

Hugo Obermaier Society. 49<sup>th</sup> Annual Meeting in Trento (10<sup>th</sup> - 14<sup>th</sup> of April, 2007)

## Hunting strategies in a mountain environment during the Late Glacial in north eastern Italy

Antonio TAGLIACOZZO\* & Ivana FIORE

Laboratorio di Paleontologia del Quaternario e Archeozoologia, Soprintendenza al Museo Nazionale Preistorico Etnografico "L. Pigorini", P.le G. Marconi 14, 00144 Roma, Italy

\* Corresponding author e-mail: [antonio.tagliacozzo@beniculturali.it](mailto:antonio.tagliacozzo@beniculturali.it)

---

**SUMMARY** - *Hunting strategies in a mountain environment during the Late Glacial in north eastern Italy* - The aim of this research is to present an updated synthesis of the results of the archaeozoological studies carried out on Late Glacial sites of the pre-alpine and eastern alpine regions. In the last few years the study of faunal remains from medium-high altitude sites (Riparo Dalmeri, Riparo Cogola and Grotta del Clusantin) have been added to those previously carried out on lowland localities (Riparo Tagliente, Riparo Soman, Riparo A di Villabruna, Riparo di Biarzo). Notwithstanding the difficulty to compare faunal samples –analyzed with different methodologies and heterogeneous as collecting strategies and number of remains – some interesting results have been obtained. These allowed the widening of our knowledge on the animals predated, the subsistence strategies and the modes of exploitation of the alpine and pre-alpine territory adopted by Epigravettain hunters. All the faunal samples are characterized by a high degree of fragmentation produced both by post-depositional phenomena (in particular frost action) and by butchering activity, but a fundamental role was played by the use of bones as fuel. The proportions among the vertebrate classes evidence the strong prevalence of mammals over birds and fishes, while amphibians and reptiles were not identified. Fishing is surely documented only at Riparo Dalmeri, where Ciprinidae were mainly caught, and hypothesized at Riparo Villabruna where salmonid vertebrae have been recovered. Also the data on bird exploitation come only from Riparo Dalmeri, where Galliformes are mainly documented. Hare, marmot and beaver are often present, but except for the marmot at Grotta del Clusantin, they never play an important economic role. Carnivore remains are present always in relatively low percentages. Brown bear and wolf are the most common carnivores, while fox, wild cat, boreal lynx, badger, pine marten, and ermine have been only occasionally identified. Lion postcranial remains were recovered only in different layers of Riparo Tagliente. There are no sure proofs that humans hunted constantly and regularly all the carnivore species documented; however, taphonomic analyses evidenced rare traces of exploitation on wolf and lion remains at Tagliente and on bear and badger at Dalmeri. Ungulate remains are the most abundant at all sites. The main hunting focuses during the Late Glacial in north eastern Italy were red deer and ibex, followed by chamois, wild boar and elk. Bovines (aurochs and bison) are quite rare and there is a single specimen of *Equus hydruntinus* from the upper layers of Tagliente. The age at death shows that hunting focused mainly on adult and young adult individuals, indicating the exploitation of animals in the age range when they provide the best quality and quantity of meat as well as the best quality of the hides. The proportions among the ungulate species, although influenced by hunting activities, reflect mainly the climatic changes that occurred during the Late Glacial and the environments around the sites. In the coldest periods there was a strong prevalence of alpine prairie species (ibex and chamois) even at low elevations, while cervids and suids were prevalent during the more temperate and humid phases, especially in lowland sites. Important information on the exploitation of ungulate carcasses have been obtained both from detailed taphonomic analyses, in particular from the study of the anatomical composition and of the human modifications identified on the bones (striae and impacts), as well as from the analysis of the spatial distribution of the bone remains at some sites. Finally, a framework of the season of occupation of the sites, established on the basis of the age at death of the ungulates (in particular neonates and very young animals) is presented.

**RIASSUNTO** - *Strategie di caccia in ambiente montano durante il Tardoglaciale nell'Italia nord orientale* - Scopo del lavoro è quello di proporre una sintesi aggiornata dei risultati degli studi archeozoologici condotti sui siti tardoglaciali dell'area prealpina e alpina orientale. Negli ultimi anni gli studi dei reperti ossei faunistici provenienti da siti di media-alta quota (Riparo Dalmeri, Riparo Cogola e Grotta del Clusantin) si sono aggiunti a quelli condotti in precedenza soprattutto su alcuni giacimenti di fondovalle (Riparo Tagliente, Riparo Soman, Riparo A di Villabruna, Riparo di Biarzo). Nonostante la difficoltà di confrontare campioni ossei faunistici studiati con differenti metodologie ed eterogenei per quanto riguarda il tipo di raccolta e il numero di resti, sono stati ottenuti alcuni interessanti risultati, che hanno permesso di ampliare le conoscenze sugli animali predati, le strategie di sussistenza e le modalità di sfruttamento del territorio alpino e prealpino da parte dei cacciatori epigravettiani. Tutti i campioni faunistici si sono rivelati caratterizzati da un'alta frammentazione dovuta sia a fenomeni post-deposizionali (in particolare l'azione del gelo) sia all'attività di macellazione; inoltre, fondamentale si è rivelato l'uso delle ossa quale combustibile. Il rapporto tra le classi di vertebrati vede la forte prevalenza dei resti di mammiferi rispetto a quelli di uccelli e pesci, mentre non sono stati identificati resti di anfibi e rettili. L'attività di pesca è documentata con certezza solo a Riparo Dalmeri, dove è attestata la pesca soprattutto ai Ciprinidi, e ipotizzata a Riparo Villabruna, dove sono presenti vertebre di salmonidi. Anche i dati sullo sfruttamento degli uccelli provengono solo da Riparo Dalmeri, dove sono documentati soprattutto Galliformi. La lepre, la marmotta e il castoreo sono spesso presenti, ma, salvo nel caso della marmotta di Grotta del Clusantin, non rivestono mai una forte importanza economica. Resti di carnivori sono attestati sempre in percentuali relativamente basse. L'orso bruno e il lupo sono i carnivori più comuni, mentre volpe, gatto selvatico, lince boreale, tasso, martora ed ermellino sono segnalati solo saltuariamente. Resti postcraniali di leone provengono soltanto da diversi livelli del Riparo Tagliente. Non ci sono prove sicure che l'uomo cacciasse

in maniera costante e regolare tutti i carnivori documentati, tuttavia analisi tafonomiche hanno messo in luce rare tracce di sfruttamento su lupo e leone al Tagliente e su orso e tasso al Dalmeri. I resti degli ungulati sono quelli più numerosi in tutti i siti analizzati. I principali obiettivi dell'attività venatoria nel Tardoglaciale dell'Italia nord orientale sono il cervo e lo stambecco, seguiti da camoscio, cinghiale, capriolo e alce. I bovini (uro e bisonte) sono alquanto rari ed è segnalato un unico elemento di *Equus hydruntinus* nei livelli superiori del Tagliente. L'età di morte mostra che la caccia era diretta in prevalenza verso individui adulti e giovani-adulti, e dunque indica uno sfruttamento degli animali nella fascia di età in cui questi sono in grado di fornire una maggior quantità e qualità di carne e una maggiore qualità del pellame. I rapporti tra gli ungulati, benché influenzati anche dalle strategie di caccia, risentono soprattutto delle modificazioni climatiche succedutesi nel corso del Tardoglaciale e dall'ambiente circostante i siti. Nei periodi più freddi prevalevano le specie di prateria alpina (stambecco e camoscio) anche a basse quote, mentre cervidi e suini erano abbondanti durante le fasi più temperate e umide, in particolare nei siti di fondovalle. Importanti informazioni sullo sfruttamento delle carcasse degli ungulati provengono sia da alcune approfondite analisi tafonomiche, in particolare dallo studio della composizione anatomica e delle modificazioni antropiche presenti sulle ossa (strie e impatti), sia dall'analisi della distribuzione spaziale dei resti ossei in alcuni giacimenti. Infine, viene presentato un quadro della stagionalità delle occupazioni dei giacimenti, stabilita valutando l'età di morte degli ungulati (in particolare i neonati e i giovanissimi).

*Key words:* north eastern Italy, Recent Epigravettian, Mammals, butchering marks, spatial organisation, seasonality

*Parole chiave:* Italia nord orientale, Epigravettiano recente, Mammiferi, tracce di macellazione, organizzazione spaziale, stagionalità

## 1. INTRODUCTION

There are over 50 Late Glacial sites identified in the eastern pre-alpine and alpine region, but only some of them yielded faunal remains, whereas in most sites the archaeological record is represented only by the lithic industry. During the last few years, the excavations carried out in medium-high altitude sites (Riparo Dalmeri, Riparo Cogola, and Grotta del Clusantin), with abundant osteological remains, allowed improving our knowledge on the animals predated, on subsistence strategies, and on the modes of exploitation of the alpine and pre-alpine territory adopted by the Epigravettian hunters (Cassoli *et al.* 1999; Fiore *et al.* 2002; Romandini 2004-2005; Fiore & Tagliacozzo 2005a, 2005b, 2005c, 2006, 2008a; Gurioli *et al.* 2009:). Previously the paleo-economic and ecologic information was based mainly on the study of faunal remains from lowland sites (Riparo Tagliente, Riparo Soman, Riparo A di Villabruna, Riparo di Biarzo) occupied, sometimes repeatedly, during the Late Glacial (Capuzzi & Sala 1980; Tagliacozzo & Cassoli 1994; Aimar & Giacobini 1995; Guerreschi 1996; Rowley-Conwy 1996; Cilli & Guerreschi 2000; Rocci Ris *et al.* 2005).

The aim of this paper is to present a brief updated synthesis on the results of the archaeozoological studies carried out at these sites, and, at the same time, to illustrate the modes of exploitation of the most important animal resources (mainly vertebrates) adopted in this mountain environment during the last phases of the last Glaciation. Syntheses on similar topics (but based on fewer sites) have been already presented by the authors in previous years (Tagliacozzo & Fiore 2000; Fiore *et al.* 2002; Fiore & Tagliacozzo 2005c; Bertola *et al.* 2007; Fiore & Tagliacozzo 2008b), while for other, more general, archaeological-naturalistic aspects, the reader may refer to the work of other groups of researchers (Broglia 1995; Dalmeri *et al.* 2001; Cusinato *et al.* 2003; Ravazzi *et al.* 2007). For a more general framework of the radiocarbon chronology of north eastern Italian Epigravettian sites and its discussion, reference can be made to previous syntheses (Broglia & Improta 1995; Bertola *et al.* 2007; Ravazzi *et al.* 2007).

## 2. THE FAUNAL SAMPLES

First of all, analyzing the archaeozoological data, it is important to emphasize that not all the sites considered in this research have been studied completely and with the same methodologies, therefore it is very difficult to compare all the data. Furthermore, there are great differences in the quantity of remains recovered and analyzed at Riparo Tagliente and at Riparo Dalmeri, with hundreds of thousands specimens, compared to Grotta del Clusantin, with over 27,000 remains, or Riparo Soman and Riparo Cogola that yielded less abundant samples variable between about 2000 and 8000 specimens (Appendice 1). The Riparo A of Villabruna yielded a total of more than 2000 specimens, but includes also bones from the more recent upper levels (4-9). The exact quantity of remains recovered at Riparo di Biarzo is not known, but the author, besides the identified specimens, mentions "a noteworthy quantity of small fragments of fragmented and comminuted bones" (Rowley-Conwy 1996: 75 and Fig. 1), that it is possible to estimate as several thousand specimens.

All the faunal assemblages are characterized by a high fragmentation that affects the possibility to identify the remains (Appendice 1). The determined specimens, in fact, reach values around 10% at Soman and at Dalmeri, while they represent just 1.3% in level 10 of Tagliente. The strong fragmentation is due both to post-depositional phenomena (in particular frost action) and to butchering activities; furthermore, a fundamental role seems to have been played by the use of bones as fuel, as documented by the noteworthy quantity of burned remains recovered. They range from 15% at Riparo Soman, to more than 35% at Riparo Tagliente and up to 82% at Grotta del Clusantin, where accumulations of burned and calcined bones in two circumscribed areas have been interpreted as dumps of hearths. Burned bones are very common also at Riparo di Biarzo where, in order to justify the high degree of fragmentation of the bones, it has been suggested that they were intentionally fragmented in small pieces in order to obtain "bone juice" by boiling. It seems that such hypothesis is not supported by clear evidences and, most of all, it is not indicated how it had been possible to boil bones for prolonged time. From the description and the im-

ages presented, the fragmentation of the bones from Riparo di Biarzo seems to be very similar to that of other pre-alpine and alpine sites of this region, and referable, besides to their use as fuel, mainly to post-depositional actions in the sedimentary deposits. The quality of the bones as fuel, although influenced by factors such as porosity, humidity, degree of fragmentation, and grease content, has been indicated by experimental studies carried out by Costamagno & Théry-Parisot (2005). Such studies evidence that, in open areas, fires fed with bones reach temperatures that are similar to those obtained employing wood, and the mean duration of combustion with flames, in the case of bones, is slightly longer than that produced with wood.

### 3. ANALYSIS OF THE FAUNAL COMPLEXES

#### 3.1. Fishes, amphibians, reptiles, birds

The ratio among the vertebrate classes shows a clear prevalence of mammal remains compared to birds and fishes, considering in addition that all the indeterminate remains belong to mammals (mostly ungulates), because it is usually possible to identify even the smallest bone fragments belonging to the other classes. In the sites studied directly by the authors (Cogola, Dalmeri, Soman) no remains of amphibians and reptiles were found, as it seems to be the case also in the other sites. It is however possible that some remains of these animals may have been included with the micromammals and therefore they have not been studied from an archaeozoological point of view. The absence of tortoise is surely due to the absence of these animals in the alpine environment (mainly in the high altitude sites), because it is often present in other Late Glacial sites of the Italian peninsula, such as Grotta della Madonna di Praia a mare (Fiore *et al.* 2004; Pino Uría & Tagliacozzo 2008) and Grotta Polesini (Radmilli 1974).

Fishing is well documented with reliability only at Riparo Dalmeri where mainly Cyprinids, among which the barbel (*Barbus plebejus*) and the chub (*Leuciscus cephalus*) were recovered together with scarce remains of trout (*Salmo trutta*) and grayling (*Thymallus thymallus*), and very rare pike (*Esox lucius*), all of medium-large size (Albertini, Tagliacozzo 2004). Fishing has been suggested also at Riparo Villabruna where vertebrae of salmonids are present (Aimar *et al.* 1992). At Riparo Cogola fish remains, referable mainly to Cyprinids – among which the chub (*Leuciscus cephalus*) and the pike (*Esox lucius*) –, were concentrated in an area identified as a probable carnivore den and this makes uncertain the capture of these animals by Epigravettian hunters (Albertini & Tagliacozzo 2005). At Riparo Soman and at Riparo Biarzo fish remains are rare, while the relatively numerous specimens from Riparo Tagliente are still being investigated.

Data on bird exploitation are available only from Riparo Dalmeri, where mainly Galliformes are documented: Tetraonidae, among which Black Grouse (*Tetrao tetrix*), Ptarmigan (*Lagopus cf. mutus*) and Willow Grouse (*Lagopus cf. lagopus*), as well as small sized Phasianidae (Common Quail, *Coturnix coturnix*); rare butchering marks have been also evidenced (Gala & Tagliacozzo under investigation). At Riparo Cogola many remains are unidentifiable and are referable to Anseriformes, Galliformes (among

which probably the Black Grouse, *Tetrao tetrix*) and Passeriformes. These remains too, just like the fish ones, come mainly from the carnivore den area and therefore cannot be surely related to human activity. At Riparo Soman, where is documented also an element of Golden Eagle (*Aquila chrysaetos*), and at Riparo Biarzo bird remains are rare; those from Riparo Tagliente are still being analyzed.

#### 3.2. Mammals

##### 3.2.1. Insectivores, lagomorphs, large rodents, and carnivores

The hedgehog (*Erinaceus europaeus*) has been included in this study because this small mammal has been sometimes exploited by humans during the Italian Upper Palaeolithic, as indicated by the butchering marks detected on specimens from Grotta Romanelli, Grotta della Madonna di Praia a mare (Fiore *et al.* 2004), Grotta Polesini and Grotta delle Arene Candide (Alhaique 1995, 1996). However, no traces of human exploitation were evidenced on the only two remains – from Riparo Soman and Riparo Dalmeri – analyzed in this research.

Hare, marmot, and beaver are often present in Late Glacial deposits of N-E Italy; however, except in the case of the marmot at Grotta del Clusantin, they never play an important economic role and their exploitation by humans is not always sure. In any case, even when they were hunted, this was a completely occasional and accidental activity. Among the lagomorphs, both the common hare (*Lepus europaeus*) and, more dubitatively, the alpine hare (*L. cf. timidus*) are documented, but very often the fragmentation of the specimens does not allow the distinction between the two species and a more “generic” *Lepus* sp. or indeterminate lagomorph is mentioned (Dalmeri, Cogola, Clusantin). Only at Tagliente the contemporaneous presence of both species is suggested (Capuzzi & Sala 1980), while at Soman, the specimens are referred only to the alpine hare (Tagliacozzo & Cassoli 1994).

The beaver (*Castor fiber*) is often present, but always in low percentages; it is surely related to the presence of humid zones in the environs (Soman, Tagliente, Biarzo), and it is absent in the highest altitude sites (Clusantin, Cogola). However, the beaver is present at Riparo Dalmeri and this seems to indicate that during the Late Glacial period on the Sette Comuni plateau there were wide humid zones as indicated also by the presence of areas with sediments of ancient lacustrine basins (Dalmeri, pers. com.).

Marmot (*Marmota marmota*) remains, a species typical of the alpine peri-glacial area, are quite numerous in the lower levels (17-13) of Riparo Tagliente, where they indicate a colder climate with the consequent lowering of the alpine prairies to an altitude closer to the plain (Capuzzi & Sala 1980). The marmot is however present, although in lesser quantity, also in the more temperate-humid upper levels. The marmot is rare at Riparo Biarzo, very rare at Riparo Dalmeri and completely absent at Riparo Cogola and Riparo Soman. There are no conclusive evidences to establish that these specimens are the results of human hunting rather than elements introduced by carnivores.

An interesting exception is instead represented by the site of Grotta del Clusantin, on the Pradis Plateau in the Carnic Pre-alps, where marmot remains, belonging to

both adult and young individuals, represent over 90% of the faunal sample. Butchering marks, referable to skinning and disarticulation, have been identified on the bones indicating that one of the main activities at this site was the exploitation of marmot in order to obtain food, fat and pelts. This site may therefore represent a specialized location for marmot hunting during the progressive human penetration into the eastern Alps (Romandini 2004-2005; Gurioli *et al.* 2009).

### 3.2.2. Carnivores

Except for the Epigravettian layers of Riparo A di Villabruna, carnivore remains are present in all the analyzed sites, always in relatively low percentages, varying from 0.8% of Grotta del Clusantin to 4.5%-4.8% of Riparo Soman (Appendice 2). A significant exception is represented by Riparo Cogola where carnivore remains reach about 9%. This datum is however influenced by the presence, in a restricted area of the site, of the residues of an ancient den with remains of wolf and bear cubs.

Brown bear (*Ursus arctos*) is the most common carnivore, being present in five out of the six sites analyzed, and in different levels (e.g., Tagliente and Soman). The remains recovered in the different sites include mainly isolated teeth as well as hand and foot bones (metapodials and phalanges) belonging to both adult and young animals. The wolf (*Canis lupus*) is also quite common and is present in five out of six sites, but it is usually represented by a lower number of specimens compared to the bear. Besides the remains referable to adult animals, neonatal and juvenile individuals are also represented (e.g., Cogola and Dalmeri). The fox (*Vulpes vulpes*), usually the most common carnivore in Italian Upper Palaeolithic sites, is relatively not frequent in the region investigated, where its remains were recovered in four sites and not in all the levels considered.

Wild cat (*Felis silvestris*) is the rarest carnivore, indicated by a single mandibular element in level 10 of Riparo Tagliente (Capuzzi & Sala 1980). Only at this latter site some post cranial remains of lion (*Panthera leo*) have been identified in different levels (Bertola *et al.* 2007). Previously the presence of this felid was indicated at Tagliente, only by the engraving on one of the blocks covering the Epigravettian burial. The boreal lynx (*Lynx lynx*), instead, besides in different levels of Tagliente, was identified also in the two Epigravettian phases of Soman. In this latter site, the recovery of a small sized fifth metatarsal suggested, although dubitatively, the contemporaneous presence of the pardina or iberian lynx (*L. cf. pardinus*, or *L. cf. pardina*; Tagliacozzo & Cassoli 1994). Considering the low number of specimens analyzed and the fact that this latter species is considered by some zoologist as a subspecies of *L. lynx*, it cannot be excluded that the dimensional difference detected in the remains from Soman may be justified more simply by a strong sexual dimorphism within the boreal lynx.

Among the mustelids, both badger (*Meles meles*) and pine marten (*Martes martes*) are present in three of the analyzed sites, but the two species are present at the same time only at Dalmeri. In general, only few remains have been recovered. The ermine (*Mustela cf. erminea*) is dubitatively present only at Grotta del Clusantin.

Excluding this latter species, more strictly related to peri-glacial mountain habitats, the other carnivores recovered in the Late Glacial sites of the examined region do not

have a particular paleo-ecological interest, because they occur in various habitats according to the availability of their preys. However, brown bear, wild cat, lynx, pine marten, and badger prefer wooded and forest areas, with conifers or broad-leaved trees, rich in rocky spaces for denning. The variety of carnivores may therefore reflect the wider forest cover that was forming in the peri-alpine and alpine region at the end of the last Glacial period.

There are no sure evidences that humans hunted constantly and regularly all the carnivores documented. In fact, there are convincing data that sometimes indicate that their remains represent the residues of predation by other carnivore or cubs dead for natural causes and abandoned in the areas used as dens in the periods when the caves or the rock-shelters were not occupied by humans (e.g., Cogola and Dalmeri). However, it cannot be denied that, besides their fat and meat, the pelt of these carnivores as well as their teeth or claws, collected to obtain charms, were important objectives. In this respect, it is significant that in most cases the specimens recovered belong mainly to cranial and distal limb portions, reflecting probably remains of the dismembering activities aiming at the recovery of charms or, even, the residues of abandoned complete pelts. Taphonomic analyses carried out on carnivore bones evidenced rare traces of exploitation on wolf and bear at Tagliente and on bear and badger at Dalmeri. In particular, at Tagliente a wolf occipital condyle shows traces of the disarticulation of the head, while butchering marks are present on the humerus and the phalanges of the lion (Bertola *et al.* 2007). At Dalmeri on a badger fibula there is a closely spaced group of striae, related to scraping activity (Fiore & Tagliacozzo 2008a). On bear bones, besides striae produced by lithic tools, there are also marks of intentional bone fracturing, in particular on a femur there are fracture edges and notches indicating a repetition of blows along the same axis. Some cuts identified on metapodials could be related to skinning, while there are doubts in the attribution of some of the traces found on the phalanges. Some of them seem to be more compatible with disarticulation than to skinning, such as those identified on the proximal part of two complete ungual phalanges, that may be more likely made for obtaining the claws rather than for some other kind of exploitation for food or for pelts (Fiore & Tagliacozzo 2008a).

### 3.2.3. Ungulates

As expected, ungulate remains are the most abundant in all the analyzed sites, with the surprising exception of Riparo Clusantin, where they reach just 8.5% of the total number of remains; however, as mentioned before, this latter site represents a hunting stand specialized for marmot exploitation (Gurioli *et al.* 2009). The percentage of the ungulates in the other sites varies between 80% in the levels 17-13 of Tagliente to about 98% at Dalmeri (Appendice 1). Ibex and red deer are present in all the sites analyzed and in all levels, followed, as number of presences in the sites, by chamois and wild boar, both absent only in levels 17-13 of Tagliente; roe deer and elk are quite frequent, while bovines are rare. The recovery of a single upper left pre-molar of a young individual of *Equus hydruntinus* in the upper levels (7b-4) of Tagliente (Capuzzi & Sala 1980) should also be mentioned. This is the only certain evidence for the presence of this equid in a sure stratigraphic context in the

pre-alpine region, reflecting the scarcity of this animal in such biogeographic zone, while this same species is very common in other Late Glacial sites in South Central Italy, in arid prairie environments, such as at Grotta Romanelli (Tagliacozzo 1992, 2003).

Peculiar is the relative frequency of wild boar (*Sus scrofa*), typical mammal of humid broad-leafed woods, whose remains were found at all sites (Appendice 3), although in general in low percentages variable between 0.3% and 6%, but with the significant exception of Riparo Biarzo where it reaches a percentage of 56% of the ungulates (the percentage of Clusantin is not significant because it is based on a very small number of specimens). The frequency of wild boar in level 5 at Biarzo is surely related to the location of the site in a valley bottom and at a relatively low altitude (165 m a.s.l.) and to the occupation period, referable to the Allerød temperate phase (Guerreschi 1996). The relative frequency of wild boar in level 10 of Tagliente (6%) may also be related to the occupation of the rock-shelter during the Bølling temperate humid oscillation and to its location in the valley bottom (250 m a.s.l.). In the high altitude sites or during the coldest periods wild boar hunting is very sporadic and occasional, indicating the scarcity of this animal.

Rare remains of aurochs (*Bos primigenius*) and bison (*Bison priscus*) have been identified only in the lowland sites of Tagliente and Soman (Appendice 3), where evidently there were the ecological conditions allowing the diffusion of small herds of bovinds. At Soman only aurochs remains were identified, while at Tagliente the remains of both species are present (Capuzzi & Sala 1980), documented also by engravings on a pebble (bison) and on one of the blocks covering the Epigravettian burial (aurochs).

Roe deer (*Capreolus capreolus*) plays an important economic role only during the most temperate phase (lev. 10) of Tagliente, where it reaches 14% of the ungulates, but it is constantly present, although always in very low percentages both in high altitude sites and during the coldest periods of the Late Glacial (Dalmeri, Cogola, Soman). The elk (*Alces alces*) too, typical indicator of temperate-cold climate and of an environment with large humid areas, is often present even in medium and high altitude sites (Clusantin, Dalmeri), but always in low percentages, except in the case of levels 17-13 of Tagliente where it represents about 8% of the ungulates. The role played by the chamois (*Rupicapra rupicapra*) in the subsistence economy of the Epigravettian populations is certainly more important; it sometimes represents the main prey species, as in the case of Soman where it reaches almost 50% of the ungulates (Tagliacozzo & Cassoli 1994).

However, red deer (*Cervus elaphus*) and ibex (*Capra ibex*), represent the main focus of hunting activity during the Late Glacial in north eastern Italy (Appendice 3), sometimes alternatively in the same site, reaching percentages up to 89% (red deer at Tagliente, lev. 7b-a) or even 95% (ibex at Dalmeri). This latter rockshelter surely represents a high altitude seasonal site specialized for ibex hunting, but this species is constantly present also at low and medium altitude sites with percentages sometimes over 50% (Tagliente lev. 17-13, Villabruna lev. 17-10, Cogola US19).

The ratio between chamois and ibex on one side and red deer, roe deer and wild boar on the other as well as the quantitative differences between the individual species in the different sites do not seem to be solely due to human

activity (hunting and butchering strategies, transport of carcasses to the site, base camp or seasonal site), but mainly reflect and are influenced by the climatic and environmental changes that occurred during the Late Glacial. In the coldest periods there is a strong prevalence of alpine prairie species (ibex and chamois) even at low elevations, while cervids and suids are prevalent during the more temperate and humid phases.

At Tagliente ibex is prevalent during the Dryas I cold phase, while red deer becomes dominant in the Bølling temperate phase (Capuzzi & Sala 1980; Rocci Ris *et al.* 2005). A cold peak (cuts 5 and 6), referable to the Dryas II, may also be recognized with an increase of cold climate animals and a contemporaneous decrease of those adapted to a temperate climate. The sequence ends at the beginning of the Allerød.

The first phase of Soman may be framed between the end of the Bølling and the Dryas II; here chamois is prevalent followed by red deer, while the first phase of Villabruna, where ibex is prevalent, but cervids are also well represented, can be referred to the Bølling interstadial.

During the Allerød temperate phase at Riparo Dalmeri, over 1200 m a.s.l., ibex is clearly prevalent. Both Cogola, a medium mountain site, where ibex is prevalent followed by red deer, and the second phase of Soman, where chamois is prevalent and ibex increases compared to the previous phase, may be referred to the Young Dryas cold phase.

#### Age at death

The study of the age at death of the ungulates provides further information on the hunting strategies adopted during the Late Glacial. At Riparo Dalmeri hunting focused mainly on young and young adult (24 individuals) and adult ibexes (21 individuals), while the capture of very young and senile animals was only occasional (Fiore & Tagliacozzo 2006). At Riparo Cogola mainly adult ibex, chamois and red deer were captured, but remains of young individuals of ibex, chamois, and wild boar are also present (Fiore & Tagliacozzo 2005b). Red deer at Riparo Tagliente was hunted mainly after six years of age (adult II age class), but also senile individuals, older than 10 years, as well as young (0-2 years) and adult I age class (3-5 years) animals are present (Rocci Ris *et al.* 2005). Roe deer hunting focused mainly on adult individuals, while wild boar was hunted both as young (9-24 months) and adult (older than 2-3 years). In both Epigravettian phases of Riparo Soman the captures of adult ungulates are prevalent (wild boar, elk, roe deer, red deer, ibex, chamois), although there are also numerous remains of young adult and young individuals (Tagliacozzo & Cassoli 1994).

In general, the age at death shows that hunting focused mainly on adult and young adult individuals, indicating the exploitation of animals in the age range when they provide the best quality and quantity of meat as well as the best quality of hides.

#### Taphonomy and butchering

The bone remains of the ungulates from some of the analyzed sites underwent detailed taphonomic analyses that allowed hypothesizing models for the treatment of ungulate carcasses and the way they were transported to the sites. Furthermore, such analyses allowed to evidence on the bones different butchering marks, such as striae produced by lithic tools and impact scars, and to identify the presence of small bone flakes ("cones") produced by percussion.

Detailed studies on the exploitation of the ungulates were carried out in particular on level 26c of Riparo Dalmeri (Fiore & Tagliacozzo 2006, 2008a), on level 10 of Riparo Tagliente (Rocci Ris *et al.* 2005) and on Riparo Cogola (Fiore & Tagliacozzo 2005b). Such analyses evidenced that there may be differences in carcass treatment for ibex and red deer in the same site (Riparo Dalmeri), while there may be similarities between different sites (Riparo Dalmeri and Riparo Tagliente).

At Riparo Dalmeri, the carcass of the ibex, probably captured in the immediate surroundings, was transported completely to the site as shown by the data on the anatomical representation and by the ratio between minimum number of elements and number of expected elements (Fiore & Tagliacozzo 2006: Tab. 6). Considering the sure seasonal occupation of the site, it is possible to hypothesize that part of the consumption of the animal resources occurred during winter in lowland base camps. However, the presence at the site of all parts of the carcass does not allow to evidence significant absences of skeletal portions and it seems reasonable that only meat, properly treated (dried, smoked?), was transported to the lowland sites. There are no sure proofs for the utilization of such procedures, but the excess of defleshing marks on long bone diaphyses of a medium sized prey such as ibex, may be a positive evidence for this procedure. Usually the highest number of defleshing marks may be found on the long bones of large artiodactyls, such as aurochs and equids, rather than on those of medium-small sized animals (Fiore *et al.* 2003).

In contrast to what happened for the ibex, the red deer carcass was treated at the kill site and only selected portions were transported to Riparo Dalmeri, possibly because of the larger size of the animal and/or the longer distance between the kill site and the rock-shelter. The whole vertebral column and both girdles (scapula and pelvis) were usually abandoned at the kill site, while limbs and cranium were transported to the site. However, it was possible to evidence a strong under-representation even of these skeletal parts, suggesting that in many instances only meat portions rather than complete limbs were introduced into the site. Such hypothesis is also supported by the strong prevalence of defleshing marks on the bones.

The introduction only of selected red deer portions was hypothesized also at Riparo Cogola, demonstrating a strict relationship between the size of the animal and carcass treatment (Fiore & Tagliacozzo 2005b).

The representation of red deer elements from layer 10 of Riparo Tagliente (Rocci Ris *et al.* 2005) is similar to that of the ibex of Riparo Dalmeri, with prevalence of cranial and distal limb elements, indicating that the red deer carcasses, in contrast to what happened at Riparo Dalmeri, were transported completely to Riparo Tagliente. The skeletal representation of the two species (Fig. 1) shows clear and surprising similarities considering the different size of the two animals. The low number of ulnae of red deer, compared to the other forelimb bones (humerus and radius) and those of ibex is difficult to explain except by hypothesizing a particular use (raw materials for tool manufacture?) of this skeletal portion. In both species, the higher number of tibia remains compared to those of femur may be explained by the higher identifiability of tibia remains, even from small fragments, in contrast to those of femur. The use of red deer metatarsals as raw material for bone tool manufacture, as suggested at Riparo Tagliente, may explain

the lower number of metatarsals compared to tibiae. The lower presence of some bones or portions of them may also be due to simple problems of identification, related to the intense fragmentation of the specimens, but it seems sure that the proportions among the bones evidenced by the different taphonomic analyses may be influenced, even very strongly, by the continuous action of site clearing from food debris, both by humans and occasionally by carnivores.

The butchering marks are very frequent on the ibex bones from Riparo Dalmeri, being present on over 25% of the specimens and evidence standardized and repeated behaviors (Fiore & Tagliacozzo 2006: Tab. 9). The distribution and the type of cuts on the different bones indicates all butchering stages: skinning, disarticulation and defleshing, besides the recovery of soft parts such as the tongue (striae on the hyoid) and of tendons. Impacts produced by stone hammers are also frequent and localized mainly on long bones, all systematically fractured, but may be even found on mandibles as well as on first and second phalanges. For the characteristics and the position on some bones, the impact on the mandibles, on the proximal ulnae, on the pelvises, and on the calcanei may be surely related to carcass portioning, but more often percussion traces were produced in order to obtain marrow.

Butchering marks are frequent also on the red deer bones from Riparo Dalmeri; they are referred mainly to meat removal or tendon cutting, while those related to disarticulation (mainly located on tarsals and metapodials) and skinning (cuts on phalanges and distal metapodials) are rare. Percussion marks are frequent on all the long bones, but also on the body of a mandible and on some phalanges and aimed at obtaining marrow. On several fragments there are numerous traces of blows, sometimes on the same spot, indicating the greater difficulty to fracture red deer bones that are more robust compared to ibex ones, for which this procedure was not documented (Fiore & Tagliacozzo 2006).

Red deer of Riparo Tagliente was also intensely butchered, but there are some differences with Riparo Dalmeri. In fact the authors (Rocci Ris *et al.* 2005) emphasize the presence at Riparo Tagliente only of cut marks on the cranial remains, while at Riparo Dalmeri impact scars related

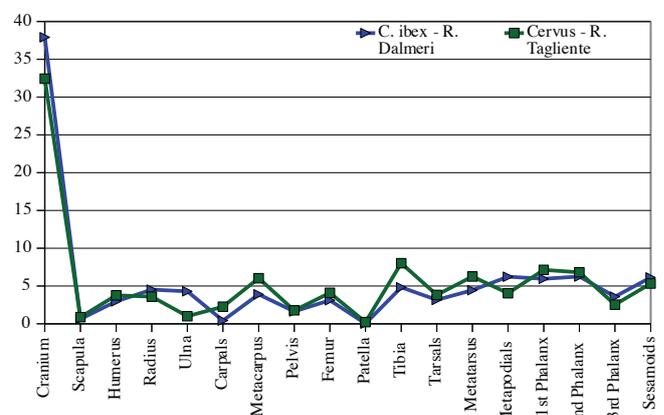


Fig. 1 - Anatomical representation of red deer from layer 10 of Riparo Tagliente and of ibex from layer 26c of Riparo Dalmeri. Fig. 1 - Rappresentazione anatomica del cervo del livello 10 di Riparo Tagliente e dello stambecco del livello 26c di Riparo Dalmeri.

to disarticulation/portioning are frequent on ibex mandibles (Fiore & Tagliacozzo 2006: Tab. 8) and have been detected also on a red deer mandible (Fiore & Tagliacozzo 2008a: Tab. 7). The intentional fracturing of ungulate mandibles is quite common in European Upper Palaeolithic sites, although there are doubts on the function of such action: if it was produced for the disarticulation of the mandible from the cranium or for the recovery of marrow from the cavity inside the mandible (Stiner 1994). In contrast to Riparo Dalmeri, there are no impact marks on red deer pelvises and calcanei from Riparo Tagliente.

#### 4. SPATIAL DISTRIBUTION OF THE BONE REMAINS

Inside some rockshelters such as Dalmeri, Cogola and Tagliente, the differential distribution of the faunal remains allowed to identify particular areas used for the exploitation of animal carcasses and for the use of space. The spatial distribution of the faunal assemblage of Riparo Dalmeri, mainly referable to ibex and indeterminate caprines, indicates that on the paleosurface 26c most of the remains are arranged almost as a semicircle around an area with fewer remains, and involve mainly the area corresponding to the entrance of the hypothesized structure (hut?). In an area close to the wall there are more frequent bones with cut marks, compared to the rest of the shelter, indicating a zone where butchering activity was more intense. This study also evidenced that bone breakage occurred very often inside the shelter that was periodically cleared from the largest fragment as indicated by the large quantity of percussion flakes compared to diaphyses with impact points (Fiore & Tagliacozzo 2005a).

Rare remains of elk, wild boar, roe deer, and chamois are distributed towards the external part of the shelter, while those of marmot, hare and beaver, also not numerous, have been found exclusively outside the habitation structure. The spatial distribution of bear and red deer bones provided some interesting information (Fiore & Tagliacozzo 2008a). Bear remains evidenced the association of some juvenile teeth, referable to a single individual, and numerous distal limb el-

ements, some with butchering marks, indicating a probable area for discarding portions without an alimentary relevance, after skinning. Two bear third phalanges with disarticulation marks, recovered only few centimeters apart, may represent the remainders of a composite object such as a charm. The distribution of red deer remains highlighted a significant association of phalanges, including the vestigial ones, which may indicate an area where distal limb elements were discarded after skinning and disarticulation.

At Riparo Cogola the high concentration of burnt remains may indicate an area where fires were repeatedly lighted, while the bones with butchering marks evidence two distinct areas: one for carcass portioning, the other for bone fracturing (Fiore & Tagliacozzo 2005b).

At Riparo Tagliente it is possible to recognize a wide area where faunal remains were preferentially accumulated (Rocci Ris *et al.* 2005) besides some small isolated heaps interpreted as dumps of remains of red and roe deer carcasses after butchering (Cilli & Guerreschi 2000).

It is clear that these hypotheses on the use of space inside circumscribed environments (caves and rock-shelters), although quite convincing, need to take into account that each single "living floor" represents actually a series of occupations, even spaced in time, and that it is not always possible to trace back, identify and separate all the taphonomic processes that lead to the formation of each archaeological deposit. Furthermore, in the interpretation it is necessary to consider the inevitable redistribution of the remains due to multiple post-depositional factors.

#### 5. SEASONALITY OF THE OCCUPATIONS

The sites considered in this research (Riparo Tagliente, Riparo Soman, Riparo Dalmeri, Riparo Cogola, Riparo A di Villabruna, Riparo Biarzo and Grotta del Clusantin) represent different situations that evidence a complex system of exploitation of the territory, characterized by considerable mobility (Bertola *et al.* 2007). A synthesis of the data on the season of occupation of the sites is presented in table 1. The seasonality was based mainly on the

Tab. 1 - Seasonality of the occupation in the different sites on the basis of the archaeozoological data (all sites from ungulates except Grotta del Clusantin from marmot).

Tab. 1 - Stagionalità d'occupazione dei diversi siti analizzati in base ai dati archeozoologici (in tutti i siti i dati sono ricavati dagli ungulati, salvo a Grotta del Clusantin dove sono basati sulla marmotta).

Season of death	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Riparo Tagliente				■	■	■	■	■	■	■	■	■
Grotta del Clusantin					■	■	■	■	■	■	■	■
Riparo Soman							■	■	■	■	■	■
Riparo Villabruna						■	■	■	■			
Riparo Dalmeri				■	■	■	■	■	■	■	■	■
Riparo Biarzo		■	■	■	■	■	■	■	■	■	■	■
Riparo Cogola							■	■	■	■	■	■

evaluation of the age at death of the ungulates (in particular neonates and very young animals), considering at all sites May-June as the birthing season for these species.

At Riparo Tagliente, the presence along the whole Epigravettian sequence except for the oldest level (cut 17), of foetal or neonate bones indicate a frequentation of the rockshelter at the end of spring and in summer, period when most ungulates give birth. The dental wear or the eruption stage of some red and roe deer mandibles and maxillae indicate that these animals were hunted between March and November during the Dryas I (starting from cut 13) and the Bølling/Allerød. The shelter was therefore surely occupied for most of the year. However, the absence of evidences for seasonal occupation during winter does not exclude the possibility of human frequentation during this period (Bertola *et al.* 2007). The archaeological and naturalistic data allow considering Riparo Tagliente as a site characterized by long and repeated occupations, frequented for most of the year.

The seasonality of the occupation at Riparo Soman between summer and autumn is defined mainly on the basis of the presence of very young chamois (Tagliacozzo & Cassoli 1994). However, for its localization and for the repeated frequentations over a long period, Riparo Soman could have also been occupied for most of the year.

The period of frequentation of Riparo Dalmeri is based both on the analysis of the eruption of ibex and red deer teeth (Cassoli *et al.* 1999; Fiore & Tagliacozzo 2005a, 2005b, 2006, 2008a), and on the study of thin sections of teeth (Curci & Tagliacozzo 2000; Facciolo in study). The dental remains of young ibex allowed to identify at least two individuals younger than two months and three other animals killed between 2 and 6 months, indicating their capture between the end of the spring and the autumn (Fiore & Tagliacozzo 2006: Tab. 4). As far as the red deer is concerned, there are at least three fawns younger than 5 months and two young animals between 12 and 18 months that allow placing their period of capture between the summer and the autumn (Fiore & Tagliacozzo 2008a: Tab. 3). The analysis of thin sections of teeth showed that the last band is usually a summer one and moreover at an advanced formation stage, therefore the season of death should be between the end of the summer and the beginning of autumn when unisexual ibex groups congregate for the mating season (Curci & Tagliacozzo 2000). Considering the data on seasonality and the prevalence of ibex remains (over 90% of the ungulates) Riparo Dalmeri may be defined as a high altitude site occupied seasonally for specialized ibex hunting, evidencing the mobility of human groups from the lowland to the mountain in order to exploit a territory that was not accessible during winter.

At Riparo Cogola the presence of dental remains of some young ibex and chamois, with an estimated age between 6 and 12 months, allowed to suggest that the Epigravettian hunters frequented the shelter between summer and autumn (Fiore & Tagliacozzo 2005b). Riparo Cogola may therefore represent a seasonal site, but the faunal evidences do not allow establishing if it was only a hunting site or if other resources were also exploited.

At Riparo A di Villabruna, a single ibex provided an age at death around 11 months, therefore with a capture in late spring. The data are too scanty to consider it surely as a seasonal camp. In the shelter there are temporary and

repeated frequentations, but it is not possible to functionally define it also because only a portion of the deposits is preserved (Bertola *et al.* 2007).

At Riparo Biarzo there are remains of young and young adult wild boar killed between 7 and 9 months (autumn-winter), between 14 and 19 months (summer-autumn), and more numerous between 9 and 14 months and between 21 and 23 months (winter-spring) (Rowley-Conwy 1996). It is therefore possible that the shelter was not used as a hunting stand, but rather as a base camp occupied all year round and especially during winter.

Grotta Clusantin, as we have seen, is considered a seasonal site specialized for marmot hunting. These animals were captured between the end of spring and the beginning of autumn, when the animals come out of hibernation, and in particular at the end of the summer when they provide the largest quantity of fat (Gurioli *et al.* 2009).

## REFERENCES

- Aimar A. & Giacobini G., 1995 - Analisi dei resti faunistici del deposito epigravettiano dei Ripari di Villabruna (Val Rosna, Belluno). In: Atti del 1° Convegno degli Archeozoologi Italiani. Rovigo, 1993, *Padusa Quaderni*: 125-134.
- Albertini D. & Tagliacozzo A., 2004 - Fresh water fishing in Italy during the Late Glacial period: the example of Riparo Dalmeri (Trento). In: Brugal J-P. & Desse J. (eds), *Petits animaux et sociétés humaines. Du complément alimentaire aux ressources utilitaire*. XXIV Rencontres Internationales d'archéologie et d'histoire d'Antibes, Antibes 23-25 octobre 2003. Editions APDCA, Antibes: 131-136.
- Albertini D. & Tagliacozzo A., 2005 - I resti di pesce provenienti dai livelli preistorici del Riparo Cogola. *Preistoria Alpina*, 40: 187-191.
- Aimar A., Alciati G., Broglio A., Castelletti L., Cattani L., D'Amico C., Giacobini G., Maspero A. & Peresani M., 1992 - Les Abris Villabruna dans la Vallée du Cismòn. *Preistoria Alpina*, 28: 227-254.
- Alhaique F., 1995 - Taphonomic analysis of the faunal remains from the «P» and «M.» layers of the Arene Candide (Savona-Italy). *Quaternaria Nova*, IV (1994): 263-295.
- Alhaique F., 1996 - Sfruttamento dei piccoli mammiferi e dei carnivori nel Paleolitico Superiore di Grotta Polesini. In: Peretto C. & Milliken S. (a cura di), *L'Adattamento umano all'ambiente, passato e presente*. Atti del XI Congresso degli Antropologi Italiani, Isernia 13-16 settembre, 1995. Edizioni ABACO, Forlì: 209-219.
- Bertola S., Broglio A., Cassoli P.F., Cilli C., Cusinato A., Dalmeri G., De Stefani M., Fiore I., Fontana F., Giacobini G., Guerreschi A., Gurioli F., Lemorini C., Liagre J., Malerba G., Montoya C., Peresani M., Rocci Ris A., Rossetti P., Tagliacozzo A. & Ziggioni S., 2007 - L'Epigravettiano recente nell'area prealpina e alpina orientale. In: Martini F. (a cura di), *L'Italia tra 15.000 e 10.000 anni fa. Cosmopolitismo e regionalità nel Tardoglaciale*. *Millenni. Studi di archeologia preistorica*, 5: 39-94.
- Broglio A., 1995 - The end of the Glacial Period in the Alpine-Po Valley Area and in the Italian Peninsula. In: Villaverde Bonilla V. (ed.), *Los Ultimos cazadores. Transformaciones culturales y económicas durante el Tardiglacial y el inicio del Oloceno en el ámbito mediterráneo*. Instituto Alicantino Juan Gil-Albert, Alicante: 147-163.

- Broglio A. & Improta S., 1995 - Nuovi dati di cronologia assoluta del Paleolitico superiore e del Mesolitico del Veneto, del Trentino e del Friuli. *Atti dell'Istituto Veneto di Scienze, Lettere e Arti*, 103: 1-45.
- Capuzzi P. & Sala B., 1980 - Il Riparo Tagliente. Analisi delle faune, biostratigrafia e cronologia dei livelli tardiglaciali. In: Fasani L. (a cura di), *Il territorio veronese dalle origini all'età Romana (contributi e aggiornamenti di ricerca preistorica)*. Fiorini, Verona: 130-136.
- Cassoli P.F., Dalmeri G., Fiore I. & Tagliacozzo A., 1999 - La chasse dans un gisement Epigravettien de montagne: Riparo Dalmeri (Trento, Italie). In: Thévenin A. & Bintz P. (eds), *L'Europe des derniers chasseurs. Épipaleolithique et Mésolithique: Peuplement et paléoenvironnement de l'Épipaleolithique et du Mésolithique*. Actes du 5e Coll. International UISPP, Grenoble, 18-23 settembre 1995. Éditions du CTHS, Paris: 459-464.
- Cilli C. & Guerreschi A., 2000 - Studio archeozoologico e tafonomico di un'area di concentrazione di reperti faunistici di Età epigravettiana (Riparo Tagliente, VR). In: *Atti del 2° Convegno Nazionale di Archeozoologia*, Asti, 14-16 novembre 1997. ABACO, Forlì: 141-149.
- Costamagno S. & Théry-Parisot I. 2005 - Propriétés combustibles des ossements. *Gallia Préhistoire*, 47: 235-254.
- Curci A. & Tagliacozzo A., 2000 - Determinazione dell'età di morte e della stagione di cattura attraverso lo studio dei livelli di accrescimento di cemento e dentina nei denti di mammiferi: l'esempio del Riparo Dalmeri (TN). In: *Atti del 2° Convegno Nazionale di Archeozoologia*. Asti, 14-16 novembre 1997. ABACO, Forlì: 23-30.
- Cusinato A., Dalmeri G., Fontana F., Guerreschi A. & Peresani M., 2003 - Il versante meridionale delle Alpi durante il Tardiglaciale e l'Olocene antico: mobilità, sfruttamento delle risorse e modalità insediative degli ultimi cacciatori-raccoglitori. *Preistoria Alpina*, 39: 129-142.
- Dalmeri G., Grimaldi S. & Lanzinger M., 2001 - Il Paleolitico e il Mesolitico. In: Lanzinger M., Marzatico F. & Pedrotti A. (a cura di), *Storia del Trentino, Vol. I: La preistoria e la proto-storia*. Il Mulino, Bologna: 76-85.
- Fiore I. & Tagliacozzo A., 2005a - Riparo Dalmeri. L'analisi dei resti faunistici: il contesto paleoecologico e l'economia del sito. In: Broglio A. & Dalmeri G. (a cura di), *Pitture paleolitiche nelle Prealpi Venete: Grotta di Fumane e Riparo Dalmeri*. Cierre, Verona: 116-121.
- Fiore I. & Tagliacozzo A., 2005b - Riparo Cogola (Carbonare, Trento): il contesto paleoecologico e lo sfruttamento delle risorse animali tra Epigravettiano e Mesolitico antico. *Preistoria Alpina*, 40: 161-188.
- Fiore I. & Tagliacozzo A., 2005c - Lo sfruttamento delle risorse animali nei siti di altura e di fondovalle nel Tardiglaciale dell'Italia nord-orientale. In: Malerba G. & Visentini P. (a cura di), Atti del 4° Convegno Nazionale di Archeozoologia, Pordenone, 13-15 novembre 2003. *Quaderni del Museo Archeologico del Friuli Occidentale*, 6: 97-109.
- Fiore I. & Tagliacozzo A., 2006 - Lo sfruttamento dello stambecco nel Tardiglaciale di Riparo Dalmeri (TN): il livello 26c. In Tecchiati U. & Sala B. (a cura di), *Archaeozoological studies in honour of Alfredo Riedel*. Ufficio Beni Archeologici, Bolzano: 59-76.
- Fiore I. & Tagliacozzo A., 2008a - Oltre lo stambecco: gli altri mammiferi della struttura abitativa dell'US 26c a Riparo Dalmeri (Trento). *Preistoria Alpina*, 43: 209-236.
- Fiore I. & Tagliacozzo A., 2008b - La caccia al Riparo Dalmeri nel Tardiglaciale dell'Italia nord-orientale. In Mussi M. (a cura di), *Il Tardiglaciale in Italia - Lavori in corso*. BAR International Series 1859: 55-65.
- Fiore I., Tagliacozzo A. & Cassoli P.F., 2002 - Ibx exploitation in the Dalmeri Rockshelter (TN) and "specialized hunting" in the sites of the Eastern Alps during the Tardiglacial and Early Holocene. *Preistoria Alpina*, 34 (1998): 173-179.
- Fiore I., Curci A. & Tagliacozzo A., 2003 - Tecniche di macellazione e sfruttamento dei grandi ungulati (*Bos primigenius*, *Equus hydruntinus*, *Cervus elaphus*) dei livelli epigravettiani di Grotta Romanelli (scavi 1954 e 1958). In: Fabbri P.F., Ingravallo E. & Mangia A. (a cura di), *Grotta Romanelli nel centenario della sua scoperta (1900-2000)*. Atti del Convegno, Castro, 6-7 ottobre 2000. Congedo, Lecce: 149-167.
- Fiore I., Pino Uria B. & Tagliacozzo A., 2004 - L'exploitation des petits animaux au Paléolithique supérieur-Mésolithique en Italie: l'exemple de la Grotta del Santuario della Madonna de Praia a Mare (Cosenza, Italie). In: Brugal J-P. & Desse J. (eds), *Petits animaux et sociétés humaines. Du complément alimentaire aux ressources utilitaires*. XXIV Rencontres Internationales d'archéologie et d'histoire d'Antibes, Antibes 23-25 octobre 2003. Editions APDCA, Antibes: 417-430.
- Guerreschi A., 1996, (a cura di) - *Il sito preistorico del Riparo Biarzo. (Valle del Natisone, Friuli)*. Edizioni del Museo Friulano di Storia Naturale, Udine, 144 pp.
- Gurioli F., Peresani M., Romandini M. & Sala B., (2009) - Predazione e sfruttamento di *Marmota marmota* nel sito epigravettiano di Grotta del Clusantin (Altopiano di Pradis, Prealpi Carniche). In:
- Pino Uria B. & Tagliacozzo A., 2008 - Rappresentazione scheletrica dei Cheloni dei livelli mesolitici di Grotta del Santuario della Madonna (Praia a Mare - CS). In: Corti C. (ed), *Herpetologia Sardiniae. 7° Congresso Nazionale della Societas Herpetologica Italica*, Oristano, 1-5 ottobre 2008. Edizioni Belvedere, Latina "Le scienze", 8: 407-411.
- Radmilli A.M., 1974 - *Gli scavi nella Grotta Polesini a Ponte Lucano a Tivoli e la più antica arte nel Lazio*. Sansoni, Firenze, 130 pp.
- Ravazzi C., Peresani M., Pini R. & Vescovi E., 2007 - Il Tardoglaciale nelle Alpi e in Pianura Padana. Evoluzione stratigrafica, storia della vegetazione e del popolamento antropico. *Il Quaternario, Italian Journal of Quaternary Sciences*, 20 (2): 163-184.
- Rocci Ris A., Cilli C., Malerba G., Giacobini G. & Guerreschi A., 2005 - Archeozoologia e tafonomia dei reperti provenienti da un livello epigravettiano (taglio 10) di Riparo Tagliente (Grezzana, VR). In: Malerba G. & Visentini P. (a cura di), Atti del 4° Convegno Nazionale di Archeozoologia (Pordenone, 13-15 novembre 2003). *Quaderni del Museo Archeologico del Friuli Occidentale*, 6: 111-123.
- Romandini M., 2004-2005 - *Studio archeozoologico dei resti faunistici del sito epigravettiano Grotta del Clusantin (Altopiano di Pradis, Prealpi Carniche)*. Tesi di Laurea Triennale, Università degli Studi di Ferrara, 124 pp.
- Rowley-Conwy P., 1996 - Resti faunistici del Tardiglaciale e dell'Olocene. In: Guerreschi A. (a cura di), *Il sito preistorico del Riparo Biarzo. (Valle del Natisone, Friuli)*. Edizioni del Museo Friulano di Storia Naturale, Udine: 61-80.
- Stiner M.C., 1994 - *Honor among Thieves. A Zooarchaeological Study of Neandertal Ecology*. University Press, Princeton (New Jersey), 447 pp.
- Tagliacozzo A., 1992 - I mammiferi dei giacimenti pre- e protosto-

- rici italiani. Un inquadramento paleontologico e archeozoologico. In: Guidi S. & Piperno M. (a cura di), *Italia Preistorica*. Laterza, Bari: 68-97.
- Tagliacozzo A., 2003 - Archeozoologia dei livelli dell'Epigravettiano finale di Grotta Romanelli (Castro, Lecce). Strategia di caccia ed economia di sussistenza. In: Fabbri P.F., Ingravallo E. & Mangia A. (a cura di), *Grotta Romanelli nel centenario della sua scoperta (1900-2000)*. Atti del Convegno, Castro 6-7 ottobre 2000. Congedo, Lecce: 169-216.
- Tagliacozzo A. & Cassoli P.F., 1994 - La macrofauna de l'Abri Soman (Val d'Adige-Italie). *Preistoria Alpina*, 28: 181-192.
- Tagliacozzo A. & Fiore I., 2000 - La chasse au bouquetin au Paléolithique supérieur en zone alpine. In: La Gestion Démographique des Animaux à Travers le Temps. VI Colloque International de l'Association "L'Homme et L'Animal", Torino, 16-18 settembre 1998. *Ibex Journal of Mountain Ecology* 5 - *Anthropozoologica*, 31: 69-76.

Appendix 1 - Ratio among the different Vertebrate classes (\*only Erinaceus, Castor and Marmota are considered).  
 Appendice 1 - Rapporto tra le diverse classi di Vertebrati (\*sono stati considerati soltanto i generi Erinaceus, Castor e Marmota).

VERTEBRATE	R. TAGLIENTE Lev. 17-13	R. TAGLIENTE Lev. 10 a-g	GR. CLUSANTIN	R. SOMAN Phase I	R. DALMERI	R. BIARZO Lev. 5	R. TAGLIENTE Lev. 7b-4	R. COGOLA US 19	R. SOMAN Phase II
	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP
Insectivores*	1			1	1		2	17	1
Lagomorphs	9	22	1	5	18		19		1
Large rodents*	50	28	470		20	16	11	18	18
Carnivores	11	46	4	22	154	19	373	168	352
Ungulates	268	2664	44	464	8418	491	405	203	372
<b>TOTAL MAMMALS</b>	<b>339</b>	<b>2760</b>	<b>519</b>	<b>492</b>	<b>8611</b>	<b>526</b>	<b>405</b>	<b>203</b>	<b>372</b>
AVES			2		86	4		12	2
PISCES				4	2055	2		72	3
<b>TOTAL VERTEBRATE</b>	<b>339</b>	<b>2760</b>	<b>521</b>	<b>496</b>	<b>10752</b>	<b>532</b>	<b>405</b>	<b>287</b>	<b>377</b>
INDETERMINATE	n.q.	211020	26637	4987	100898	n.q.	n.q.	4874	3080
<b>TOTAL REMAINS</b>	<b>339</b>	<b>213780</b>	<b>27158</b>	<b>5483</b>	<b>111650</b>	<b>405</b>	<b>405</b>	<b>5161</b>	<b>3457</b>
Burnt remains	n.q.	n.q.	22257	1023	20607	n.q.	n.q.	1600	425

VERTEBRATE	R. TAGLIENTE Lev. 17-13	R. TAGLIENTE Lev. 10 a-g	GR. CLUSANTIN	R. SOMAN Phase I	R. DALMERI	R. BIARZO Lev. 5	R. TAGLIENTE Lev. 7b-4	R. COGOLA US 19	R. SOMAN Phase II
	%	%	%	%	%	%	%	%	%
Insectivores*	0,3			0,2	0,01				
Lagomorphs	2,7	0,8	0,2	1,0	0,2		0,5	8,4	0,3
Large rodents*	14,7	1,0	90,6		0,2	3,0	4,7		0,3
Carnivores	3,2	1,7	0,8	4,5	1,8	3,6	2,7	8,9	4,8
Ungulates	79,1	96,5	8,5	94,3	97,8	93,3	92,1	82,8	94,6
MAMMALS	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
MAMMALS	100,0	100,0	99,6	99,2	80,1	98,8	100,0	70,7	98,7
AVES			0,4		0,8	0,8		4,2	0,5
PISCES				0,8	19,1	0,4		25,1	0,8
VERTEBRATE	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
TOTAL IDENTIFIED		1,3	1,9	9,0	9,6			5,6	10,9
INDETERMINATE	n.q	98,7	98,1	91,0	90,4	n.q	n.q	94,4	89,1
Burnt remains	n.q	36	82,0	18,7	18,5	n.q	n.q	31,0	12,3

Appendix 2 - Number of Identified Specimens (NISP) for insectivores, lagomorphs, large rodents and carnivores in the different phases of the analyzed sites.  
 Appendice 2 - Numero di resti identificati (NISP) di insettivori, lagomorfi, grandi roditori e carnivori nelle differenti fasi dei siti analizzati.

SPECIES	R. TAGLIENTE Lev. 17-13	R. TAGLIENTE Lev. 10	GR. CLUSANTIN	R. SOMAN Phase I	R. DALMERI	R. BIARZO Lev. 5	R. TAGLIENTE Lev. 7b-4	R. COGOLA US 19	R. SOMAN Phase II
	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP	NISP
<i>Erinaceus europaeus</i>				1	1				
<i>Lepus europaeus</i>	7	7					1		
<i>Lepus cf. timidus</i>	2	7		5			1		1
<i>Lepus</i> sp.		8	1		18			17	
<i>Marmota marmota</i>	50	26	470		3	15	18		
<i>Castor fiber</i>		2			17	1	1		1
<i>Canis lupus</i>		15	1	3	17		1	2	7
<i>Vulpes vulpes</i>		5			16	1			5
<i>Felis silvestris</i>		1							
<i>Lynx lynx</i> / cf. <i>Lynx</i>	2	2		7			3		3
<i>Lynx</i> cf. <i>pardinus</i>							present		1
<i>Panthera leo</i>	present								
<i>Meles meles</i>		6			5	4			
<i>Martes martes</i>				8	1			1	
<i>Mustela cf. erminea</i>			1						
<i>Ursus arctos</i>	11	17		4	46	14	7	14	2
<b>TOTAL NISP</b>	<b>72</b>	<b>96</b>	<b>473</b>	<b>28</b>	<b>124</b>	<b>35</b>	<b>32</b>	<b>34</b>	<b>20</b>

Appendix 3 - Number of Identified Specimens (NISP) and percentage of the ungulate species in the different phases of the analyzed sites.  
 Appendice 3 - Numero di resti identificati (NISP) e percentuali delle specie degli ungulati presenti nelle differenti fasi dei siti analizzati.

UNGULATES	R. TAGLIENTE Lev. 17-13	R. TAGLIENTE Lev. 10 a-g	GR. CLUSANTIN	R. SOMAN Phase I	R. VILLABRUNA Phase I (only %)	R. DALMERI	R. BIARZO Lev. 5	R. TAGLIENTE Lev. 7b-4	R. COGOLA US 19	R. SOMAN Phase II
	NISP	NISP	NISP	NISP	NISP %	NISP	NISP	NISP	NISP	NISP
<i>Equus hydruntinus</i>								1		
<i>Sus scrofa</i>		158	2	14		2	275	1	3	1
<i>Bos primigenius</i> / cf. <i>Bos primigenius</i>		13		2						18
<i>Bison priscus</i>		12								
<i>Bos-Bison</i>	59	29						3		
<i>Capra ibex</i>	180	82	5	77		7445	35	6	81	86
<i>Rupicapra rupicapra</i>		109	2	215		5	14	14	8	170
<i>Capreolus capreolus</i>	3	372		6		6	3	10	6	4
<i>Cervus elaphus</i>	5	1856	3	145		373	164	297	40	66
cf. <i>Alces alces</i>	21	17	2	5		2		2		7
<b>TOTAL NISP</b>	<b>268</b>	<b>2648</b>	<b>14</b>	<b>464</b>		<b>7833</b>	<b>491</b>	<b>334</b>	<b>138</b>	<b>352</b>

(Appendix 3 - Continued)  
(Appendice 3 - Continua)

UNGULATES	R. TAGLIENTE Lev. 17-13	R. TAGLIENTE Lev. 10 a-g	GR. CLUSANTIN	R. SOMAN Phase I	R. VILLABRUNA Phase I (only %)	R. DALMERI	R. BIARZO Lev. 5	R. TAGLIENTE Lev. 7b-4	R. COGOLA US 19	R. SOMAN Phase II
NISP %	%	%	%	%	%	%	%	%	%	%
<i>Equus hydruntinus</i>								0,3		
<i>Sus scrofa</i>		6,0	14,3	3,0	4,1		56,0	0,3	2,2	0,3
<i>Bos primigenius</i> / cf. <i>Bos primigenius</i>		0,5		0,4						5,1
<i>Bison priscus</i>		0,5								
<i>Bos-Bison</i>	22,0	1,1						0,9		
<i>Capra ibex</i>	67,2	3,1	35,7	16,6	56,6	95,0	7,1	1,8	58,7	24,4
<i>Rupicapra rupicapra</i>		4,1	14,3	46,3	21,4	0,1	2,9	4,2	5,8	48,3
<i>Capreolus capreolus</i>	1,1	14,0		1,3		0,1	0,6	3,0	4,3	1,1
<i>Cervus elaphus</i>	1,9	70,1	21,4	31,3	17,9	4,8	33,4	88,9	29,0	18,8
cf. <i>Alces alces</i>	7,8	0,6	14,3	1,1		0,03		0,6		2

