size and various strengths.

Small cats are frequent at Verona.

Domestic birds, mainly fowls, of a large size like the Roman Age forms, have been found in large amounts at Verona.

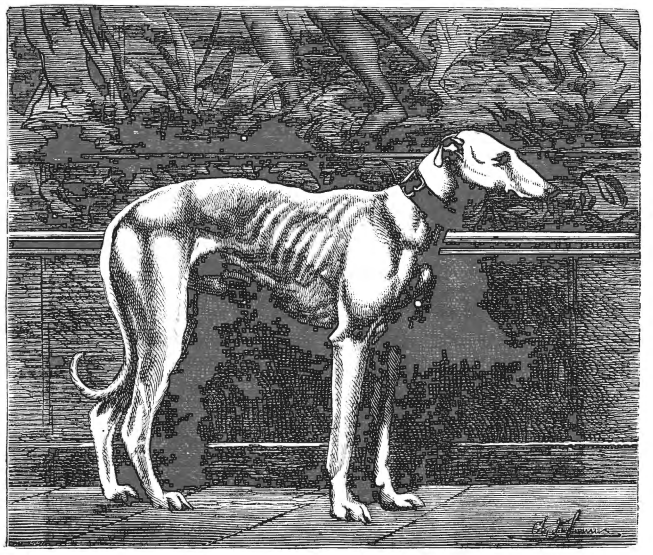

Fig. 19 - Dog (after: *I Mammiferi*, Luigi Figuier, 1892).
Fig. 19 - Cane (da: I Mammiferi*, Luigi Figuier, 1892).*

Economy

The economy was less organised and was subdivided into more isolated areas than in Roman times. It shows some regressive tendencies: for instance, Mediaeval Verona is restricted to only the centre of the once extensive city.

But the economic centres may be of variable importance: castles (Castel di Drena), monasteries (Torcello), larger towns (Verona), small sites (Stremitzer), trade centres (San Pietro in Venice), each with its specific needs.

The butchery ages have the familiar pattern of self-sufficient sites, although a tendency towards more sophistication is visible.

At Verona the butchery of adults is high (68% of cattle, 67% of caprines), probably because of imports of meat on the hoof from the countryside in order to butcher animals already exploited for wool, milk and other needs.

This phenomenon is more accentuated in Venice, and is perhaps related with trading activities, and at Torcello, related with church establishments (adults at Torcello: cattle 80%, caprines 80%; at San Pietro: cattle 80%), where in the unusual environment of the islands of the lagoon the population was composed of traders and fishers, and there were monasteries and churches probably living partially on imports.

The butchery methods are a cultural aspect of the economy, as we have mentioned in Chap. 4.5.

At Verona the sagittal halving of the carcass along the centre of the spine in a dorso-ventral direction was the rule. At San Pietro in Venice the spine of pigs was instead sectioned transversally, dorso-ventrally and oral-aborally but without a halving in a lengthwise direction.

At Castel di Drena the same method used in Verona was employed for caprines and pigs (cattle are not well represented) but at other sites butchery techniques usually follow the one attested at San Pietro.

Moreover, in Verona the body was dismembered with heavy strokes, as at Roman Aquileia, and was not cut as carefully as in older times. It may be supposed that at Verona butchery was done by experienced craftsmen while at other sites the procedure was more traditional or less professional.

Conclusions

The Mediaeval economic structure was not so well developed as in Roman times but still kept a modern character. The improvements which probably took place towards the end of the Middle Ages have not yet been studied, as with most of the various problems of this epoch in North-eastern Italy, and await further research.

RIASSUNTO - Il lavoro è una sintesi delle ricerche dell'Autore sull'evoluzione delle popolazioni e dell'economia animale nell'Italia nord-orientale dal Neolitico al Medioevo. Le ricerche sono distribuite nell'insieme dell'area, ma i siti archeologici presi in considerazione sono concentrati maggiormente nella sezione che dallo spartiacque alpino fra il Nord- ed il Sud-Tirolo si estende attraverso il Trentino, il Veronese ed il Polesine fino al mare Adriatico. L'evoluzione delle popolazioni animali e del loro apporto all'economia ed alla vita delle comunità umane è più lenta di quella degli aspetti culturali e storici, riflette però accuratamente i movimenti di fondo delle trasformazioni dell'economia, della tecnica e delle tradizioni. Un primo punto centrale dello sviluppo è la neolitizzazione, cioè la trasformazione da un'economia di caccia ad una di allevamento, che può aver luogo con grande immediatezza oppure con una lenta evoluzione fino al Neolitico superiore, epoca nella quale essa è di solito terminata. Anche le forme animali, per es. i buoi, sono di statura e corporatura molto differenti secondo le aree. L'età del Bronzo presenta un'economia di allevamento ed agricola con caratteri più uniformi – se si eccettua la composizione percentuale dei principali gruppi domestici – ed un'introduzione di nuove popolazioni, come per esempio di piccoli buoi, che tende ad avere luogo su di una vasta scala regionale. Nell'età del Ferro inizia una diversificazione delle forme (parecchie forme di cani, buoi, cavalli, caprovini, ecc.) e delle loro dimensioni con distinzione

fra regioni alpine (piccoli buoi, grandi caprovini) e la pianura (grandi buoi e caprovini di media statura) che raggiunge nella successiva età Romana uno sviluppo importante e generale. Nel Medioevo si ha un regresso delle forme, specialmente degli animali di importanza economica, come i buoi ed i caprovini, nelle Alpi e molto meno nella pianura. Gli animali con altra destinazione d'uso, come i cani ed i cavalli, proseguono la loro diversificazione. Il confine fra le faune alpine e quelle della pianura si sposta quindi ed anche si oblitera a seconda degli eventi storici, migratori e di colonizzazione. La composizione delle faune è invece maggiormente stabile ed ancorata a caratteristiche regionali. L'abbondanza di suini nelle aree presso l'Adriatico, di ovini nell'Emilia, di buoi e poi di ovini, con diminuzione di maiali più a nord verso le Alpi, è spesso ricorrente, anche se è essa pure legata a evoluzioni e situazioni locali come nel Neolitico od in altre epoche. L'analisi delle età di macellazione, dei metodi di macellazione e di disarticolazione, delle percentuali di presenza degli individui dei due sessi e di castrati, ecc. ha permesso di ipotizzare differenti modi di sfruttamento di prodotti primari e secondari, la preferenza per certi animali, l'impiego di alcuni per il trasporto ed il lavoro. Altre analisi hanno messo in evidenza le caratteristiche speciali dell'impiego di certi animali nelle cerimonie tradizionali ed in particolare funerarie.

SUMMARY - This paper is a synthesis of the Author's studies on animal populations and economy in North-eastern Italy from Neolithic to Middle Ages. The research covers the whole area, but the archaeological sites investigated are mainly concentrated in the regions extending from the Alpine watershed between North and South-Tyrol, across Trentino, Veronese and Polesine to the Adriatic Sea. The evolution of both animal populations and their role in the economy and life of human societies is slower than the evolution of cultural and historical aspects, but it reflects accurately the basic changes in economy, technology and traditions. The first important stage is the Neolithisation, that is the economical transformation from hunting to stock-breeding, which can take place rather abruptly or, viceversa, rather slowly, till the Late Neolithic, when it is usually complete. The animal forms too, such as cattle, usually vary considerably in height and body structure in the different areas. During the Bronze Age stock breeding and agriculture show more uniform aspects, apart from the percentage composition of the main domestic groups. New population, such as small cattle, are now introduced, usually on a large scale. In the Iron Age animal forms (many forms of dog, cattle, horse, sheep and goats, etc.) and their dimensions begin to present different characteristics in the Alpine regions (small cattle, big sheeps and goats), in comparison with the plain (big cattle, big sheep and goats). In the following Roman period the change is important and generalized. In the Middle Ages there is a regression of forms, mainly in the animals which are economically important, such as cattle, sheep and goats in the Alps; the phenomenon is much less important in the plain. The animals which are used mainly for other purposes, as dogs and horses, continue their differentiation. Consequently the boundary between the Alpine population and those of the plain moves and even disappears due to historical events of migration or colonization. On the contrary, the faunal composition is more stable and strongly linked to regional characteristics. The abundance of pigs in the areas near the Adriatic, of sheep in Emilia, of cattle, and sheep, together with a reduction of pigs to the north towards the Alps, is often recurrent, though depending also on evolutions and local situations, as in Neolithic or in other periods. The analysis of the slaughtering age, butchering and dismemberment methods, percentage variations in male, female and castrated animals and so on has allowed to make hypotheses on different exploitation systems of primary and secondary products, men's preferences for certain animals and their use for transport or working activities. Other hypotheses have pointed out the special use of certain animals in traditional and mainly funeral cerimonies.

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Lavoro pervenuto nel marzo 1995.

Several other small deposits were studied by the Author. Many are from sites near Trieste (Friuli Venezia Giulia) which are not always well dated. The most important are the Mesolithic Grotta Benussi (Riedel, 1976C) and the Castelliere degli Elleri, which probably dates to the Late Bronze Age (Riedel, 1976D).

Near Trieste there is also the "Knochenhöhle" (Grotta delle Ossa, Jama J na Prevali) at Škocjan in Slovenia, which is dated to the 12th-4th centuries BC (Riedel, 1977).

Some small Mediaeval deposits (Wolkenstein-Selva, Stufels, Sonnenburg, Burganlage "am Kofel" in the Ahrntal) were examined in South Tyrol (Riedel, 1985C).

G. Clark has studied many Bronze Age sites (Clark, 1986).

Deposits studied by other Authors are quoted in the text when needed. Some of them are the followings:

Bachsfall – Salzburg – BA-E-M – Pucher, 1994
Birgitz – Tyrol – IA-L – Guem, 1956
Bludenz – Voralberg – BA-L – Amschler, 1939
Castions di Strada – Friuli – BA-L; IA – Petrucci, 1990A
Fiavé – Trentino – BA-E-M – Jarman, 1975
Gradisca sul Cosa – Friuli – IA – Petrucci, 1990
Grotta Azzurra – Venezia Giulia – ML until IA – Cannarella & Cremonesi, 1967
Invillino-Ibligo – Friuli (Carnia) – RA-L; MA-E – Stork & Driesch, 1987
Kelchalpe – Tyrol – BA-L – Amschler, 1937
La Vela – Trentino – NL – Sala, 1977
Monte Covolo – Lombardia (Brescia) – NL-L; BA-E – Barker, 1979
Monte Leoni – Emilia (Parma) – BA – Bonardi & Scarpa, 1982
Piovego – Veneto (Padova) – Palaeoveneto – Azzaroli, 1980
Porpetto – Friuli – BA – Petrucci, 1990A
Razza di Campegine – Emilia (Reggio Emilia) – NL-M – Sala in: Cazzella *et al.*, 1975
Riparo Gaban – Trentino – ML – Clark, 1990
Rivoli – Veneto (Verona) – NL – Jarman, 1976A
Santorso – Veneto – 5th-2nd centuries BC – Cassoli & Tagliacozzo, 1991
Tabina di Magreta – Emilia (Modena) – BA-M – De Grossi Mazzorin, 1987
Udine, piazza Venerio – Friuli – BA-IA – Petrucci, 1990A

Table 1 - List of the bone deposits.
Tabella 1 - Lista dei depositi ossei.

NO.	LOCALITY	DISTRICT	AGE	BIBLIOGRAPHY
1	Acquaviva	Trentino	MS,NL,CA	Riedel, 1982A
2	Albanbühel	South Tyrol	BA/M	Riedel & Rizzi, 1995
3	Altino	Veneto	RA	Riedel, 1985
4	Aquileia	Friuli	RA, 1-50 y. AD	Riedel, 1979C
5	Aquileia	Friuli	RA	Riedel in: Verzár-Bass, 1991; Riedel, 1994B
6	Barche di Solferino	Lombardy	BA/E	Riedel, 1976A
7	Bovolone	Veneto	Middle ages	Riedel, in preparation
8	Bozen, Waltherplatz	South Tyrol	12th-13th centuries AD	Riedel, 1991
9	Braida Roggia	Friuli	BA/L	Riedel, 1981
10	Canar	Polesine	BA/E	Riedel, in preparation
11	Casalandri	Veneto	Celtic Ist century BC	Riedel, 1987C
12	Castello di Drena	Trentino	13th-15th centuries AD	Riedel, manuscript
13	Castelrotto	Veneto	5th-4th centuries BC	Riedel, 1985A
14	Cavalzara	Veneto	BA/L	Riedel, 1979
15	Ciaslir Monte Ozol	Trentino	BA/L, IA	Riedel, manuscript
16	Cisano	Veneto	BA/E/M	Riedel, 1990
17	Colognola ai Colli	Veneto	4th-2nd centuries BC	Riedel, 1984B
18	Colombare, Negrar	Veneto	NL/L, CA	Riedel, 1976B
19	Cornuda	Veneto	NL/L (ca. 5000 y. BP)	Riedel, 1988
20	Coseano	Friuli	RA	Riedel in: Ventura, 1987
21	Doss Grum	Trentino	BA/L, IA	Riedel, manuscript
22	Eppan	South Tyrol	BA/L	Riedel, 1985B
23	Feniletto	Veneto	BA/L	Riedel, 1982B
24	Fimon	Veneto	NL/BA	Riedel, 1948
25	Fingerhof	South Tyrol	NI/L, BA/E	Riedel, 1986A
26	Fondo Paviani	Veneto	BA/L	Riedel, 1979
27	Grotta d'Ernesto	Trentino	MS/E	Riedel, 1994
28	Innichen, S. Candido	South Tyrol	RA	Riedel, 1983
29	Isera	Trentino	CA	Jarman, 1970; Riedel & Rizzi, in prep.
30	Isolone Prevaldesca	Lombardy	BA/M/L	Riedel, 1975
31	Joannis di Ajello	Friuli	RA	Riedel, pers. obs.
32	Lasino	Trentino	BA/E	Tecchiati, 1991
33	Le Brustolade	Veneto	Pal-Venet 450-350 y.BC	Riedel, 1984A
34	Ledro	Trentino	BA/E/M	Riedel, 1976
35	Ledro B	Trentino	7th-8th century AD	Riedel in: Dal Rì & Piva, 1986
36	Moletta di Arco	Trentino	MS/L until CA	Riedel, 1984E
37	M. Crocetta Cerro V.	Veneto	BA/L	Riedel, in preparation
38	Monte Mezzana	Trentino	CA	Riedel, 1979A
39	Mozzecane, Quarto T.	Veneto	BA/M	Riedel, 1987
40	Nogara Olmo	Veneto	BA/L	Riedel, in preparation
41	Nogarole Rocca	Veneto	BA/M	Riedel, in preparation
42	Oppeano	Veneto	Pal-Venet. 9-6th cent.BC	Riedel, 1987A
43	Pieve, Cologna ai C.	Veneto	NL/M	Riedel, 1992A
44	Pfatten, Vadena	South Tyrol	BA/L, IA/E/M	Riedel, in preparation
45	Povegliano	Veneto	7th century AD	Riedel, in preparation
46	Poviglio	Emilia	BA/M/L	Riedel, 1989
47	Pozzuolo del Friuli	Friuli	IA/E/M	Riedel, 1984
48	Ronchetrin	Veneto	NL/L	Riedel, 1989B
49	Sabbionara, Veronel.	Veneto	BA/L	Riedel, in preparation
50	Sabbionara, Veronel.	Veneto	BA/L (end)	Riedel, in preparation
51	S. Briccio, Lavagno	Veneto	IA/E/M	Riedel, 1950
52	S. Giorgio, Valpolic.	Veneto	4th century BC	Riedel, 1992B
53	S. Giorgio, Valpolic.	Veneto	9th century BC	Riedel in: Salzani & Riedel, 1990
54	S. Monica, Riccione	Romagna	NL/L	Riedel, manuscript

NO. LOCALITY	DISTRICT	AGE	BIBLIOGRAPHY
55 S. Maria di Zevio	Veneto	2nd-1st century BC	RIEDEL, 1992C
56 San Valier	Trentino	6th-11th centuries AD	RIEDEL, 1987B
57 Setteponti, Peschiera	Veneto	BA/M/L	RIEDEL, 1982
58 Sonnenburg	South Tyrol	CA, BA	RIEDEL, 1984C
59 Spilamb. S. Cesario	Emilia	NL/M to CA	RIEDEL, 1981A
60 Spina	Emilia	Greek Etruscan 5-4th BC	RIEDEL, 1978
61 Stufels, H. Dominik	South Tyrol	IA	RIEDEL, 1986B
62 Stufels, H. Stremitzer	South Tyrol	4th-2nd centuries BC	RIEDEL, 1986B
63 Stufels, H. Dominik	South Tyrol	RA	RIEDEL, 1984D
64 Stufels, Senoner	South Tyrol	RA	RIEDEL, 1984D
65 Stufels, H. Stremitzer	South Tyrol	10th century AD	RIEDEL, 1979D
66 Terranegra	Veneto	7th-4th centuries BC	RIEDEL, 1979
67 Torcello	Veneto	RA/L, MA; main deposit Tb 5th-12th cent. AD	RIEDEL, 1979
68 Torretta	Veneto	14th-16th centuries AD	RIEDEL, 1986C
69 Udine, castello	Friuli	IA/L	Riedel, in preparation
70 Udine, castello	Friuli	RA, MA/E	Riedel, in preparation
71 Valeggio	Veneto	Celtic – 1st century BC	RIEDEL, 1987C
72 Val Liona	Veneto	NL/BA	RIEDEL, 1948
73 Venezia, S. Pietro	Veneto	6th-8th centuries AD	Riedel, in preparation
74 Verona	Veneto	6th-14th centuries AD	RIEDEL, 1994A
75 Vidulis	Friuli	RA	Riedel, manuscript
76 Volano	Trentino	RA	RIEDEL & SCARPA, 1988

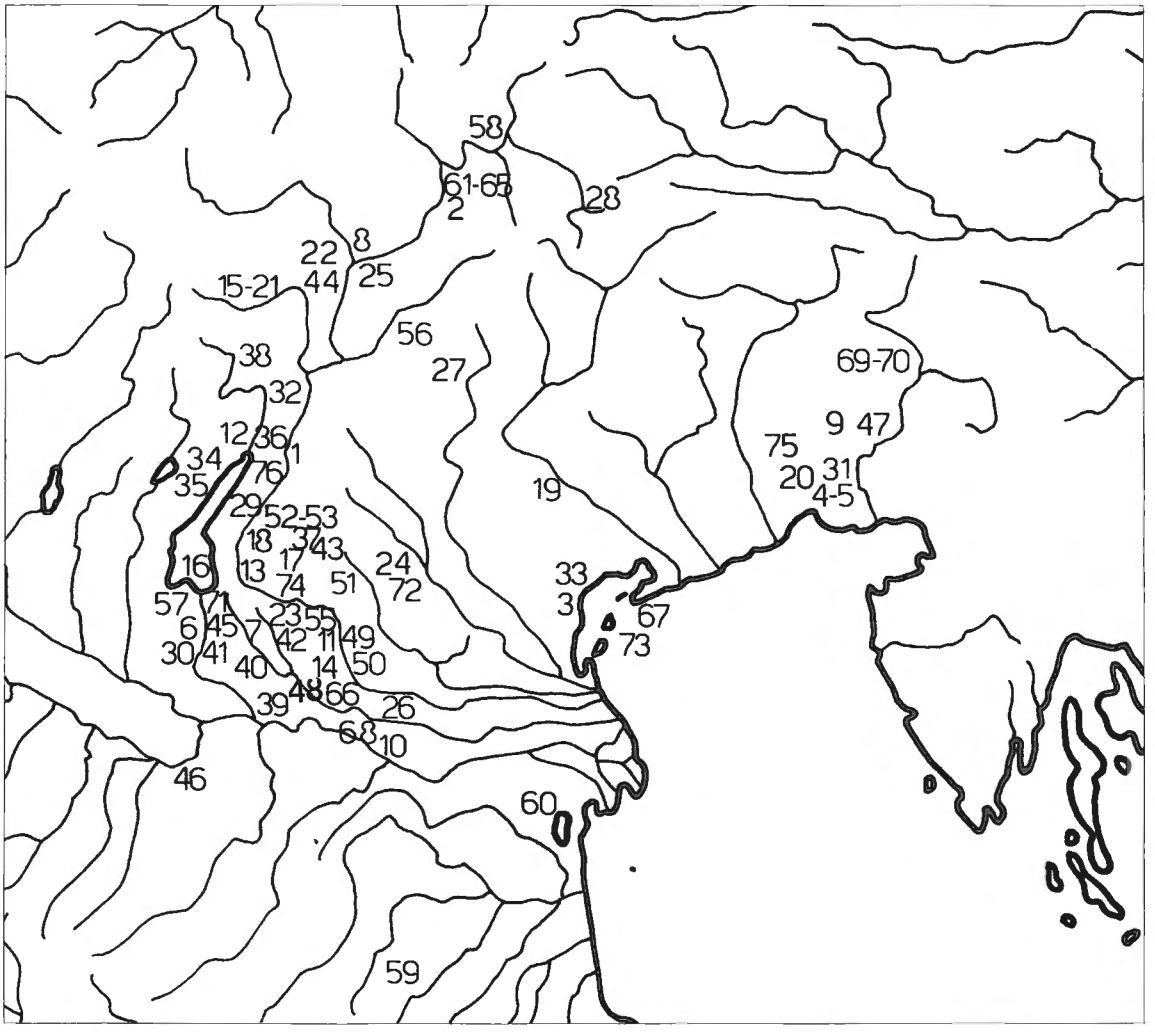

Fig. 20 - Map of the bone deposits.
Fig. 20 - Mappa dei complessi faunistici.

Table 2 - Composition of the main faunas (Fig. 4, Tab. 3).
Tabella 2 - Composizione delle faune principali (Fig. 4, Tab. 3).

		Age	Number of remains % Cattle	Caprines	Pig	NR
	A2					
1	Colombare	NL, CA	42.2	28.2	29.6	841
	B 1a					
2	Albanbühel	BA/M	40.4	53.2	6.4	10260
3	Stufels H. Dominik	IA	39.5	48.6	11.8	2076
4	Pfatten-Vadena BA-L	IA/E/M	40.6	40.7	18.7	3522
5	Ledro	BA/E/M	24.1	67.6	8.3	7464
6	Lasino	BA/E	33.2	52.1	14.7	1963
7	Cisano	BA/E/M	34.2	50.5	15.3	582
	B 1b					
8	Innichen-San Candido	RA	16.1	74.5	9.4	721
9	Stufels Senoner	RA	24.7	49.7	25.6	1506
10	Stufels H. Dominik	RA	29.0	45.3	25.7	1128
	B 1c					
11	Bozen Waltherplatz	MA	39.7	45.4	13.9	453
12	San Valier	MA	41.1	46.2	9.4	1462
	B 1d					
13	Poviglio	BA/M/L	19.4	54.0	26.7	2208
14	Tabina di Magreta	BA/M	16.0	48.0	36.0	520
	B 2a					
15	Eppan-Appiano	BA/L	54.4	22.5	23.3	1318
16	Castelrotto	IA/M	47.3	30.9	21.8	2395
17	Colognola	IA/M	38.2	26.6	35.3	1829
18	Barche	BA/M	39.0	30.0	31.0	2470
19	Nogarole	BA/M	37.6	41.8	20.6	998
20	Isolone	BA/M/L	43.9	36.1	20.0	2925
	B 2b					
21	Sonnenburg	BA/E/M	56.9	30.8	9.3	542
22	Stufels-Stremitzer	MA	48.9	35.7	15.4	915
	B 3a					
23	Pozzuolo	IA/E/M	40.9	21.9	37.2	1972
24	Altino	RA	36.6	19.5	44.0	722
	B 4a					
25	Castello di Drena	MA	24.1	39.6	36.3	661
26	Verona	MA	31.7	35.3	32.9	12903
27	Invillino-Ibligo	RA, MA	24.8	44.1	31.1	21642
28	Castello di Udine	RA, MA	27.1	38.9	34.0	1056
	B 5a					
29	Canar	BA/E	25.5	29.1	45.4	20235
30	Spina	EA	23.5	17.6	58.8	10000
31	San Pietro (Venezia)	MA	18.6	11.8	69.7	1190
32	Torcello	MA	31.2	20.9	47.9	1880

	Minimum number of individuals				Weight (Kg)			
	% Cattle	Caprines	Pig	MNI	% Cattle	Caprines	Pig	W
	A 2							
1	28.9	37.8	33.3	45	-	-	-	-
	B 1a							
2	26.6	65.7	7.7	207	70.9	23.8	5.3	146
3	33.9	45.9	20.2	109	71.6	21.6	6.8	30
4	39.6	39.6	20.8	96	68.7	18.4	12.9	50
5	11.9	78.3	9.3	691	51.9	40.4	7.7	240
6	-	-	-	-	69.1	19.5	11.4	23
7	31.9	55.3	12.8	47	71.6	19.8	8.6	10
	B 1b							
8	25.0	45.8	29.2	24	59.3	35.0	5.7	5
9	29.5	38.6	31.8	44	48.7	32.7	18.6	15
10	22.2	48.1	29.6	54	68.7	18.4	12.8	15
	B 1c							
11	19.0	47.6	33.3	21	65.5	19.7	14.8	4
12	24.4	48.8	14.6	72	68.4	25.8	5.8	18
	B 1d							
13	-	-	-	-	-	-	-	-
14	20.0	50.0	30.0	30	-	-	-	-
	B 2a							
15	28.3	39.6	32.1	53	75.4	8.3	16.3	34
16	27.7	41.6	30.7	101	75.6	12.7	11.7	44
17	20.8	40.3	39.0	77	68.5	11.7	19.7	38
18	18.1	42.1	39.8	221	-	-	-	-
19	19.6	51.0	29.4	46	53.6	16.3	13.0	23
20	29.1	45.8	25.2	437	-	-	-	-
	B 2b							
21	42.0	39.7	17.6	68	83.2	8.8	8.0	14
22	40.3	45.5	14.3	77	74.4	14.0	10.6	16
	B 3a							
23	30.2	23.3	46.6	116	60.6	10.1	29.0	48
24	21.1	36.8	42.1	28	70.6	8.6	20.8	19
	B 4a							
25	26.9	34.6	38.5	26	53.0	19.1	27.9	7
26	16.4	42.9	40.7	359	56.1	19.1	24.9	210
27	10.6	50.1	39.2	349	-	-	-	-
28	20.4	44.9	34.7	49	56.6	21.2	22.2	22
	B 5a							
29	15.4	39.4	45.2	487	51.4	13.9	34.7	357
30	-	-	-	-	-	-	-	-
31	19.2	30.8	50.0	26	41.2	8.7	50.1	20
32	18.2	31.8	50.0	88	52.5	12.6	34.9	38

Table 3 - Faunal composition groups (NR).
Tabella 3 - Gruppi di composizione della fauna (NR).

A. Neolithic - Copper Age

1 Faunas with many wild animals; Moletta, Isera, Cornuda, Fimon–Molino Casarotto

2 Faunas with few wild animals NL-CA; cattle > caprines, pigs; Colombare, Monte Covolo, Fingerhof, Monte Mezzana

B. Bronze Age until the Middle Ages

1 Faunas with many caprines

1a BA-IA; caprines ≥ cattle > pig (few); Albanbühel, Ledro, Pfatten, Cisano, Lasino, Stufels H. Dominik

1b RA; caprines > cattle ≥ pig; Innichen, Stufels Senoner, Stufels H. Dominik

1c MA; caprines > cattle (many) > pig (few); San Valier, Waltherplatz

1d BA; caprines > pig > cattle (few); Poviglio, Tabina di Magreta

2 Faunas with much cattle but also with a tendency to a balanced composition

2a BA-IA-MA; cattle > caprines ≥ pig; Isolone, Barche, Colognola, Castelrotto, Nogarole, Eppan

2b BA-MA; cattle > caprines > pig (few); Sonnenburg, Stufels H. Stremitzer

3 Faunas with many cattle and pig

3a IA-RA; cattle = pig > caprines; Pozzuolo, Altino

4 Faunas with an approximately balanced composition

4a MA; caprines ≥ cattle, pig; Castello di Drena, Castello di Udine, Verona, Invillino-Ibligo

5 Faunas with many pigs

5a BA-EA-MA; pig > cattle > caprines; Torcello, San Pietro, Spina, Canar