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## THE WILD ANIMALS OF NORTHEASTERN ITALY FROM NEOLITHIC TO MEDIEVAL TIMES: AN ARCHAEOZOOLOGICAL COMMENT\*\*

**SUMMARY** - Archaeological bone deposits result from human activity and are not necessarily the mirror of the whole fauna of the region. Therefore the percentage ratio of the remains of an animal species in the deposits may be different from that of the animal in the local population. Finally, when species are represented by very few remains, these can be of an animal of other areas which were imported living or as parts of the total carcass or as isolated bones.

Wild animals were very important only in the subsistence systems of Mesolithic or of Early Neolithic type. But in many Neolithic faunas — and always at the end of this period — and in the Bronze and Iron Ages, domestic animals predominate and game was of very restricted importance. Wild animals are usually barely present in the faunal samples from Roman to Medieval times. When these still predominated at earlier times, they were indispensable both for their meat and for antlers, bones, hides, etc. for crafts, but they were later replaced, in most cases, for all these products by the domestic animals. Therefore, later on, when wild animals were no more an important economic factor and little hunting was essential for meat, it was nevertheless necessary to protect fields, crops, granaries and livestock from predators and pests. Hunting was also necessary for hides and fur production and for smaller uses and finally it continued as a prestige activity during the Middle Ages.

Animals such as the aurochs and the wild pig were perhaps domesticated in northern Italy or crossed with already domestic animals, but no deposit has yet provided the opportunity to demonstrate such a process incontrovertably.

The wild animal fauna is very uniform after the Neolithic. Some differences are due to climate, morphological factors and vegetation. Red deer is always predominant, followed by wild pig which were important in the plain, and less so or absent, in mountainous areas. The brown bear remains were at first widely distributed, although the species retreated later to the forested mountains. Beaver and otter are linked to humid environments. Ibex and chamois are only in high mountainous locations. Most of the other wild animals described here are ubiquitous in the study area.

Remains of wild animals (red and roe deer, wild pig and brown bear excepted) are still not known in sufficient amount to analyze successfully in detail their population, but nevertheless they already give us valuable insights into the faunas.

The sizes of the animals are very near those of the north alpine areas. They are well known for some species (red deer, wild pig, roe deer etc.); for others, additional material and size measurements are needed.

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\* Trieste (Italy).

\*\* Age abbreviations in the text and in the table: MS, Mesolithic; NL, Neolithic; CA, Copper Age; BA, Bronze Age; IA, Iron Age; EA, Etruscan Age; RA, Roman Age; MA, Middle Age; E/M/L, Early/Middle/Late.

If a site is so quoted in the text without references, this can be found in the list of sites with references of the location map of sites.

The wild animal presence and their frequency are given for every site in the table of this paper. A location map of sites and their list and ages is also given.

The Author is particularly grateful to Professor B. Sala of Ferrara University for providing much of the information given in the text. Special thanks are due to Professor G. Barker of Leicester University (UK) for revising the original manuscript into intelligible English.

**RIASSUNTO** - *Aspetti dell'archeozoologia degli animali selvatici dell'Italia nordorientale fra il Neolitico ed il Medioevo.* I resti faunistici raccolti negli scavi archeologici appartengono quasi esclusivamente ad animali relativi ad attività umana e quindi non rispecchiano esattamente la fauna di una regione. Ne consegue quindi che la percentuale dei resti di una specie animale riscontrata in un deposito archeologico può non essere identica alla presenza della specie nella fauna locale. Inoltre se delle specie sono presenti con pochi resti, questi possono appartenere ad individui trasportati ancora in vita da altre aree, oppure importati nel sito solo come parti di carcassa o di pezzi isolati.

Gli animali selvatici sono molto importanti solo in sistemi economici come il Mesolitico o il primo Neolitico: ma anche in molte faune neolitiche (sempre se della fine di questo periodo) e nell'età del Bronzo e del Ferro, gli animali domestici predominano mentre quelli selvatici rivestono un'importanza ridotta. Durante l'età Romana e Medioevale gli animali selvatici sono appena presenti.

Quando questi ultimi erano ancora predominanti, erano indispensabili per la produzione di carne, mentre palchi, ossa, pelli ecc., venivano impiegati nell'artigianato. In un periodo seguente le funzioni svolte dagli animali selvatici vennero quasi tutte sostituite da quelle svolte dai domestici.

Quando gli animali selvatici non furono più di notevole rilevanza economica e la caccia non era più fondamentale per l'approvvigionamento in carne, la loro uccisione avveniva allo scopo di proteggere i raccolti, i depositi di viveri e gli animali domestici, possibili prede di carnivori e di altri animali nocivi. La caccia veniva inoltre praticata per il rifornimento di pelli e per altri fattori meno importanti; oltre che come attività di prestigio durante il Medioevo.

Animali come l'uro ed il cinghiale vennero forse addomesticati in Italia settentrionale, oppure incrociati con animali già domestici, per quanto nessun deposito archeologico ci abbia permesso finora di seguire in dettaglio questo processo.

La fauna selvatica è sempre molto uniforme dopo il Neolitico. Alcune differenze sono dovute al clima, a fattori morfologici ed alla vegetazione. I cervi predominano quasi sempre, seguiti dai cinghiali che sono più diffusi in pianura e meno (talvolta assenti) in montagna. Gli orsi bruni avevano una notevole distribuzione, ma si ritirarono poi in zone montane. Castoro e lontra sono legati ad ambienti umidi. Gli altri animali sono in genere più o meno ubiquitari.

Anche se i resti di animali selvatici (esclusi il cervo, il capriolo, il cinghiale e l'orso) non sono sufficientemente numerosi per un'analisi dettagliata delle popolazioni, essi ne permettono comunque una buona conoscenza.

Le dimensioni degli animali sono molto vicine a quelle riscontrate per l'area alpina settentrionale. Mentre sono ben conosciute per alcune specie, quali cervo, cinghiale, capriolo, ecc., per alcune altre sarebbe necessario l'esame di ulteriori materiali.

## PREFACE

The faunal samples from the Neolithic to the Middle Ages in northeastern Italy invariably include bones of medium-and large sized game from a few to considerable numbers. The results of their osteological study must be carefully and critically assessed if we want to obtain information on the importance and functions of these animals in their natural environment, in the local economy and in the life of the local human populations. The analysis of several sites in northeastern Italy has enabled us to outline the development of faunas from Neolithic to Medieval times (RIEDEL, 1986a). This paper will concentrate on interpreting the faunal deposits of these sites and on assessing the importance of the wild animals in the samples, taking into account also some more recently studied settlements.

The Neolithic is a transitional epoch when hunting ceased slowly to be an essential human activity. Many of its bone deposits display nearly only wild animals, other have a sizeable quantity of domestic ones, in others the domestic animals are totally predominant (up to 90%/95% of the remains). While at the end of the Neolithic the third situation was normal (and remained so in the later epochs), the development of stock keeping during the Neolithic itself was gradual and irregular. In some areas domestic stock predominate from Early Neolithic times (for example in the northern Garda region, at Moletta Patone: RIEDEL, 1984d). In others (eg Molino Casarotto: BAGOLINI *et al.*, 1973, and Cornuda: RIEDEL, 1988), the wild animals still predominate in the Late Neolithic. Explanations of this fact must be searched

for in the domestication process, which was a system imported from outside, which easily developed along migration routes or open environments or in good pasture areas and then slowly penetrated into more isolated sites outside the main populated areas.

When Mesolithic forms of exploitation still prevailed, wild animals were an important part of the local economy, usually through hunting for meat. Later they become, in a very slow transition, a negligible product, killed less and less for meat and more for the protection of the settlements and of the agricultural fields, cultivated within a still largely natural environment (UERPMANN, 1977). In later epochs hunting was often an activity of privileged groups for prestige and other analogous non-economic reasons, or was an occasional elimination of pests such as the fox, or was a residual economic interest for furs or other commodities.

We must first consider carefully the relationship between the bone deposits and the faunal population living at a given time. The remains do not give the exact composition and other characteristics of the local fauna because they belong almost entirely to animals killed by man and consist only of those bones which were not thereafter lost in processes of destruction and so remained accessible to study.

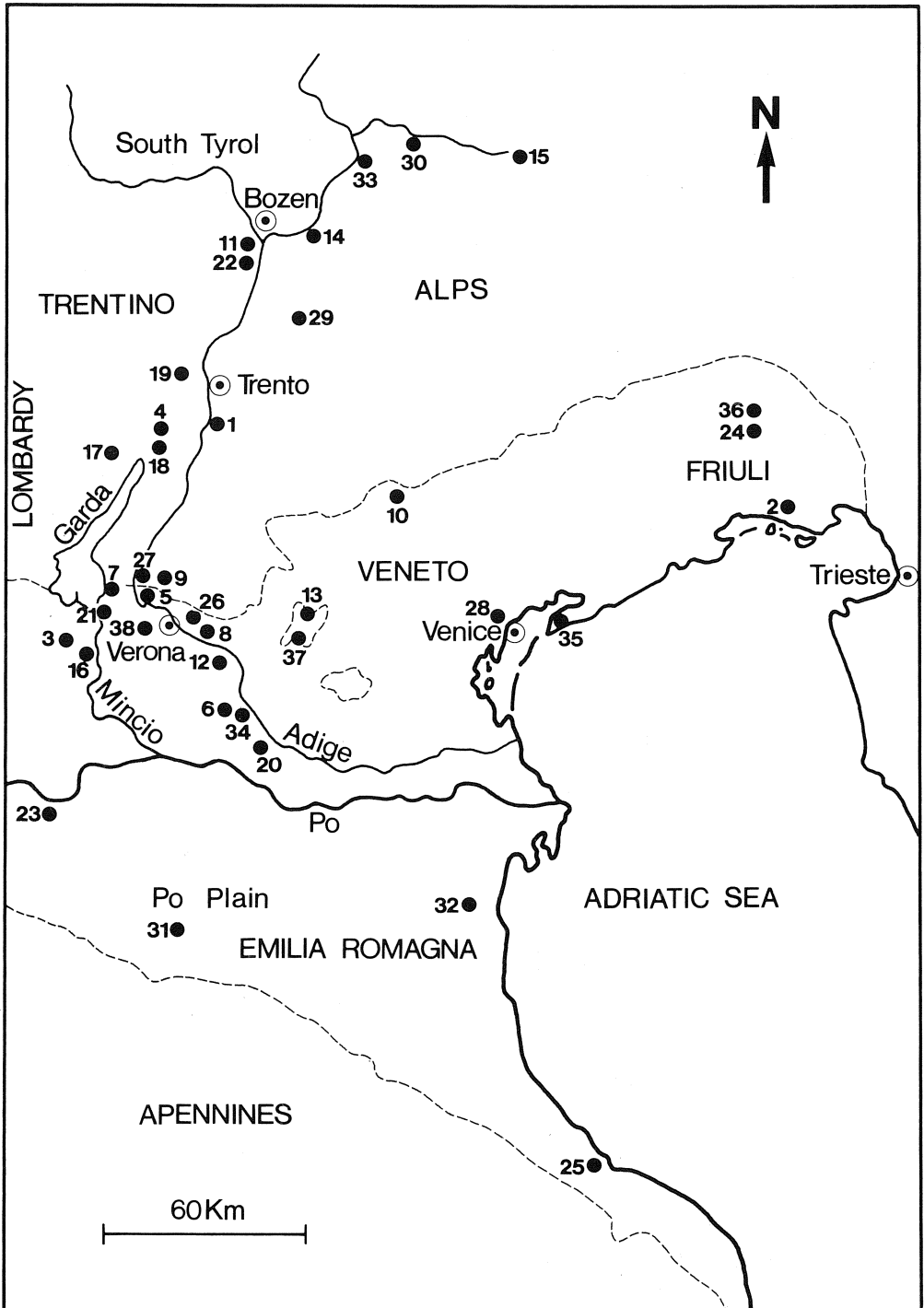
In an ancient hunting economy the largest part of the deposit is of animals of an important nutritional value, usually large-sized, and frequent in that fauna. When husbandry characterizes the economy, the small wild animal bones can be instead the result of more selective killing of predatory animals or of hunting for prestige or for other reasons. But while the differences between the two types of hunting are probably not important, so far as they can be seen from the bone deposits, it is always true that they are both the result of a selection among the local animals done by man.

If remains of a wild form are in a large number, this animal certainly lived in the immediate vicinity of the site, but if the bones are not so numerous they could have been brought from far away places. Thus a few bones of brown bear or beaver do not certify that these animals were a component of the local fauna. When dealing with few bones one should also consider the skeletal parts recovered. Third phalanges, for example, may have been kept in furs (IREGREN, 1988), a jaw and a skull can be a trophy, the presence of only some bones of the skeleton can be due to slaughtering away from the main site. So, for example, the ibex horncores of Aquileia (RA) were imported from outside (RIEDEL, 1979c), and the frequent red deer antlers are usually deciduous and not from living animals.

The bone deposits of wild animals are therefore only partially similar to the local fauna and are not necessarily an indication of the local biotopes and in any case not directly related only to the immediate vicinity of the site.

Another important point considering bone deposits of all origin is their evolution beginning with the differential conservation of their elements. The bones which are excavated and then studied are only a part of the skeleton of the animals killed. After slaughtering, dismembering and fracturing, and also burning for food, taking off some antlers, horncores and bones for handicraft purposes, the remains lay on the soil, are fractured by the trampling of man and animals, are gnawed, broken or taken away by dogs, rodents and other animals, are attacked by the humid acid in the soils and so on.

Bones of captured or sacrificed animals are subject to special treatment, such as the dismembering and use of only some parts of the body. Concerning domestic animals, we noticed this in funeral offerings of Celtic tradition in Casalrandri and Valeggio (Verona) (RIEDEL, 1987b) of some parts of pig and other animals. In other cases the skeleton can be sometimes kept together with a process of only partial



destruction. We can cite the complete removal of all ribs from a skeleton of a young bull of Pfatten-Vadena (BA(L)) (RIEDEL, in prep.); or the beheading of a horse in a grave of Povegliano near Verona (Lombardic Age) (RIEDEL, in prep.); or the complete conservation of Palaeovenetic horses in Le Brustolade near Altino (RIEDEL, 1984a). If we consider now the final phase of the excavation and of the osteological studies, we observe that not all the bones are collected, especially if sieving methods are not applied and bones and splinters are very small, these last, moreover, being often difficult or impossible to identify. As wild animals are usually few and in nearly all deposits less represented than domestic fauna, all these destructive processes result in a statistical sample which is smaller and less homogeneous than a domestic sample. But although it is less suitable for detailed interpretation it usually gives, if its origin is taken into account, important information.

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Fig. 1 - Sites distribution map (for ages see note 2).

1. Acquaviva; NL(E)-CA; CA; RIEDEL, 1982c.
2. Aquileia; RA (1st c. A.D.); RIEDEL, 1979d.
3. Barche; BA(E); RIEDEL, 1976e.
4. Castel di Drena; MA(L); RIEDEL, in prep.
5. Castelrotto; IA(M); RIEDEL, 1985a.
6. Cavalzara; BA(L); RIEDEL, 1979a.
7. Cisano; BA(E); RIEDEL, in prep.
8. Colognola; IA(L); RIEDEL, 1984c.
9. Colombare; NL(L)-CA; RIEDEL, 1976f.
10. Cornuda; NL(L); RIEDEL, 1988.
11. Eppan-Appiano; BA(L); RIEDEL, 1985b.
12. Feniletto; BA(L); RIEDEL, 1982b.
13. Fimon; NL-BA; RIEDEL, 1948.
14. Fingerhof; NL(L); BA(E); RIEDEL, 1986b.
15. Innichen-San Candido; RA; RIEDEL, 1983a.
16. Isolone; BA(L); RIEDEL, 1975.
17. Ledro; BA(E-M); RIEDEL, 1976a.
18. Moletta Patone; MS(L)-NL(E); NL(E); NL(M-L); RIEDEL, 1984e.
19. Monte Mezzana; NL(L); RIEDEL, 1979e.
20. Paviani; BA(L); RIEDEL, 1979a.
21. Peschiera; BA(L); RIEDEL, 1982a.
22. Pfatten-Vadena; BA(L); IA(E); IA(M); RIEDEL, in prep.
23. Poviglio; BA(L); RIEDEL, in prep.
24. Pozzuolo; IA(E-M); RIEDEL, 1983b.
25. Riccione (Santa Monica Autodromo); NL(L); RIEDEL, in prep.
26. San Briccio; IA(E-M); RIEDEL, 1950.
27. San Giorgio in Valpolicella; IA(L); RIEDEL, in prep.
28. San Pietro-Venezia; MA (6th-9th c.); RIEDEL, in prep.
29. San Valier; MA(E-M); RIEDEL, 1987a.
30. Sonnenburg; CA; BA; MA(L); RIEDEL, 1984d.
31. Spilamberto San Cesario; NL(L); CA; RIEDEL, 1981.
32. Spina; EA; RIEDEL, 1978.
- 33a. Stufels Dominik; IA; RA; RIEDEL 1986c, 1984b.
- 33b. Stufels Senoner; RA; RIEDEL, 1984b.
- 33c. Stufels Stremitzer; IA(M); MA(M); RIEDEL, 1979b.
34. Terranegra; IA(E-M); RIEDEL, 1979a.
35. Torcello; RA; MA(E-M); RIEDEL, 1979c.
36. Udine; BA(L)-IA(E); RA(L)-MA(E); RIEDEL, in prep.
37. Val Liona; NL-BA; RIEDEL, 1948.
38. Verona; MA; I 6th-7th c.; II 10th-11th c.; III 13th c.; IV 13th-14th c.; RIEDEL, in prep.

## Description of the animals

Wild animals of interest for man can be subdivided into four different groups:  
— Large animals such as red deer and wild pig hunted in important number for meat and to protect agricultural fields.

— More rarely hunted animals like roe deer and hare.

— Pest such as wild cat, linx, marten, fox and wolf which nevertheless may have had some practical value for hides and furs.

— Animals which may be considered useful and important and whose remains may thereafter be imported if not locally living. Examples include beaver, otter, brown bear, ibex and chamois, whose hides, furs, bones, skulls, horncores and other products are suitable for prestige, medicinal and other purposes. They may be sacrificed, kept in captivity and so on.

### Red deer

The red deer (CASTELLI, 1939; RAESFELD, 1964; MÜLLER, 1982; NIETHAMMER and KRAPP, 1986) usually lives in woods but also near more open environments. It rises in summer up to the location of ibexes which live only above the forest limit. Red deer, and much after it the boar, is the more often hunted animal. It can be found in all bone deposits which are more than a few fragments. The red deer was a much favoured game animal which could live in all northern Italy, the mountains included, and was large-sized and therefore an appreciated prey.

In some older Neolithic faunas, as at Cornuda, when wild animals prevail, the red deer is the important animal of the site (*ca* 40%); otherwise and especially later, when domestic animals take the place of the wild, it is rare (Moletta (NL) *ca* 8%, Barche (BA) *ca* 8%, Spina (EA) *ca* 5% of the total population). Usually in Roman times and in the Middle Ages it was barely existant. After the Neolithic, it was of no economic importance.

Red deers live now in South Tyrol (especially in Vinschgau-Val Venosta) from the lower valley in the winter up to the forest limit, but disappeared in Trentino during the last century. They live also in reserves throughout Italy, such as near Ferrara (Mesola). These have been considered survivors of the more important populations of the lower Po Plain (CASTELLI, 1939), but their origin is probably not autochthonous. In earlier times, when the red deer was numerous, it was hunted as an appreciable contribution to the meat supply. At least from the end of the Neolithic onward it was hunted mostly to protect agricultural fields. Later it was reserved for prestige; in the Middle Ages and later, the tendency was to maintain deer for the upper classes. Shed deciduous antlers were always much used in handicrafts.

The role of the red deer is anyway always firmly established as the most important among the wild animals of the area.

Age and sex determinations are of interest, if the remains are numerous, that is only in some sites. The red deer individuals of the bone deposits are more usually adults or nearly so. Only in the dubiously dated site of Cladrecis, which includes Mesolithic and later prehistoric implements, were found numerous young specimens (RIEDEL, 1983b).

Certain determinations of sex from pelvis and skulls are rare. Stout animals, clearly males, so identified with other bones, are not frequent.

## Roe deer

The roe deer prefers woods and lower altitudes than the red deer but is adapted now to plains and to the fringes of cultivated land. It has therefore an archaeological distribution similar to the red deer and has been found often, but in lesser quantity (MÜLLER, 1982). Its complete absence in some deposits is due to its scarcity and its less probable appearance in small samples of wild animals. Only at Barche (BA) was there a higher minimum number of individual red deer than usual.

The roe deer is a species somewhat similar and subordinate to the red deer. It follows the expansion of farming and cultivated land and is adapted to most environments in all epochs. Roe deer hunting was more difficult than that of red deer because of its more solitary behaviour. Whereas red deer was nearly eliminated in recent times, the roe deer always had possibilities of expansion and became a privileged game animal. Today it is common, for example, in South Tyrol and in the Trieste Karst.

## Ibex and Chamois

Ibex lives only above the forest limit. The chamois is adapted to rock landscapes at a slightly lower biotope than the ibex, but above the forest limit during the summer (BARTOLOMEI and SALA 1972; NIEVERGELT, 1965; COUTURIER 1938, 1964; SALA, 1983). These animals are always higher than territory used by red deer (BOSCATO and SALA, 1980).

Remains of ibex and chamois are very rare, normally consisting of isolated bones or fragments of uncertain determinations. For the most part, these animals have no economic importance. They live still in high mountains of South Tyrol (A.N.N.L., 1987).

The ease of hunting ibex and chamois (and also red deer) depends very much on their age and sex. Young adult males live usually in more exposed positions than females and their youngsters, and are less careful and attentive to their safety than older animals; they are therefore easier to kill and more prone to accidents.

We can cite here, although they are of an earlier period, the ibex skeletons of the Early Mesolithic of the Grotta d'Ernesto in Valsugana near Trento (RIEDEL, in prep.), which are mostly young adult males. They were therefore perhaps easier to kill, or were victims of accidents after penetrating into the cave, as do sometimes also present-day animals. But the presence in the same cave of red deer of both sexes argues against increased male mobility.

The chamois of the lake-village (*palafitta*) of Ledro (BA), according to their cores, are all males.

## Aurochs

During the Holocene, the aurochs preferred to live in more or less wooded areas like northeastern Italy when topography is not steep.

Few remains are well dated and reliably identified; those that are belonged to the Late Neolithic. Wild cattle were present at Cornuda (Treviso) and also, on the evidence of a very small sample, in Riccione, Santa Monica. Some bones at Colombaro (Verona) (CA), near aurochs in terms of size, are in fact of very large domestic cattle, while similar or larger remains at Barche (Lombardy) (BA), Cladrecis (Eastern

Friuli) (MS/BA) and in Grotta Cotariova (Trieste Karst) (BA?) are of no sure date and identification. The aurochs bones come from sites in or near the north Italian plain, where the aurochs has already been identified, as for example, at Razza di Campegine (NL) (CAZZELLA *et al.*, 1975).

The aurochs could have been locally domesticated as it was in other European countries, as suggested for Hungary (BÖKÖNYI, 1984). Crossings are quite probable, as seen from several, not easily determinable remains. But up to now no site has yielded evidence, in the faunal remains, for two large (domestic and wild) populations, with transitions which could be interpreted as the result of domestication (cf. BÖKÖNYI, 1984; PUCHER, 1987).

### Wild pig

The boar lives normally in woodlands or bushes, rarely in mountainous areas (MÜLLER, 1982).

Bones of wild pig have been found in many sites. Whilst usually not very abundant, nevertheless pig is the more important animal of the wild fauna after red deer.

In the older faunas, such as Cornuda (beginning of the Late Neolithic) or Molino Casarotto (slightly older) (BAGOLINI *et al.*, 1973) where wild animals prevail, boars are very numerous (15% at, for example, Cornuda); otherwise they are in small quantities. Hunting of wild pigs was essential for the protection of agricultural fields against ravaging animals.

In recent times, in Europe, boar, like red deer, became a game animal for the sport of privileged people whose pleasure was above the peasants' interest as was the case at the end of the 18th Century in Saxony (HOHENSTEIN, 1931).

Wild pigs have been found from the Neolithic up to the Middle Ages and in most types of environments in the Alps (Ledro and Eppan) (BA), on the plain (Bache and Isolone) (BA) and on the coast (Spina) (EA) and in all of northeastern Italy from Pozzuolo in Friuli (IA) to Bache (BA) in Lombardy.

In the mountains of the Alps their remains are very few, but they are sometimes numerous on the plain (Bache (BA), Spina (EA)). The optimum landscape for these animals is in fact fairly low and humid, and other areas are more marginal and a refuge.

The boar can always be domesticated. Crossings between wild and domestic forms are biologically easy to obtain (LAURANS, 1975) and were in fact produced: in France, for example, they were rarer in Celtic times than in the Middle Ages (MENIEL, 1987). They were nevertheless not specially favoured even in recent times, as in 18th Century France (POPLIN, 1976).

Both pig and boar frequent wooded areas and eat from their products. The domestic form is otherwise typical of an agricultural way of life, thriving on agricultural and other waste, besides on forest pasture.

The local domestication of the boar has been suggested took place elsewhere in Europe (BÖKÖNYI, 1984); northeastern Italy could also have been a place for such domestication.

While in older populations such as at Razza di Campegine in Emilia (NL) (CAZZELLA *et al.*, 1975), the large wild pig is nearly the only pig form present, in some sites like Cornuda (NL) there are two equivalent wild and domestic populations, with animals of two different kinds of size and stoutness. In other areas as at Colombare (CA), Bache (BA) and elsewhere, small domestic pigs prevail and the large boars are few.



As explained in another paper in preparation — taking into account in particular the site of Cornuda — a real mingling of the two forms at the size limit of the domestic and wild forms, which could indicate a process of domestication, is not yet demonstrated in northern Italy, although it could have been a quite possible event. Some crossings between the two forms are surely present.

The boar and the domestic pig differ in Roman and Medieval times not only in terms of their size and stoutness, but also in terms of their morphology, seen especially in the case of the skull, which in boar has an elongated and straight profile, in domestic pigs has an incavated and shorter profile. The form of the lacrimals can also be diagnostic.

In prehistoric and protohistoric times, nevertheless, the morphology of the two forms was still more similar as seen at Barche and Ledro (BA) (RIEDEL, 1986a), than in later times. Morphological variations within the boar itself is at any event considerable (NIETHAMMER and KRAPP, 1986) but not enough to interfere with the domestic pig, which has for its part a still larger variation.

### **Brown bear**

The brown bear is normally ubiquitous (COUTURIER, 1954). It lives in small groups or in isolation, with breeding taking place every one/two years (BOSCAGLI, 1988). In northeastern Italy it has been found in small numbers at several sites from Neolithic to the Middle Ages. It is more frequent (114 remains) only in the relatively more isolated alpine site of Ledro (BA).

Today brown bear lives in larger populations (40/80 individuals) in the Abruzzi and in the surrounding regions, few near the Yugoslav border and a few individuals (*ca* 15) always on the brink of extinction in some valleys of the Trentino (BOSCAGLI, 1988). These are the last refuges of a species which once had a much wider distribution, for example in the hills near the wooded plain of Cornuda in the Veneto (NL). All together the brown bear has been found in 13 deposits, with usually few bones. In areas where it was frequent it could have been killed because it represented a danger to crops. The discovery of a few bones in later faunal samples from well populated areas could be explained by the fact that the bear was for man a strange animal, which attracted interest. The bones may be of captured animals and kept and shown as an attraction, whilst the fur could have been exported and the smoked meat appreciated. Its jaws and skulls could be trophies and cult objects (BATTAGLIA, 1943), canines used for decoration, and so on. Isolated teeth or phalanges may indicate trade and the presence of furs also in human burial grounds (IREGREN, 1988). In fact, as already explained, when dealing with few bones, one should also consider the context and nature of the bones recovered. Thus third phalanges may have been kept in furs, a jaw and a skull may be a trophy, the presence of only some sort of bones could be due to slaughtering outside the consumption sites. Usually the scarce bear remains of the areas studied by us include phalanges or long bones together with jaw remains (Isolone (BA), Barche (BA)), sometimes only isolated fragments (a calcaneus in Eppan (BA) and a carpal bone in Sonnenburg (BA)). The brown bear was definitely not an animal of significant economic importance.

Some remains at Ledro (BA) have revived the long-lived discussion about the existence of a small brown bear variety sometimes called *Ursus arctos formicarius* Evers. or «*Ors formigarol*», whose presence is often claimed in the Italian and Swiss Alps and also in Spain, Scandinavia and Russia (MÜLLER, 1912; CASTELLI, 1935). According to Stehlin (in CASTELLI, 1935), however, such small bears are probably

individuals undernourished when young and are not a distinct variety or separate species. Research on the Ledro Bronze Age population, compared with recent bear remains of the Far East (Kamtchatka) (RIEDEL, 1986a), incline us to suppose that bear sizes increase steadily during life and hence that a large size variation within a local population is normal.

### **Beaver and Otter**

Beaver and more rarely otter were found in some sites from Neolithic to the Middle Ages in the north Italian plain, but also in the Adige Valley, in Trentino and in South Tyrol. Their remains are very scarce. They lived in the Holocene throughout northern Italy, the beaver in fact extending as far south as Rome, and the otter still further south, and disappeared in later times (LINSTOW, 1908; HINZE, 1950; MASON and MACDONALD, 1986).

These animals are an indication of water: the vicinity of running water, or, for the otter also of standing water, is necessary for these animals and their way of life. They were variously useful for furs, meat and healing products (MARCUSZI, 1986). When few bones are present they could be of animals killed at a distance from the site where the bones are found.

### **Other medium-sized animals**

Bones, usually very few, of predatory mammals were found in many deposits (fox, wolf, wild cat, lynx, stone marten, marten, badger). These were not necessarily important for the human economy and were killed occasionally when they caused damage to crops and livestock. At the same time, however, their furs and other products could be useful and were therefore also sometimes sought deliberately.

Fox and wolf are normally completely ubiquitous. The wild cat and the lynx are of wooded biotopes. The marten prefers forested and also mountainous regions, stone marten typically nearer to plains or to cultivated fields. The badger has also a wide distribution but not above the forested areas (MÜLLER, 1982).

They were therefore widely distributed until recent extermination of many wild populations. Some of them (stone marten, marten, badger, fox) are still living in the region, for example, in South Tyrol (A.N.N.L., 1987).

The fox is known in the Mesolithic and the Early Neolithic as of some importance (up to 4% and 7,5%) in central and southern Italy (WILKENS, 1987; VIGNE, 1988) but it is always very scarce during these periods and also later in northern Italy (RIEDEL, 1986a; BARKER, 1983). This is considered a local characteristic different from other mediterranean areas (VIGNE, 1988). An exception is nevertheless Moletta (NL) in Trentino, with many foxes and hares, perhaps because animals were in this shelter when it was not inhabited by man.

In other countries, such as Anatolia, foxes had a cult importance (VIGNE 1988), furs were perhaps used, but their practical importance for man is not quite clear.

The wolf is now only in the Abruzzi and Molise, with some extensions northwards and southwards (220/240 individuals) (BOITANI, 1986). It lives in small groups of 7/8 individuals; old ones live alone. The medical or superstitious uses of parts of this animal were many (BOITANI, 1986) and furs were also probably valued.

The remains of wild cat are few in every deposit where they have been found. Their size is various and not always of typical wild animals so that their identifica-

tion is usually possible but not always evident.

Domestic cat are supposed to have been introduced to Europe in Greek and Roman times (PIEHLER, 1976), the domestication having taken place in the Near East (BOESSNECK, 1988).

In Egypt (BOESSNECK, 1988) the domestication of the cat was a very long process taking perhaps two millennia up to Roman times. Both wild and domestic forms were only one population and their distinction was not biologically relevant.

In our area the scarcity of remains would point to the sole presence of the wild form before Roman times, but this fact must not be taken for granted and needs further investigation. In Medieval times domestic cats are numerous in Verona and Venice.

Finally we find beside predatory animals also the hare, *Lepus capensis*, which is nearly ubiquitous, but replaced by *Lepus timidus* in the high Alp mountains. These are still living species in the region (A.N.N.L., 1987; MÜLLER, 1982).

The hare we have identified was probably always the *Lepus capensis*. Its remains are always few. It was more frequent only at Moletta Patone in Trentino (NL) perhaps because, as supposed also for the fox, animals were in this shelter also when it was not occupied by man.

In Roman times the hare was kept in captivity in «*leporaria*» before slaughtering, as probably at Magdalensberg in Carinthia (HORNBERGER, 1970); but in our area, as already stated, only few amount of bones of this animal have been found from more recent deposits with the exception of Moletta. As for the frequency of these medium-sized mammals, hare, fox, badger and wild cat are found often and hare is the most common. The lynx was identified only at Barche (BA).

## Size of the animals

The investigation of the size of the animals and of its variation and development is an important part of the faunal study of domesticated populations. It can be undertaken because the amount of remains is usually high and the size changes are important. Such size variations reflect the development of husbandry practice and changes in economy through the time and space and can happen rapidly.

The size development of wild animals, however, is difficult to ascertain. With the exception of some Neolithic faunas, the remains are few and give no reasonably large statistical samples to calculate average figures, variations and distributions, whilst contemporary homogeneous assemblages are rare. The development of size characteristics is moreover usually slow and barely important except perhaps in some extreme conditions as in the high mountains or when in recent times there are strong manmotivated pressures or a relaxation of competition.

Detailed data on the size of the more important wild animals have been given and discussed in a recent paper (RIEDEL, 1986a). Here we give a summary of them, together with some new considerations and informations on the Neolithic and more recent faunas.

The withers height of the red deer (about 116 cms, a little less in Ledro (BA) and a little more in Barche (BA) and in Spina (EA)) is analogous to the alpine population of Switzerland ( $\bar{x}$  118,5 cms) and of Bavaria ( $\bar{x}$  121 cms). These animals are middle-sized between the larger forms in eastern and the smaller in southern Europe (PIETSCHMANN, 1977). Some remains are often of very stout, probably male, individuals and hint at a marked sex dimorphism and size variation within the same population. When a larger amount of width measurements, as at several sites are

available, the average figures are fairly analogous. Comparisons with recent red deer are difficult because modern populations in northeastern Italy are few, live in special conditions (CASTELLI, 1939) and are not always indigenous.

The wild pig (see details in RIEDEL, 1986a) is about one metre high or a few centimetres less. Its width measurements show also, in comparison for example with the Neolithic bears of Polling in Bavaria (BLOME, 1968) and with other sites, that the forms of northeastern Italy are similar to the boar of the interior alpine countries. Smaller and slender-sized races are in southern Europe, for example Spain (DRIESCH and BOESSNECK, 1980) and Portugal (DRIESCH and BOESSNECK, 1976). For Herre (in NIETHAMMER and KRAPP, 1986), recent boar sizes increase in Europe from southeast to east and northeast, that is from Spain and Sardinia through Germany to Russia. In recent times, in central Italy, according to TOSCHI (1965), the boar is small, that is from 60 to 90 cms high. But it should be asked whether these smaller withers heights of recent boars are found also in medieval or earlier populations; studies are done in Tuscany in this direction by C. Corridi (pers. comm. 1989).

The measurements of the aurochs remains are at the lower variation limits of the species.

Several remains of roe deer have been measured and hint at sizes not very different from recent populations of the Alps, such as those in Bavaria (BOESSNECK, 1956).

Measurements of brown bear were taken mainly on Ledro specimens (BA) of the Alp mountains as well as a few from other sites (RIEDEL, 1986); some new unpublished data have been obtained from Cornuda, from Verona and elsewhere. They show, for this animal, a very large variation — always within the usual sizes of western Europe and of the Alps — due also to a long period growth during adulthood (RIEDEL, 1986a).

The wolf is only sometimes present, now and then with small-sized remains.

Also the wild cat is sometimes small, for example at Terranegra (IA), but sometimes is also very robust as at Udine (BA/IA). An interpretation of this fact is difficult because of the unsure size limits between domestic and wild populations.

The study of several sites (RIEDEL, 1986a) has given a number of measurements for the medium-sized animals such as fox and badger. These measurements did not allow me to recognize a development of the average sizes of the animals or differences between sizes typical of northeastern Italy and those known for instance in the north-alpine countries (see Seeberg in BOESSNECK *et al.*, 1963). It is possible that these differences, if any existed, were very slight at least until a few hundred years ago. This problem needs further consideration on the basis of new data.

### Remarks on some other sites

Many wild animals remains (59% out of the total of 1054) have been found in the Cladrecis cave near Cividale at the eastern border of Friuli near Slovenia (RIEDEL, 1983b). Its age is not well established, the findings including Mesolithic/Neolithic tools and later ceramics of the third millennium uncal. BC. Besides red deer, roe deer, wild pig, brown bear and possibly the aurochs, 24% of the total is of small wild animals (fox, wild cat, *martes* sp., badger, hare, beaver). The sizes are similar to those of the Neolithic fauna of Seeberg (Switzerland) (BOESSNECK *et al.*, 1963) but could be typical also for the Mesolithic. Young animals are frequent in all species.

Finally we might cite some faunas of the Trieste Karst, in the immediate vicinity

Tab. 1 - Number of remains of the wild animals<sup>1</sup>.

	Moletta	Moletta	Acquaviva	Moletta	M.te Mezzana	Cornuda	Riccione	Fingerhof	Colombare	Val Liona <sup>3</sup>	Fimon <sup>3</sup>
	MS(L)-NL(E)	NL(E)	NL(E)	NL(M-L)	NL(L)	NL(L)	NL(L)	NL(L)	NL(L)-(CA)	NL-BA	NL-BA
Red deer	12	7	10	13	16	321	3	—	52	[4]	[14]
Roe deer	1	1	1	4	—	6	2	—	15	—	[8]
Chamois	—	—	—	—	—	—	—	—	—	—	—
Ibex	—	—	—	—	—	—	—	—	—	—	—
Aurochs	—	—	—	—	—	—	23 <sup>2</sup>	—	—	—	—
Wild pig	—	—	—	—	—	121	6 <sup>2</sup>	—	17	[4]	[8]
Brown bear	—	—	—	—	—	11	—	1	12	[1]	[1]
Beaver	—	—	—	—	—	1	—	—	—	[1]	[2]
Otter	—	—	—	—	—	—	—	—	—	—	[1]
Badger	2	2	—	—	1	1	—	—	2	[1]	—
Wolf	2	—	—	5	—	—	—	—	—	—	[2]
Fox	11	14	—	32	—	—	—	—	1	[2]	—
Wild cat	—	1	—	5	1	—	—	1	1	[1]	—
Lynx	—	—	—	—	—	—	—	—	—	—	—
Marten and stone marten	—	—	—	3	2	—	—	—	2	—	[1]
Hare	4	1	—	26	6	—	—	—	4	—	—
Wild animals remains n.	32	26	11	88	26	515	34	2	106	[14]	[37]
Wild animals remains %	24.8	31.7	73.3	47.8	18.8	63.0	1.0	11.1	—	—	—
Wild and domestic animal remains n.	129	82	15	184	138	817	54	195	954	[24]	[63]

<sup>1</sup> The data of some still unpublished remains could be later slightly changed. —: none; +: some.

<sup>2</sup> The distinction between wild and domestic cattle and pig is sometimes difficult.

<sup>3</sup> The figures between angular brackets of Fimon and Val Liona are of minimum number of individuals and not of the number of fragments.

Tab. II - Number of remains of the wild animals<sup>1</sup>.

	Spilamberto CA	Acquaviva CA	Sonnenburg CA	Sonnenburg BA	Fingerhof BA(E)	Cisano BA(E)	Barche BA(E)	Leadò BA(E-M)	Isolone BA(L)	Eppan BA(L)	Pfatten BA(L)	Poviglio BA(L)	Peschiera BA(L)	Femiletto BA(L)
Red deer	3	8	1	16	—	7	267	230	102	20	9	+	6	3
Roe deer	—	1	—	—	—	—	107	19	30	—	—	+	2	1
Chamois	—	—	—	—	—	—	—	18	—	1	—	—	—	—
Ibex	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Aurochs	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Wild pig	14	—	—	—	—	—	90	12	10	—	2	—	—	—
Brown bear	—	—	—	1	—	—	7	114	1	1	—	—	—	—
Beaver	—	1	—	—	—	—	2	—	—	—	—	—	—	—
Otter	—	—	—	—	—	—	2	—	—	—	—	—	—	—
Badger	—	1	—	—	—	—	4	2	—	—	1	—	—	—
Wolf	—	—	—	—	—	1	—	2	—	—	—	—	—	—
Fox	—	—	—	—	—	—	4	4	2	—	4	—	—	—
Wild cat	—	—	—	—	—	—	2	—	—	—	2	—	—	—
Lynx	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Marten and stone marten	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Hare	—	1	—	—	—	—	1	—	1	—	2	+	—	—
Wild animals remains n.	17	12	1	17	1	8	494	401	146	22	20	—	8	4
Wild animals remains %	73.9	70.6	1.9	2.4	1.0	1.3	16.2	2.3 <sup>4</sup>	4.6	1.5	1.4	—	2.0	3.3
Wild and domestic animals remains n.	23	17	53	703	99	593	3049	9276 <sup>4</sup>	3179	1426	585	ca.1500	399	92

<sup>4</sup> The total fragments figure and the percentage ratio of the animal remains are taken from RIEDEL (1976a). The figures of the individual wild animal species include also remains from bone deposits of the same site but still unpublished.

Tab. III - Number of remains of the wild animals<sup>1</sup>.

	Paviani BA(L)	Cavalzara BA(L)	Udine BA(L)-IA(E)	Pfatten IA(E)	Pozzuolo IA(E-M)	S. Briccio IA(E-M)	Terranegra IA(E-M)	Castelrotto IA(M)	Pfatten IA(L)	Colognola IA	Stufels Dominik IA	San Giorgio Valpolicella IA(L)
Red deer	9	6	11	20	42	+	41	35	3	74	15	3
Roe deer	—	—	2	—	6	+	—	—	—	—	—	1
Chamois	—	—	—	—	—	—	—	—	—	—	—	—
Ibex	—	—	—	—	—	—	—	—	—	—	1	—
Aurochs	—	—	—	—	—	—	—	—	—	—	—	—
Wild pig	1	—	12	3	3	—	9	2	1	52	2	—
Brown bear	—	—	—	—	—	—	—	2	—	—	2	—
Beaver	—	—	—	7	—	—	—	—	—	8	—	—
Otter	—	—	—	—	—	—	—	—	1	—	—	—
Badger	—	—	—	—	—	—	—	—	—	—	—	—
Wolf	1	—	—	—	—	—	—	1	—	1	—	—
Fox	—	—	—	2	—	—	1	1	—	—	4	—
Wild cat	—	—	1	—	—	—	1	—	1	—	1	—
Lynx	—	—	—	—	—	—	—	—	—	—	—	—
Marten and stone marten	—	—	—	—	—	—	—	—	—	—	—	—
Hare	—	—	—	—	—	—	—	2	1	—	5	—
Wild animals remains n.	11	6	26	32	51	+	52	43	7	135	30	4
Wild animals remains %	3.9	3.7	9.5	1.9	2.5	—	18.6	1.7	1.2	6.7	1.4	0.9
Wild and domestic animals remains n.	284	164	274	1458	2052	—	279	2469	1699	2018	2148	423

Tab. IV - Number of remains of the wild animals<sup>1</sup>.

	Stufels Stremitzer IA(M)	Spina EA	Stufels Seanoer RA	Stufels Dominik RA	Innichen RA	Aquileia RA	Torcello RA	Udine RA(L)-MA(E)	Verona I <sup>7</sup> MA (6th-7th c.)	Verona II <sup>7</sup> MA (10th-11th.c)	Verona III <sup>7</sup> MA (13th c.)	Verona IV <sup>7</sup> MA (13th-14th.c)	S. Pietro Venezia MA (6th-9th.c.)
Red deer	2	290 <sup>5</sup>	4	7	2	—	1	6	+	+	+	+	3
Roe deer	—	+	—	—	—	—	—	7	—	+	+	—	—
Chamois	—	—	—	—	—	—	—	—	—	—	—	—	—
Ibex	—	—	—	—	—	3 <sup>6</sup>	—	—	—	—	—	—	—
Aurochs	—	—	—	—	—	—	—	—	—	—	—	—	—
Wild pig	—	290 <sup>5</sup>	11	—	4	—	—	—	+	+	+	—	—
Brown bear	—	—	—	—	—	—	—	—	+	+	+	—	—
Beaver	—	+	—	—	—	—	—	—	—	+	+	—	—
Otter	—	+	—	—	—	—	—	—	—	—	—	—	—
Badger	—	+	—	1	2	—	—	—	—	—	—	—	—
Wolf	—	+	—	—	—	—	—	—	—	—	—	—	—
Fox	—	+	—	3	—	—	—	—	+	+	+	—	—
Wild cat	—	—	—	—	—	—	—	—	—	—	—	—	—
Lynx	—	—	—	—	—	—	—	—	—	—	—	—	—
Marten and stone marten	—	—	—	—	—	—	—	—	—	—	—	—	—
Hare	—	—	13	1	1	—	—	—	+	+	+	—	—
Wild animals remains n.	2	600 <sup>5</sup>	28	10	9	3	1	13	+	+	+	+	3
Wild animals remains %	1.5	10.0 <sup>5</sup>	1.8	0.9	1.2	—	1.3	1.2	—	—	—	—	1.0
Wild and domestic animals remains n.	131	6000 <sup>5</sup>	1536	1150	740	—	76	1073	ca.2800	ca.2500	ca.5900	ca.112	296

<sup>5</sup> The bone remains figures of Spina are very approximate.

<sup>6</sup> The ibex horncores from Aquileia have been found in a cattle horncores deposit and are probably imported.

<sup>7</sup> The study of the Verona deposit is not completed. All wild animals indicated with a cross have been found with few remains. In Verona another species identified is the hedgehog.



Tab. V - Number of remains of the wild animals<sup>1</sup>.

	San Valier MA(E-M)	Stufels Stremitzer MA(M)	Torcello MA(E-M)	Castel di Drena MA(L)	Sonnenburg MA(L)
Red deer	26	2	8	2	12
Roe deer	—	—	2	—	—
Chamois	—	—	—	—	—
Ibex	—	—	—	—	—
Aurochs	—	—	—	—	—
Wild pig	—	2	—	—	—
Brown bear	—	—	—	—	—
Beaver	—	—	—	—	—
Otter	—	—	—	—	—
Badger	—	—	—	—	—
Wolf	—	—	—	—	—
Fox	—	—	—	—	—
Wild cat	4	—	—	—	—
Lynx	—	—	—	—	—
Marten and stone marten	—	—	—	—	—
Hare	—	—	1	3	—
Wild animals remains n.	30	4	11	5	12
Wild animals remains %	2.0	0.4	0.6	0.7	42.9
Wild and domestic animals remains n.	609	964	1694	671	28

of the town, which are known from old excavations and are not always well dated. The Grotta Benussi has a typical Mesolithic fauna which includes a wide array of wild animals from the predominant red deer to the more rare ones like the otter (RIEDEL, 1976a). The Grotta Cotariva is quite interesting (for example for the abundant wild pig and for the large cattle), but its dating to the Neolithic or Bronze Age is uncertain and further studies are needed (RIEDEL, 1976b). The Caverna dell'Edera gives a section from the Neolithic to the Iron Age with some wild animals. Elleri is mainly a Bronze and Iron Age *Castelliere* where wild animals are scarce and similar to those of the Venetian area (RIEDEL, 1976c).

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## GLI ISOTOPI DELL'OSSIGENO COME INFORMATORI PALEOCLIMATICI Alcuni dati sperimentali\*\*

**RIASSUNTO** - Studi precedenti hanno permesso di definire l'esistenza di una relazione diretta e quantitativa che lega la composizione isotopica dell'ossigeno ( $^{18}\text{O}/^{16}\text{O}$ ) nel fosfato delle ossa di diverse specie di mammiferi con la temperatura media annua al suolo delle località di provenienza di tali animali. Potendo applicare tale relazione a campioni di mammiferi vissuti in età preistorica risulta evidente la possibilità di compiere studi di tipo paleoclimatico e paleoidrologico.

Si presentano i risultati ottenuti da campioni provenienti da alcuni siti preistorici della Pianura Padana e dal villaggio di Fossacesia Marina sulla costa Adriatica.

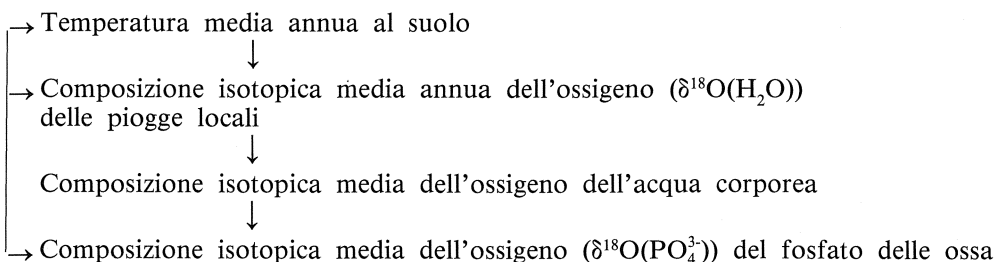
I dati isotopici si accordano bene con le informazioni sulla situazione climatica durante l'Atlantico ottenute con altre metodologie di studio; eventuali variazioni e fluttuazioni locali vengono discusse.

**SUMMARY** - *Oxygen isotopes as climatic indicators. Some experimental data.* Oxygen isotope composition ( $^{18}\text{O}/^{16}\text{O}$ ) of bone phosphate from different mammal species coming from some prehistoric sites of the Po Valley and from the Neolithic village of Fossacesia Marina (CH) have been carried on. Previous studies have demonstrated the existence of a direct, quantitative relationship between oxygen isotopic composition of bone phosphate and mean annual temperature. The existence of such relationship allows to study the ancient environment and climate.

The trend of climate, during prehistoric periods, agrees well with the data obtained from other methodology of study; some fluctuations of climate in the studied sites are also discussed.

### INTRODUZIONE

È stata ormai provata l'esistenza (LONGINELLI e NUTI, 1973; LONGINELLI e PERRETTI PALDAINO, 1980; LONGINELLI, 1984; LUZ e KOLODNY, 1985) in diverse specie di mammiferi viventi, di relazioni dirette e quantitative tra le seguenti variabili:



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\*\* Lavoro eseguito col contributo del Museo Civico di Scienze Naturali di Brescia.