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THE MESOLITHIC HUNTERS OF THE TRENTINO: A CASE STUDY IN HUNTER-GATHERER SETTLEMENT AND SUBSISTENCE

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ABSTRACT

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This dissertation contributes to the understanding of Mesolithic settlement and subsistence change through a regional case study of archaeological data from the Trentino in northern Italy.

It is argued in this thesis that in order to understand this period of hunter-gatherer prehistory, it is necessary to examine both animal bones and lithic material. These represent the main forms of archaeological evidence recorded from a series of valley bottom rock shelter and open air high altitude sites in the Trentino. An interpretative framework using risk based models is broadly applied to these data. Risk management is considered from the perspective of maintaining necessary dietary levels, through maximising the nutritional value of animal resources (animal bone data) and by tool technology (lithic materials). Butchery data are considered as evidence for hunters obtaining important sources of nutrition, including carbohydrates and vitamins, through marrow and bone grease extraction (e.g. Speth 1991). Mesolithic stone tools are examined in terms of the risks of failing to kill or capture hunted animals - through the application of 'maintainable' and 'reliable' aspects of microlithic technology and its residue (e.g. Torrence 1989). The extraction and provisioning of raw materials required to manufacture and repair hunting technology also provides a regional perspective to stone tool using strategies.

Broadly, the rock shelters contain long term data-sets of animal bones and lithics. These provide a diachronic perspective to subsistence change. The open air sites offer a contrasting spatial perspective of Mesolithic settlement sites. Lithic material and site location, in relation to the surrounding topography, provides a framework for interpreting subsistence activities. The Grotta d'Ernesto cave provides further subsistence data related directly to ibex and red deer hunting. The combined study of animal bones and lithics, together with long-term and spatial perspectives provides a framework for then extending the scale of analysis from site based to regional in scale. Changes in settlement patterns are related to environmental processes that included increases in forest density, a reduction in mountain pasture areas and increased resource diversity in the valley bottom areas. Early Mesolithic subsistence is thus characterised as having a high altitude summer hunting component in which significant numbers of animals were killed and processed, while the later Mesolithic populations focused settlement and subsistence strategies in the lower altitude areas throughout the year.

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CHAPTER 1

INTRODUCTION TO THE STUDY

This dissertation is a case study of faunal and lithic data from hunter-gatherer sites in the mountain region of the Trentino in northern Italy. The principal aim of the study is to examine Mesolithic subsistence and settlement change through a *c.*5000 year period.

The study of the Mesolithic has, in the past, been affected by a view that often sees the period as a prelude to farming, a period that has neither the artistic traditions of the previous Upper Palaeolithic or the settlement and monumental sites of the Neolithic (e.g. Gamble 1986). The archaeology of the Upper Palaeolithic or the Neolithic are in many ways easier to study. This is because the data are so much more accessible (e.g. the rich cave art of Lascaux or the monuments of the Neolithic, of which there are plenty of theoretical models to attach to the data (Mithen 1990 or Thomas 1991)). In contrast the Mesolithic does not have a clear identity and the data is often poor - perhaps vague lithic scatters in the plough-soils of southern England (e.g. Clark and Schofield 1991) or an arrow-tip embedded in an animal bone (Noe-Nygaard 1974). This study attempts to redress this Mesolithic inferiority complex by demonstrating that these, the last hunter-gatherers of Europe, have a story to tell. By combining the study of stone tools with animal bones, we can examine how settlement and hunting strategies evolved in a period from the last ice age, which saw major climatic change of the kind that we are yet to be reminded of (e.g. *Rio Declaration on Environment and Development* 1992).

Mesolithic regional case studies, that examine change through time, are relatively uncommon in the literature. Most attention has focused on specific hunter-gatherer theoretical or methodological issues and tend to model short-term processes. These include simulating hunter decision-making (Mithen 1987 and 1990), examining Mesolithic social complexity (Bender 1978, Rowley-Conwy 1983 and 1986) or exploring processes such as lithic procurement or inter-assemblage variability (e.g. Myers 1989). Many of these studies rely on single classes of data, and do not explicitly recognise the advantages of the combined analysis of inter-related forms of evidence (i.e. lithics and fauna). Even studies that examine Mesolithic subsistence do not necessarily examine change through time (e.g. Jochim 1976), or if they do it is to contrast the Mesolithic with the later Neolithic period (e.g. papers in Zvelebil (ed) 1986). Jochim's later work does, however, recognise the advantages of both a long-term perspective on subsistence change, and the use of more than one type of archaeological data (Jochim 1989 and 1998). In the cases where long term adaptations are studied, the data are often poor in quality or represented by small sample sizes (e.g. Clark 1983 and Jochim 1998).

This study is seen as complementing much of this important earlier work, by offering a regional approach to a collection of sites with faunal and lithic assemblages. Although I recognise the need to go beyond the 'palaeoeconomic' descriptive approaches to regional studies (e.g. papers in Higgs (ed) 1972 and 1975) that initiated the broader study of economic archaeology, the interpretative framework used offers a cautious approach due to the incompleteness of the archaeological record.

Examining archaeological evidence for change is a principal element of this study. These changes will be viewed from the perspective of the evolution of increasing forested environments and resource diversity, rather than through social elements such as emerging cultural complexity, which the data under examination cannot focus upon (e.g. Bender 1978, papers in Price and Brown (eds) 1985). There are no Mesolithic cemeteries or evidence for sedentism or storage (social or otherwise) such as in Denmark (Rowley-Conwy 1983). Changes in settlement use, lithic procurement and site provisioning, hunting strategies and processing of meat and other animal resources are all aspects that can be traced in this archaeological record, and will come under examination.

The Research Framework: Focusing on Data and the Scale of Analysis

This research has had a long period of development, which started in 1986 when the writer carried out faunal studies from the rock shelters in the area of Trento. During this time there have been some changes in the overall approach to the study of hunter-gatherers.

From my perspective, I see much of this change as a 'loss of innocence' (Clarke 1973) and an acceptance of the limitations of archaeological field data. The 1970s and early 1980s were a time when archaeology was still enjoying the optimism generated in the

1960s by such seminal publications as Binford (1962 and 1968), Clarke (1968), Higgs (ed) (1972 and 1975) and Lee and DeVore (eds) (1968). The 1970s saw much of this early theory and 'New Archaeology' being given a quasi-scientific rigor, in which quantitative methods and statistical analysis were supposed to add credibility to the incomplete remains of past human activity (e.g. Doran and Hodson (1975), Cherry *et al* (eds) (1978) and Thomas (1978)). Research ranged from the modelling of the diffusion of farming across Europe (Ammerman and Cavalli-Sforza 1973) to simulation studies of hunter-gatherers based on sound ethnographic data and optimal foraging theory (e.g. Keene 1981, O'Connell and Hawkes 1981).

And then came taphonomy. In 1981, publications by Binford, Brain and Gifford focused attention onto issues concerning site formation processes that built on earlier studies such as Binford (1978a) and Behrensmeyer and Hill (1980). The incomplete nature of archaeological deposits was now confirmed. Agents such as carnivores, geological and climatic weathering processes, as well as human modifications, including butchery activity, were all seen to influence the raw data used by archaeologists to model and interpret prehistoric subsistence. My studies grew out of the gradual realisation that not only were such processes questioning the validity of much previous subsistence analysis (including quantitative faunal studies), but also that animal bone data could offer more about hunter-gatherer subsistence than estimating the numbers, age and sex ranges of hunted animals (e.g. Binford 1981).

Detailed ethnoarchaeological studies (Binford 1978a and 1981) and living experiments (e.g. Brain 1981) have shown not only how carnivores modify or accumulate bone material, but also how to identify different forms of butchery evidence (e.g. bone dismemberment from filleting or marrow extraction). My conclusion drawn from these studies is that behavioural analysis is more useful to subsistence analysis than just recording the numbers of bones found. How animals were exploited in terms of hunting and butchery patterns offers more meaning than answering the question of how many individual animals were present in each assemblage (Minimum Number of Individuals or MNI - Grayson 1984). Chapters 7 and 8 will illustrate this point, as the truncated nature of the rock shelter deposits and the 'spit' method of excavation makes quantification of animal numbers a questionable exercise.

Out of the realisation of the problems of focusing too closely on site specific data, or models that are too developed to allow application to poor or incomplete data-sets, this study offers a more 'broadly defined' approach to examining regional archaeological trends related to Mesolithic subsistence change.

Gould (1994) has argued that archaeologists can get too specific in their study of change and adaptation, and makes the point that we need to achieve the right level of abstraction so that both data and models have a chance of contributing to our understanding of processes such as subsistence change. From this perspective the scale of analysis is important. This is particularly the case in situations where archaeological assemblages or deposits may be incomplete for reasons including taphonomy, sampling and excavation strategies, and human behaviour itself. It is argued that the depth of theoretical analysis must, in some cases, make way for a more coarse grained approach to understanding long-term change in the archaeological record. The detailed theoretical models used in many aspects of optimal foraging theory (e.g. Keene 1981, Mithen 1990, Bettinger 1991) are not appropriate in situations where archaeological data can be considered poor or incomplete.

In discussing long-term change in the African Lower Pleistocene, Stern has characterised the archaeological record as time slices that average into 70k year units (1993). She argues that archaeologists currently lack the theory for understanding human or hominid behaviour over such long time scales. This is a view echoed by Gould (1994) and addressed by Gamble in his study of the Middle Pleistocene archaeological record of England (1996). As a means of overcoming such interpretative problems, Gamble examines the scale of the Pleistocene data. He contrasts this in terms of high quality information including *in situ* deposits like Boxgrove (the 'flagships'), and a second class (the 'dredgers') comprising stray finds such as rolled handaxes, which form the highest proportion of available data (Gamble 1996). As archaeologists cannot ignore the second class of data, Gamble suggests a framework for examining long-term change. By 'tacking' between different scales of data, it is possible to contrast the scale and temporal resolution of past behaviour (e.g. the rolled handaxes and Boxgrove, or between a 15 minute flint knapping event and 70k year unit of accumulated archaeological activity).

The important issue here for Gamble is recognising the different spatial and temporal scales to which behavioural questions are relevant (1996). This is also a basic issue for this study, which not only covers over 5000 years of settlement history, but also spatial and altitude scales that cover mountain and valley areas.

Although this study is not dealing with 70k year time spans, the question of scale is still relevant. The rock shelters in the Adige valley are initially seen as the 'flagship' sites and have deposits representing *c.*5000 years of human occupation (see Chapters 7 and 8). There are few rock shelters in Britain or Europe that contain these continuous deposits of flint and animal bones for the whole of the Mesolithic period. However, on closer inspection, the only practical way to examine this data is by dividing into units of analysis that correspond to 250-300 year time units. Although we may be able to identify 'events' that took place within some of these units, in most cases we are witnessing trends or processes in the data through hundreds of years.

The Mesolithic record from the Trentino can be viewed in terms of 'tacking'. We can tack from the processes seen in the rock shelter deposits to flint assemblages specifically associated with certain events (e.g. intercept/ambush hunting, the repair of projectile arrows in Area 8 at Colbricon, or the fire-side activity in the Grotta d'Ernesto cave). These identify specific events or tasks that undoubtedly took place as repeated behaviour, and it is through studying such repetition that we can build a framework for examining changes and trends in the Mesolithic archaeological record.

Work by Kuhn (1995) has demonstrated how the combined analysis of stone tools and animal bones (Stiner 1994) can provide more detailed insights into prehistoric subsistence. In this case the subject was Mousterian and Epigravettian lithic procurement in central Italy.

This study also examines these two forms of prehistoric subsistence evidence. The lithics are the tools used to kill the animals that form the faunal assemblages, and these remains constitute the main artefactual and ecofactual data from the case study sites. Chapters 2 and 3 develop a framework for specifically understanding these data. In line with the view that model building has to reach the right level of abstraction to deal with both the spatial and temporal aspects of the data, as well as with associated taphonomic factors, a generalised framework, in which both lithic and faunal remains can be integrated, is proposed. This relates to risk management within a changing environment, and the provisioning of places with raw materials for tools. The following sections will outline how the Chapters will develop this study of the Mesolithic in the Trentino.

The Study Area

The Trentino region comprises an area of sub-Alpine land to the north of the Po Valley in northern Italy (see Figure 1.1). The main river in the area is the River Adige and this broadly forms the western boundary of the study area. The main town in the region is Trento. This is located centrally on the River Adige between Verona (to the south of the study area) and the Brenner Pass which forms the border with Austria to the north. At Trento, two rivers, the Avisio and the Brenta, flow south-west into the Adige. These take water from the Dolomite area of the Alpe di Siusi and the Lagori Chain to the south. The area around Trento and these two mountain areas form the main study area (see Plates 1 and 2). In addition, further sites in the Valsugana (to the south of the Lagori Chain) and a site to the north of Lake Garda, are also considered in the wider study.

The evidence, comprising faunal and lithic material, comes from a series of well-defined archaeological sites that consist of rock shelter deposits, open-air lithic scatters and a cave. A quarry site with evidence of use during the early Mesolithic period, together with geological information on the provenancing of stone tool raw materials are also considered. An environmental framework for studying Mesolithic subsistence and settlement change is provided by a series of pollen records that cover the vegetational changes from the early post-glacial through to the Atlantic period.

The Scope of the Study

Chapter 2 provides a review of key contributions to hunter-gatherer studies. These include Jochim's (1976) concept of the Resource Use Schedule, in which it is proposed that subsistence strategies determine the location of settlement and demographic arrangements, as well as introducing concepts relating to random and selective hunting in the Mesolithic period (e.g. Mithen 1987). The second part of Chapter 2 develops a broad approach to risk management. It discusses how lithic data (technology) can be interpreted

Figure 1.1 Location map of the study area

T = Trento

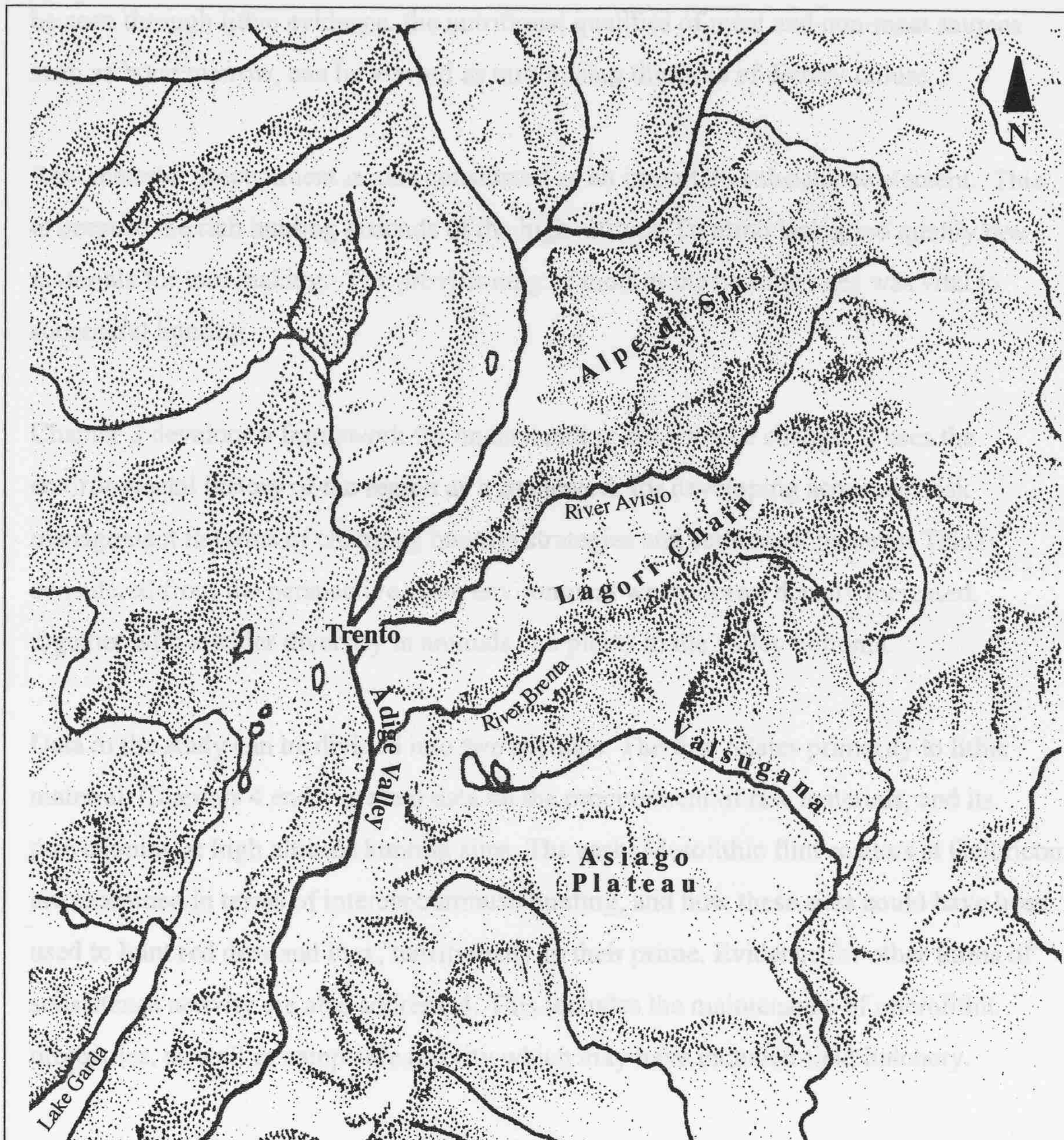

Figure 1.2 The main topographic features in the study area

as a means of reducing the risks of hunting failure. Faunal assemblages can also be studied from the perspective of risk management. Apart from hunting tactics, which may be seen through lithic evidence, the nutritional qualities of meat and non-meat sources such as bone marrow, can be viewed as minimising the risks of dietary failure.

Raw material procurement is also considered as an important subsistence element. This is because the rich hunting grounds of the high altitude Trentino lack good quality raw materials for tool making. The provisioning of tools at the hunting sites was vital to successful hunting.

Chapter 3 develops a framework for understanding subsistence change. It uses the environmental history of the region as a framework for developing aspects of risk management in terms of changing hunting strategies and settlement patterns. This is considered from the perspective of an environment where forest density increased, together with a wider diversity in animals and plants in the valley bottoms.

Data in the study can be divided into two sections. The first relates primarily to lithic material. Chapters 4 and 5 present data on the procurement of raw materials, and its provisioning at high altitude hunting sites. The early Mesolithic flint scatters at Colbricon are examined in terms of intercept/ambush hunting, and how these sites could have been used to hunt red deer and ibex, nutritionally in their prime. Evidence for other forms of subsistence activity are also addressed. This includes the maintenance of microlithic projectiles, as well as camp side activity which may have included field butchery.

The second part of the data study mainly concerns faunal remains. Chapter 6 provides an introduction to the Adige valley rock shelters in terms of their locations in the valley, as well as methodological issues relating to site formation processes and interpretative frameworks for studying and faunal (and lithic) material, which is presented as a series of case studies in Chapters 7 and 8. Chapter 8 also examines smaller, valley based sites that date to the later Mesolithic.

Chapter 9 presents the faunal material from Grotta d'Ernesto. This cave contains better preserved animal bone relating to specific hunting events, as opposed to trends or processes seen in the bones from the rock shelters. The presentation of this data is therefore seen as 'tacking' from the broad trends to something more specific (Gamble 1996). Although the quality of this assemblage allows for a more detailed study of some of the taphonomic processes that took place compared to the other bone assemblages, the final interpretation of both natural and cultural 'events' also has uncertainties.

Chapter 10 will summarise the conclusions reached from the preceding chapters and will provide a regional model of Mesolithic settlement and subsistence change in the Trentino, together with proposals for future research work.

Plate 1: A view looking down to the Adige Valley and Trento

Plate 2: A view looking up towards the Lagori Chain area

CHAPTER 2

THE ARCHAEOLOGY OF MESOLITHIC HUNTER-GATHERERS: DEVELOPING FRAMEWORKS

Introduction

As outlined in Chapter 1, most current theory and approaches to hunter-gatherer subsistence are more suited to the study of short-term adaptations, as opposed to longer-term regional studies. This is partly because these archaeological contributions rely on anthropological data and models. This chapter begins by reviewing the more significant archaeological contributions to prehistoric subsistence and risk management in terms of studying technology (including raw material procurement), as well as nutrition (animal bones). More recently writers such as Stern (1993), Gould (1994) and Gamble (1996) have advocated the need to apply the right level of abstraction in model building and data analysis in order to provide the appropriate understanding of the long-term archaeological record. This is particularly relevant to regional studies of change, where the quality of and types of data can vary significantly. As a result, the second part of this chapter explores an approach, which is more general, but allows the two main data sources (stone tools and animal bones) to be linked into the overall concept of risk management.

Both the faunal and lithic remains used in this study are limited in terms of their overall level of preservation (e.g. truncated rock shelter deposits or lithic scatters devoid of organic material). In order to maximise our interpretation of these data, in terms of a regional study, it is necessary to provide an integrated framework and overview of both lithic and faunal material from a single analytical perspective. From the general perspective of subsistence strategies, the risk of failure to procure or kill the chosen animal or plant source is something that hunter-gatherers need to minimise. Effective use of lithic technology (e.g. arrows to kill) can provide one means of reducing such risks. From this same perspective of dietary failure, food selection based on the nutritional qualities of hunted animals, in terms of providing adequate nutritional levels (e.g. fats and carbohydrates), can be explored through aspects of faunal analysis.

Ecological Modelling

Although the study of all prehistoric hunter-gatherer subsistence is clearly focused on archaeological data (including faunal remains and lithic material), the frameworks for understanding the meaning of this material, and its distribution within the landscape is based on anthropological analysis. Anthropology has provided the frameworks for developing models for understanding hunter-gatherer subsistence decision making. As early as the 1960s anthropologists such as Lee (1968 and 1969) implicitly recognised that risk, cost and energy minimization were important principles in hunter-gatherer subsistence. The !Kung bushmen of the Dobe in southern Africa were seen as subsisting on a *low risk, high return* diet - primarily of plant foods such as mongongo nuts. Although meat was consumed and regarded as ritually very important to the bushmen, hunting was considered by Lee to be a *high risk, low return* strategy (Lee 1968: 40).

Archaeologists such as Jochim (1976) and Binford (1980) have provided major contributions to the study of prehistoric subsistence by adopting Lee's (1968 and 1969) observations and formally applying economic anthropological principles to prehistoric data (e.g. Polanyi 1959 and Rapoport 1960). An important starting point for this study is Jochim's 1976 contribution to hunter-gatherer settlement and subsistence modelling. In many respects this was the first work to explicitly apply, in detail, the ecological and economic principals that were implicit at a more basic level in previous studies (e.g. papers in Higgs ed. 1972 and 1975). Jochim's work led to further refinements of ecological theories within prehistoric archaeology that form the basis of this study and a major review of hunter-gatherer foraging strategies is given in Kelly (1995).

Jochim applied the principle of the 'rational decision maker': in which an individual takes into account all the possible consequences of each course of action available to that person (1976:4-5). The concept of the rational decision maker is, however, based on culturally defined goals, as rationality is culturally specific. Using this as a basis, Jochim developed a model of hunter-gatherer settlement and subsistence which was grounded in four inter-related decision making concepts:

- the state of knowledge of the decision maker
- the criteria for the decision
- the solution (or strategies involved)
- and the procedures involved

The various states of knowledge are characterised by Jochim as certainty, risk and uncertainty, and he considered that hunter-gatherers lived in a world of "partial uncertainty" or risk. This is because the exact consequences of economic choices are not known, but are estimates based on previous experience as well as current information from scouting expeditions or information exchange. Jochim defined risk as "... each action is known to lead to a set of possible specific outcomes, each occurring with a known probability" (1976:5).

Jochim applied Game Theory to decision making under conditions of uncertainty, where subsistence is seen as a one-person game or gamble against nature. Out of a possible five criteria that can be used to guide decision making processes (Wald, Savage, Hurwicz, LaPlace and Simon criteria), Jochim applied the Simon satisficer criterion. Unlike the other criteria which focus on the minimum yield or highest average payoff, the Simon satisficer seeks to satisfy some predetermined aspiration level and Jochim suggests that this may reflect real world decision making more appropriately (1976:6). The Simon satisficer criteria was chosen because hunter-gatherer decision making also relates to the procurement of non-edible material such as hides and antler.

Of some significance to later discussions is the fact that hunter-gatherers may have had conflicting objectives, which are likely to have resulted in the acceptance of submaximal levels of adaptation. The procurement of raw materials for tools and suitable locations for sheltered settlement are all factors that require consideration within the decision making processes. The procurement of tool materials during (or embedded in) hunting expeditions may, for example, result in less animals being caught than if hunting were the sole activity. Alternatively, lower grade raw materials are extracted for tools to fit in with the hunting strategies rather than just focusing on specialised lithic extraction. Therefore, following on from the Simon satisficer criteria for decision making, there is a basic dichotomy between pure and mixed strategies. Pure strategies are very specific, while mixed strategies involve exploitation of more than one resource, or the performance of more than one task (e.g. hunting red deer and obtaining raw material during the same expedition). Such practices are more common to hunter-gatherer subsistence than pure strategies, and therefore mixed strategies are used in Jochim's model (1976:7). As this thesis combines faunal and lithic data from the perspective of prehistoric subsistence strategies, the study lends itself to the principals of mixed strategies, that includes raw material procurement.

The procedures used to operationalise the above decision making processes are based around the principle of minimization of effort, or the maintenance of expenditure within predefined ranges. Such decision making is, however, a complex procedure. This is due to a number of reasons including conflicting subsistence requirements such as choosing which animals and plants to exploit from a large number of potential resources within different habitats and at different times of the year. In addition, alternative activities and seasonal changes in settlement location, as well as the different social values of a particular group indicate how complex these decision making processes are. Jochim (1976:8) argues that this complexity requires a structured approach that only systems theory can offer. Archaeologists like Flannery (1968) had already demonstrated that a systems approach could be used as a framework for subsistence analysis.

Jochim (1976) applied a systems approach to subsistence analysis. This focused on solutions to problems relating to the location and timing of economic activities of a hunter-gatherer group. These 'problems' refer to issues such as which resources to exploit, by how much, where and when. It assumes that the answers to these questions will determine the size of the group needed to successfully carry out the tasks. These questions and their solutions are sub-divided by Jochim into three subsystems, of which the Resource Use Schedule is the prime determinant (the preferred range of foods and other resources exploited), which in turn influences the Site Placement and Demographic Arrangements.

Resource Use Schedule

↙↗ ↖↘

Site Placement ⇔ Demographic Arrangement

Although the primacy of the Resource Use Schedule is accepted here, it is based on the assumption that strategies of resource exploitation will, in nearly all cases, influence the location of settlement and population numbers. This study will examine different hunting strategies (intercept and encounter hunting) from the perspective of changes in settlement patterns. In some cases, however, the location of settlement does not always relate precisely to food exploitation. Ethnoarchaeological research post-dating Jochim's (1976) work introduces concepts such as 'logistical mobility' and 'task specific sites' - where groups of hunters work away from a base camp, perhaps for a few days or weeks, in order to exploit resources before returning to the main settlement with enough provisions for longer term storage (e.g. Binford 1978a and b). Mountain hunters may, for example, spend the summer months living off red deer and ibex and storing food for the winter months before moving to the more sheltered valley areas during the colder seasons.

The basic goal in the Resource Use Schedule is to achieve a secure level of food. "The minimum number of calories necessary for the biological viability of the population provides a minimum aspiration level" (Jochim 1976:16). Ethnographic study indicates that because of conflicting demands on time and energy, such as non-food material, the actual aspiration level is often not far above the minimum level (e.g. Sahlins 1968 and 1972). The minimum number of calories necessary for the biological viability of the population is an important concept that will be enlarged upon in relation to nutrition and the evidence from faunal remains such as marrow extraction.

As an alternative to securing the minimum level of resources to keep a population viable, Binford argues for security of resource procurement (1991). Binford examined this concept from the perspective of ethnoarchaeological work with the Nunamiut, and considers that a strong element with regard to security is how hunter-gatherers share their resources, as well as sharing information concerning their procurement. This introduces a range of social processes that are beyond the scope of most of the archaeological data presented in this study. However, in order to satisfy both food and non-food requirements, security of resource procurement is clearly necessary, and this may have involved co-operative works such as group hunting.

A further way that hunters achieve security is through having several prey species to exploit "... stability of an ecosystem increases with the number of links in the food web" (Jochim 1976:16). The ethnographic literature contains examples indicating that such risk minimization strategies are widespread, and, as in Jochim's (1976) Resource Use

Schedule, they can help dictate the location of settlement sites. For example, in the event that hunting strategies fail, the Great Slave Lake Indians in North America locate their temporary hunting camps near rivers with good fishing (Mason 1946). The Adige valley rock shelters were located in close proximity to a large lake/river system as well as access to large mammals. These rock shelters, particularly from the later Mesolithic periods, will be examined from the perspective of greater resource diversity.

The above factors form the framework for a decision making process which relates to the exploitation of a given range of resources. Hunter-gatherers obviously have extensive knowledge of those resources most important to their subsistence strategies. These include animal behaviour, the seasonality of resources and past success rates at hunting. Jochim, using ethnographic data, seeks to sort these into six attributes or 'measures of performance'- weight, density, aggregation size, mobility, fat content and non food yields (1976:23-26). These form the basis of his Resource Use Schedule and allow assessment of the individual attributes relative to each other. For example:

"*Secure food and non-food income*: A resource is of greater significance to meeting this objective the greater its weight and non-food yield, and its risk decreases as the density increases and its mobility decreases. Thus a resource may be rated by: wnd/m" (where w = weight, n = non food yield, d = density and m = mobility (Jochim 1976: 25)).

"*Taste*: a resource is tastier the greater its fat content": f (where f = fat content (Jochim 1976:25))

Alternatively, "*Prestige*: A resource is more prestigious the greater its weight, fat content, non food yield, and mobility, and the lower its density: wnfm/d" (where w = weight, n = non food yield, f = fat content, d = density and m = mobility (Jochim 1976:26)).

These attributes represent three out of a series of six guiding principals in the decision making processes relating to the Resource Use Schedule. The other three consist of *population aggregation at minimum cost*, *variety* and *sex role differentiation* (Jochim 1976:25-26) and are not outlined because they are not as applicable to the data within this study. Jochim applies these six Resource Use principals to ethnographic data from the

Round Lake Ojibwa of North America, and how the secondary sub-systems of settlement location and demographic arrangement have a determining effect on the settlement and subsistence patterns. The resulting information is then used to develop a model capable of predicting aspects of hunter gatherer subsistence decision making, and then tested with archaeological data from Mesolithic sites in southern Germany (Jochim 1976:83-188).

Although it is outside the scope of this study to outline the full results, Jochim's work represents a pioneering contribution to hunter-gatherer studies. From the point of view of this study it is sufficient to conclude that Jochim's work was one of the first to recognise that any archaeological study of subsistence needs to consider the interrelated nature of sub-systems such as resource exploitation, population and settlement systems. Jochim was also one of the first to recognise that much of the diversity in subsistence and settlement strategies can be accounted for through controlling or reducing levels of risk or costs of exploiting food resources. The levels of cost and risk were seen by Jochim as dependent on mobility, density and unit size of the resource being exploited (1976:25). A major difference between this work and my regional study is that Jochim (1976) did not examine hunter-gatherer subsistence strategies from the perspective of change through the long period of the Mesolithic. More recently Jochim has been carrying out further fieldwork in southern Germany, and has published the results as refinements to his 1976 study through a series of time slices of Late Palaeolithic, Early Mesolithic and Later Mesolithic periods (Jochim 1998).

Simulating Hunter Decision Making

Further developments relating to subsistence analysis and risk management have involved the use of computer simulation (e.g. Keene 1981, Mithen 1987 and 1990). Both Bettinger (1991) and Kelly (1995) provide extensive reviews and examples of case studies. Most simulation work, however, has been ethnographic in nature, and benefits from good quality field data that can always be re-examined when the results do not seem to fit the computer predictions (e.g. Winterhalder and Smith (eds) 1981). Archaeology does not have this advantage. It also suffers from the fact that the easiest data to model is short term 'single events' (as seen by anthropologists) - archaeology tends towards longer time scales.

Mithen's work is focused on Palaeolithic and Mesolithic archaeological data and argues that simulation provides an inferential tool that can be used to recognise distinct prehistoric hunting strategies (1987 and 1990). By using data from living red deer populations as a model, Mithen pursues a benefit - risk - cost analysis to contrast the Upper Palaeolithic environment of northern Spain with its tundra and rich patches of woodland with the forested environments of Mesolithic Denmark. Three recognisable hunting strategies used in this analysis (and based on interpretations by faunal analysts) comprise: 1) random hunting as practised in northern Spain (Clark and Straus 1983) in which game drives or stalking/trapping strategies are suggested. 2) a strategy in which only adults of both sexes between the ages of 4 - 8 years were hunted. 3) a similar strategy to 2) but in which there was a bias towards male red deer. Both 2) and 3) are selective hunting strategies that are believed to have been practised in Mesolithic Denmark (e.g. Bay Petersen 1978).

By examining the variation between Upper Palaeolithic and Mesolithic hunting we can begin to see diachronic variation as opposed to shorter-term studies (e.g. Jochim 1976).

Mithen's simulation models benefit, risk and cost for each of the above hunting strategies. Unlike previous studies (e.g. Jochim 1976), in which hunting and other resource exploitations were based on a time frame of a single year, Mithen adopts a multi-year framework in which fluctuations in red deer population densities are more readily open to study. The red deer meat acquired will vary from week to month depending on seasonal changes and other factors. From this Mithen estimates the 'benefit' as the mean annual yield of meat, and the variability in this (calculated by the coefficient of variation (standard deviation as a percentage of the mean)) over a fixed number of years as the estimate of 'risk'.

The third factor, 'cost' is complex and has a variety of different elements. Mithen summarises these as energy and time expenditure (making tools, hunting itself and animal processing), as well as social costs such as organising hunting expeditions (Mithen 1987 and 1990). To this we could add the maintenance costs of damaged hunting equipment. With regard to the three hunting strategies outlined above (1: random and 2 & 3: selective hunting), all have search, pursuit and processing costs.

Regardless of the hunting strategy, Mithen argues that search time will be more or less the same, as hunters as a rule rapidly assimilate information on herd location and its density. The main differences would be in pursuit and processing costs. Both pursuit and processing costs would depend on how many animals were killed. As the number increases, the pursuit and processing costs would also increase proportionately. My view is that it is possible to reduce these costs if large numbers of animals were killed at one area, such as at sites like Colbricon in northern Italy, where ibex or red deer were intercepted (see Chapter 5). The pursuit costs would be minimised and processing costs would also be managed more effectively through 'economies of scale' by group processing the carcasses. Mithen's view on costs is necessarily 'coarse grained', as factors such as age and sex of the red deer, their nutritional well-being (e.g. Speth 1983) and the thickness of their hide, will all affect both pursuit and processing costs. On this basis Mithen uses the number of animals taken each year as an estimate of the costs of the strategy.

A further factor likely to effect pursuit costs is the environmental changes caused by increased density of forest conditions in the later Mesolithic period (see Chapter 3). The costs of travelling to hunting grounds, which in the case of the Trentino, may also have increased, making the high altitudes uneconomic to hunt.

In order to provide the basis to examine contrasts between different prehistoric hunting strategies, Mithen used sex and age dynamics information from modern red deer populations from the island of Rhum in Scotland. Information on age ranges, the proportion of females, and the proportion which will produce females calves, was fed into the models. The same process was carried out for males and the simulation then followed for a natural population of red deer. Mithen then simulated different hunting techniques along the lines of random, adult and male red deer orientated hunting (Mithen 1987). The results of the computer processing are presented in graphical form as 'cost' plotted against 'benefit' and 'risk' against 'benefit' (Mithen 1987: Figures 8.7 and 8.8). These plots demonstrate that random hunting (as appears to have been practised in the Upper Palaeolithic of northern Spain) was more costly per unit of animal caught, but more risk minimising. In contrast, strategies focusing on adults and adult males (as seen in the Mesolithic periods in Denmark), are clear strategies aimed at obtaining greater quantities of meat, but with a greater degree of risk. Mithen therefore characterises Upper Palaeolithic hunting as 'risk minimising' and Mesolithic strategies as 'energy maximising' (Mithen 1987:104).

This outline of Mithen's use of computer simulation demonstrates that prehistoric subsistence analysis can go beyond the approaches developed by Jochim (1976), and that even in archaeological data-sets with post-depositional and other problems, such as small sample sizes, patterns relating to prehistoric decision making can be extracted from faunal data, and that the risk of failing to procure required levels of food is a fundamental factor to consider.

Hunter-Gatherer Risk Management: Technology and Nutrition

Measuring and Predicting Risk

From a hunter-gatherer perspective, risk can be defined as the probability of failing to meet dietary requirements. Risk management can be assessed by the effectiveness of subsistence strategies to control the spatial and temporal distribution of resources. There are two crude measures relating to resource availability that can be used for characterising the degree of risk. Firstly, the temporal variability on an annual timescale, relating to the growing season, will determine how long resources will be accessible. This can be approximately measured by latitude from the Equator - the shorter the season (the higher the latitude), the greater the level of risk. Secondly, the greater the mobility of the prey, the greater the risk (Torrence 1983 and 1989). To this we can add differing levels of resource density (e.g. population numbers, herd size). How these altered through periods of environmental change will affect the degree of risk.

Risk reducing factors for securing a reliable level of food depend on the ease at which the resource can be exploited. Difficult prey types (e.g. animals that are mainly solitary and adapted to mountainous or rocky environments - such as ibex (Riedel 1994)) will require more procurement time, and this can result in conflicts with other activities. We shall examine how technology can overcome some of these problems (Torrence 1983 and 1989).

Jochim (1976) noted that taste is an important subsistence factor for hunter-gatherers, and that this is closely liked with fat content. Although fat is often seen as fundamental to questions of taste in hunter-gatherer contexts (e.g. Rogers 1972 and Worsley 1961), more recent writers have demonstrated that fat is not only good to taste, but also contains valuable vitamins, particularly for hunters in cold climates or where there are significant seasonal resource shortages (Speth 1983 and 1991). In such cases fat is a fundamental need rather than a desire.

The minimisation of risk, in terms of animal exploitation, can be achieved through storage of meat or other animal products, or through strategies that alter or influence the spatial territory of a particular species. For example, burning forest and undergrowth to encourage new browse to grow will attract animals to congregate in order to feed and is known to have taken place in the Mesolithic period (e.g. Mellars 1976 and Simmons 1996). In this way hunters are influencing the aggregation patterns of animals and making their location within an environment more predictable. There is evidence from pollen records that such activity occurred in the Mesolithic in the study area (Oeggl and Wahlmüller 1994). In some cases it may be possible for hunter-gatherers to choose alternative resources to exploit, so as to reduce the reliance on a particular resource. During the later Mesolithic in northern Italy, the hunting of ibex was replaced by a greater reliance on other animals. It will be argued that this was a response to increased levels of risk associated with ibex hunting. As the tree line increased in altitude, animals such as ibex moved into more inaccessible areas to hunt, while population densities of red deer are likely to have reduced as well.

Time Management and Risk

Within any community the management of time and the conflicting requirements of different but complementary tasks will determine the overall success of a subsistence strategy. When the amount of time to carry out a particular task is sufficient, but where other forms of activity may be competing with that task, then organising or <u>scheduling of time</u> will be important. In seasonally constrained environments, such as the Trentino in northern Italy, the management of time is likely to have been critical to the minimisation or avoidance of risk of dietary failure. In order to maximise the exploitation of resources which may only be available for limited periods of time, it may also be necessary to schedule other activities around these restricted periods. This is a fundamental aspect of hunter-gatherer subsistence (e.g. Jochim 1976 and Binford 1978b).

From ethnographic studies, particularly in the northern latitudes which have highly seasonal climates, there is good evidence for scheduling activities. Torrence (1983) refers to Eskimo groups who lived off stored foods while they manufactured and repaired equipment in advance of the hunting season. Binford has demonstrated how the Nunamiut Eskimo schedule the procurement and maintenance of tools to avoid time conflicts within a highly seasonal subsistence strategy. Tool processing is 'embedded' into the subsistence strategies so that valuable food gathering time is not directly affected or compromised by tool production time (Binford 1979). Embedded lithic procurement, carried out during hunting trips, reduces the need to organise task specific groups to extract raw materials. Tool procurement can therefore be carried out when there is surplus time for extraction work or when the hunt has failed. As an alternative to 'embedded' tool procurement, where lithic material needed to make tools does not occur in the hunting areas, specialised procurement activity may be undertaken. Maintenance and repair work can also be 'embedded' or scheduled into periods when hunters are waiting for animals at hunting stands. Chapter 5 will discuss evidence of 'embedded' lithic maintenance activity at north Italian sites such as Colbricon, whereas evidence for specialised lithic procurement will be examined in Chapter 4.

It is clear that seasonality is fundamental to time scheduling, to the extent that in less seasonal environments, time management may not be such an important constraint as strategies aimed at reducing the processing costs of plant materials (e.g. Jochim 1976, Myers 1989).

Most anthropological contributions to the study of risk management are based in economic or ecological theory, and are a development from Jochim's 1976 study (e.g. Keene 1983, Smith 1981, Winterhalder 1986, Winterhalder and Smith (eds) 1981). The most comprehensive review of anthropological approaches to subsistence analysis is Kelly (1995). In many cases this research uses optimal foraging theory and computer modelling (e.g. linear programming models) based on anthropological data to predict archaeological hunter-gatherer subsistence. Much of this work was clearly normative in the way that it demonstrates how hunter-gatherers should behave. Further research examined the social means of reducing risk (Minnis 1985, Wiessner 1982 and Whitelaw 1983). Developing out of these studies attention has been given to the technological aspects of reducing risk (e.g. Torrence 1983, 1989 and Myers 1989). This is important because tools (e.g. lithics) form an important component of most prehistoric archaeological assemblages, and technology must be considered one of the key forms of reducing aspects of the risk to fulfil dietary needs.

Technology

Torrence (1989) focuses on the immediacy of the short-term perspective from the point of view of tools as a means of reducing risk (e.g. an arrow killing an ibex). Her basic principal is that technology is developed to solve problems. A fundamental problem to solve is the prevention of loss - every time a resource is encountered, there is a potential risk that it will not be captured or killed. Furthermore, the time for pursuit may be extremely limited. It is from this perspective that technology is seen as fundamental to both risk and time management (e.g. Torrence 1989 and Myers 1989).

There are two dimensions that technology or tools function at in order to reduce risk. Firstly, the overall use of technology within the subsistence strategies can be organised to minimise the effects of short-term risk. These include stone tool procurement, manufacture and maintenance and relate to the integration of technology into the overall subsistence strategy (Torrence 1983). These are largely related to time management. Secondly, and also of importance, is the nature or composition of the tool assemblage itself - if the amount of time is limited in the pursuit of an animal, then tools which increase the speed or efficiency at which the activity is carried out will be used. Ethnographic study of tools has demonstrated that concepts such as assemblage structure, diversity and complexity offer a means of classifying tools with regard to risk. These concepts provide the basis for characterising tools as ‘reliable’ or ‘maintainable’ (Bleed 1986) and represent two variables within lithic assemblages that are relevant to the study of archaeological data from the Mesolithic period.

Tool Assemblage Structure

If the amount of hunting time is limited, tools which increase the speed or efficiency at which the activity is carried out, will be used. The need to reduce the risk of hunting failure can be seen to be directly related to the structure of an assemblage (see Figure 2.1). Torrence has addressed this issue by examining tool assemblage structure in some detail (1983). She defines three dimensions to assemblage structure: composition (the functional categories of tools), diversity (number of tool types present) and complexity. Complexity refers to the average number of parts per tool or the total number of components in a tool kit and is considered from the perspective of this study to be closely linked with diversity. These dimensions to assemblage structure are considered in relation to ethnographic data collected by Oswalt, in which he proposes a typology of three major types of tools: instruments, weapons and facilities (Oswalt 1976 and Table 2.1).

Tool type	Example	Food types	Further comments
Instrument:	digging stick	plant / animal	Plants incapable of movement
Weapon:	arrow / projectiles	animal	Moving animals
Tended facility:	fish dam	fish	Weapon used to kill
Untended facility:	traps	animal / fish	Trap and kill
'Natural' facility:	hunting standings	animal	Facilitate hunting large numbers

Table 2.1: Summary of main tool types and related food sources- developed from Oswalt (1976) and Torrence (1983)

Torrence demonstrates that hunting can vary with latitude. Closer to the Equator, where time is not such a limiting factor, animals are hunted with weapons and instruments, while in the northern latitudes untended facilities such as traps are used more frequently (Torrence 1983:17). Untended facilities such as traps are useful when search time is high, as more than one can be used at a time. Tended facilities such as dams are ideal when fish are aggregated together and the hunter-fisher can make multiple kills. Such facilities are used in conjunction with weapons. It is argued here that hunting stands can be considered from the perspective of tended 'natural' facilities, in that they allow the land-form to provide opportunities for multiple kills. In the Italian Alps hunting stands are recorded in positions where oncoming animals (red deer and ibex) would have found terrain difficult to escape from during a sustained arrow attack by Mesolithic hunters (see Chapter 5). It is argued that such natural facilities reduce the mobility of the prey and thus reduces the risk of hunting failure (e.g. Torrence 1983). Straus (1993) has also provided an overview of how Upper Palaeolithic hunters used the land-form to facilitate mass killing successes. He also draws attention to the evolution of Upper Palaeolithic technology that gave humans specialised capabilities to exploit these mass kill situations, and to lessen the risk of hunting failure (Straus 1993). It is argued here that the bow and arrow, essentially a Mesolithic invention, would have been a highly effective weapon in mass kill intercept situations [illegible]

Weapons are also used [illegible] animals, and can be used to extend the effect [illegible] such as the bow and arrow. Such weapons [illegible] densities to warrant tended facilities, such as [illegible]

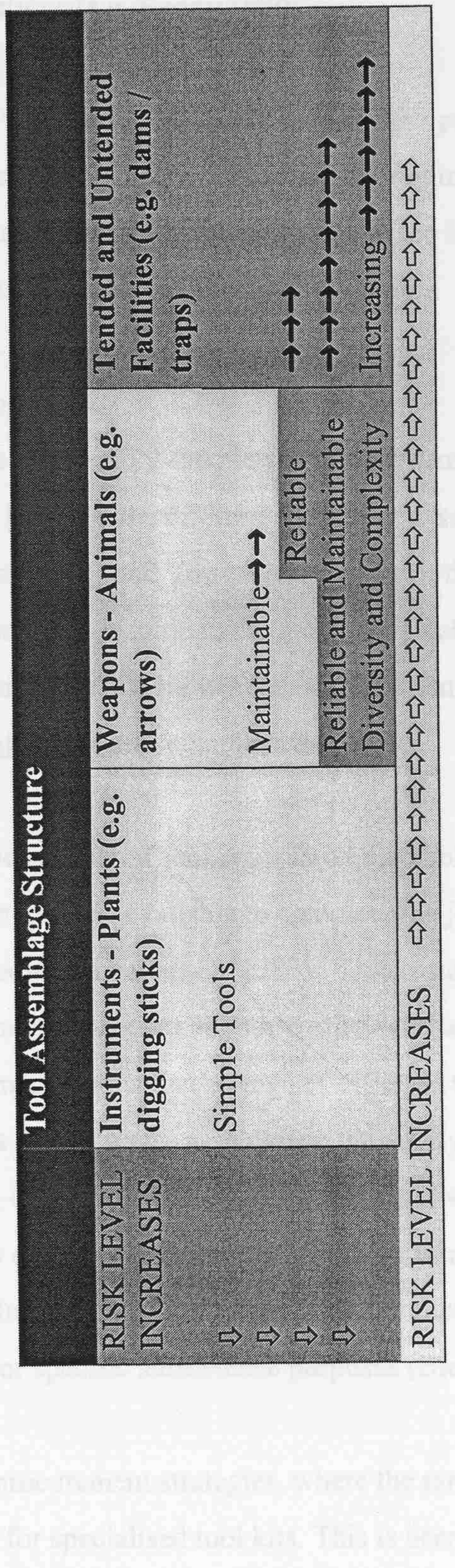

Figure 2.1 Summary diagram showing inter-relationship between different tool concepts and their relationship to differing levels of risk. This study focuses on Weapons.

Tool Diversity and Co[illegible]

It is often impossible to [illegible] assemblages, and as a result it is difficult to distinguish [illegible] assemblage structure as outlined above. Oswalt (1973 [illegible] therefore attempted to focus on approaches that are more [illegible] diversity and complexity of tool assem[illegible] can then be used to interpret lithics in terms of [illegible]

Torrence argues that the [illegible] assemblages should be negatively correlated to the [illegible] with small quantities of time, the diversity of [illegible] highly specialised tools used for a small [illegible] general purpose tools. Special purpose equipment [illegible] will undertake the same task and will result in a [illegible] therefore partly related to time management. An [illegible] a limited range of species within a highly [illegible] risk, and to reduce the time spent on hunting [illegible] increased to include special purpose tools for specific [illegible] purposes (Torrence 1989).

For more generalised procurement strategies, where the range of resources is higher, there will be less need for specialised tool kits. This is because the levels of risk are provided an overview of how Upper Palaeolithic hunters used the land-form to facilitate mass killing successes. He also draws attention to the evolution of Upper Palaeolithic technology that gave hunters specialised capabilities to exploit these mass kill situations, and to lessen the risk of hunting failure (Straus 1993). It is argued here that the bow and arrow, essentially a Mesolithic invention, would have been a highly effective weapon in mass kill intercept situations (e.g. Rozoy 1989).

Weapons are also used without facilities primarily for the pursuit animals, and can be used to extend the effective pursuit time through efficient tools such as the bow and arrow. Such weapons can be used when animals are in too low densities to warrant tended facilities, such as in encounter hunting situations.

Tool Diversity and Complexity

It is often impossible to ascribe tool function to lithic assemblages, and as a result it is difficult to distinguish between the different aspects of assemblage structure as outlined above. Oswalt (1973 and 1976) and Torrence (1989) have therefore attempted to focus on approaches that are more recognisable in the archaeological record: diversity and complexity of tool assemblage and how these variables can then be used to interpret lithics in terms of maintainable and reliable technologies.

Torrence argues that the number of tool types in an assemblage ".... should be negatively correlated to the amount of time available to complete the job; with small quantities of time, the diversity of tools will be large" (1983). This assumes that highly specialised tools used for a small number of uses are more efficient than general purpose tools. Special purpose equipment means that a range of different tools will undertake the same task and will result in a more diverse assemblage. Diversity is therefore partly related to time management. An example is taken from the Eskimo who hunt a limited range of species within a highly seasonal environment. In order to minimise risk, and to reduce the time spent on hunting, the range of technological components is increased to include special purpose tools for specific subsistence purposes (Bleed 1986).

For more generalised procurement strategies, where the range of resources is higher, there will be less need for specialised tool kits. This is because the levels of risk are lower. This is demonstrated in Torrence's scatterplot - (1983: Fig 3.1) which plots the total number of tool types against latitude for a range of different ethnographic groups. It shows that there is a significant relationship between tool diversity and resource specialisation, as seen through latitude. Lower latitude groups near the Equator exploit a broader range of resources in a low risk environment and their tool diversity is comparatively low. Higher latitude groups exploiting a more specialised range of resources utilise a more diverse tool assemblage. This is likely to compare with Mesolithic hunting in the Trentino mountains.

Although measuring diversity is considered more straight-forward than determining artefact structure, from an archaeological perspective it is not always easy to determine whether an individual artefact is a complete tool or part of a composite tool. Even with a detailed typological framework, as is available for the Mesolithic material in the Trentino (e.g. Broglio and Kozlowski 1983), the functional characteristics of the lithic assemblages is never clear. The concept of complexity within a tool assemblage is therefore considered to have greater archaeological value (Torrence 1989). Tool complexity is measured in terms of 'technounits' or the number of each component or integrated and physically distinct part that forms a finished artefact. In theory archaeologists can recognise 'technounits' as individual artefacts. Complexity is then either calculated as the total number of technounits in an assemblage, or the average number of technounits in each tool (Torrence 1989).

In the same way that tool diversity increases with latitude and with higher levels of risk, the complexity of tools can also be seen to increase. Torrence argues that complexity is inversely related to the availability of time. Rather than using simpler tools to provide the same function, the investment of extra time in manufacture is more than saved during its use (Torrence 1983). Complex tools such as hafted stone implements (and composite projectiles as used in the Mesolithic period) are time saving and risk reducing in that individual parts can be replaced if broken. This avoids the need to construct an entirely new tool. The use of such tools relates directly to the scheduling of time to invest in their manufacture. There is evidence for this kind of activity at the Colbricon sites (see Chapter 5).

For the purposes of this study it is argued that diversity and complexity are closely linked concepts. Complexity refers to components within individual tools, while diversity refers to the range of tools present. As with tool assemblage structure, a clear distinction between tool diversity and complexity is difficult because the terms are more readily identifiable through ethnographic work than from an archaeological perspective. Within archaeological assemblages, where less is known about the function and the nature of lithic artefacts, and composite tools in particular, it is very difficult to distinguish clearly between these two terms. This view is supported by the fact that even with a detailed typological framework, the functional attributes of lithic assemblages are not clear for the Mesolithic material within this study. Moreover, a very large percentage of the material within a site assemblage relates to debitage associated with lithic manufacture and repair. Such material is therefore outside the framework of lithic diversity or complexity. A lithic interpretative framework for the Mesolithic needs to accommodate waste material.

Reliable and Maintainable Tools

The fact that technology is organised in order to minimise risk of hunting failure can be explored beyond the concepts of diversity and complexity. When time is scheduled to manufacture or maintain tools, a more precise tool using strategy will be employed. Bleed has discussed design strategies by distinguishing between reliable and maintainable systems (1986). More recently it has been accepted that these represent variables and not separate types of technological systems (Myers 1989 and Torrence 1989) and that these may be more visible in archaeological analysis.

Maintainable technologies are employed when the pattern of tool use is either continuous or unpredictable and their design is based on modular components. Each component in maintainable tools serves a unique task and component failure will result in the total failure of that tool. It is therefore necessary for maintainable tools to be capable of being quickly and easily repaired. The tool user, or hunter, would therefore be expected to carry spare components, and it is noteworthy that the Castelnovian human burial at Mondeval de Sora contained grave goods of flint blades suitable for further processing into projectiles (Alciati *et al* 1994). The burial is interpreted as a Mesolithic hunter, complete with tool processing equipment and resin and propolis (this is produced by bees

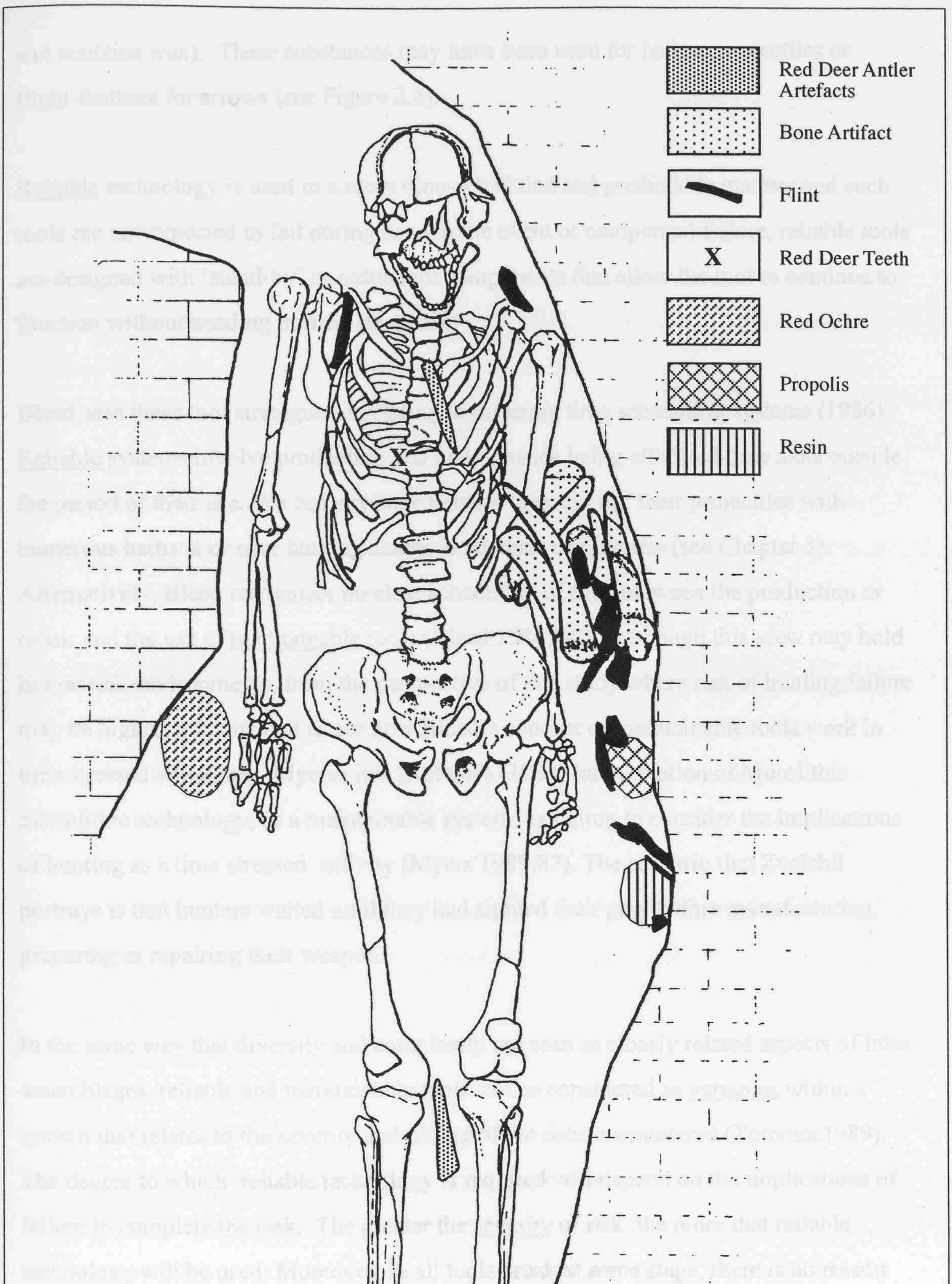

Figure 2.2 Castelnovian hunter burial from Mondeval de Sora

and contains wax). These substances may have been used for hafting projectiles or flight-feathers for arrows (see Figure 2.2).

Reliable technology is used in a more time-scheduled and predictable manner and such tools are not expected to fail during use. In the event of component failure, reliable tools are designed with 'stand-by' or redundant components that allow the tool to continue to function without needing immediate repair.

Bleed sees these tool strategies as relating to differing time scheduling systems (1986). Reliable systems involve production and maintenance being allocated time slots outside the period of their use. We can envisage hunters 'gearing up' their projectiles with numerous barbs at or near hunting stands in advance of their use (see Chapter 5). Alternatively, Bleed recognises no clear scheduling of time between the production or repair and the use of maintainable tools (Bleed 1986:740). Although this view may hold in low risk environments, from the perspective of this study where risk of hunting failure may be higher, it is difficult to see how Bleed's concept of maintainable tools work in time stressed situations. Myers cites Zvelebil's (1984) interpretation of Mesolithic microlithic technology, as a maintainable system, as failing to consider the implications of hunting as a time stressed activity (Myers 1989:87). The scenario that Zvelebil portrays is that hunters waited until they had sighted their prey before manufacturing, preparing or repairing their weapon.

In the same way that diversity and complexity are seen as closely related aspects of lithic assemblages, reliable and maintainable tools can be considered as variables within a system that relates to the severity and timing of the risks encountered (Torrence1989). The degree to which reliable technology is required will depend on the implications of failure to complete the task. The greater the severity of risk, the more that reliable technology will be used. Moreover, as all tools break at some stage, there is no reason why reliable tools need not be designed to be repairable outside the usual time scheduled for their manufacture and use: the tools will be designed to be maintainable as well. Torrence sees reliability as a response to the severity of the risk and maintainability as relating to the timing of that risk. In high risk environments there will be a high investment in reliable technology with a degree of maintainability.

A good example of tools that are both reliable and maintainable, as well as complex are the microlithic assemblages of the Mesolithic period, and in particular projectiles which contain numerous components (e.g. Myers 1989). It is argued here that identifying reliable from maintainable aspects from within flint scatters is unlikely to be practical. Instead, these concepts provide part of a more generalised framework for understanding Mesolithic flint material. The issues relating to the timing of maintenance and other preparation activity are considered as outside the scope of this study (even though well preserved flint scatters exist in the study area). These two qualities of stone tools: being quickly repaired within hunting timescales (maintainable), and reliable, in that if they are damaged, they will continue to perform, are seen as basic elements of the Mesolithic tool kit. By refining these definitions in too much detail, they can cease to be applicable to the broad levels of data under consideration (e.g. Gould 1994).

A further significant factor is that the variables of reliable and maintainable technology refer to processing activity as well as to tools themselves. This allows the analysis to include the residue associated with lithic workings, whereas the concepts previously discussed (complexity and diversity) only provide a framework for the tools themselves.

Implicit to the concept of maintainable and reliable technology is the fact that time is scheduled to process the tools. We can expand the concept of dedicated time for tool processing by examining specialised raw material procurement.

The Procurement of Raw Materials

The previous sections have focused on design aspects of technology. A second aspect relating to tools concerns their supply, or making sure that technological solutions are available where and when they are needed (Kuhn 1995). We have already noted that tool procurement and manufacture can be 'embedded' into other aspects of subsistence (Binford 1979). Binford has also referred to the issue of planning which, in this case, ensures the availability of tools in situations where it would not otherwise be possible to have them (Binford 1979 and 1989). Hunter-gatherers may therefore need to schedule time to procure specialised raw materials.

Kuhn develops the concept of technological provisioning from the perspective that food and raw materials for tools are not distributed within the landscape in a uniform manner, and that areas rich in food resources will not necessarily be rich in the raw materials. A good example are the high altitude Lagori Chain hunting areas which are located away from the raw material sources used at sites such as Colbricon (see Chapter 4). As a response to such situations, hunter-gatherers needed to resolve problems relating to the supply of hunting sites with raw materials. Technological provisioning refers to "...the depth of planning in artefact production, transport and maintenance, and the strategies by which the potential needs are met" (Kuhn 1995:22). Subsistence strategies therefore have to consider the procurement of raw materials, as well as obtaining the edible resources themselves.

Clearly the provisioning of raw materials in relation to the resources being exploited is fundamental to the success of any hunting strategy. From this perspective, the study of prehistoric subsistence calls for an integrated study of both lithic provisioning and hunting strategies. This is a central theme to this regional study. Although this research focuses on faunal remains, stone tools and the residue associated with their manufacture form an important element in any study of prehistoric subsistence (e.g. papers in Torrence ed 1989). Kuhn's work on the Middle Palaeolithic Mousterian and Upper Palaeolithic in the Latium region of central Italy follows a similar integrated approach (1993 and 1995). Detailed lithic analysis was undertaken from the perspective of the faunal material (Stiner 1994), and helped provide an 'economic' perspective to lithic technology. The Kuhn/Stiner research warrants a brief outline, because it represents an excellent example of how it is possible to gain a fuller understanding of prehistoric subsistence by integrating the studies of lithic and faunal data.

Mousterian and Epigravettian Lithic Procurement

During the Mousterian period there is a marked variation in core reduction techniques. Evidence taken directly from faunal analysis for Mousterian scavenging is associated with a radial preparation of disc-cores (Levallois technique). When applied to the small pebble raw material, it resulted in a limited number of relatively large and broad flakes in relation to the size of the core. By contrast, lithic material associated with Mousterian hunting is characterised by flakes that were detached in parallel from one or two platforms located at the ends of the cores. Using the same raw material of small pebbles, this technique resulted in a large number of smaller flakes per core.

The lithic material associated with scavenging shows further evidence of intensive exploitation in the form and frequency of retouch, and the pieces were often extensively reduced or resharpened. Hunting assemblages were less often reduced or resharpened. A third observation is that although the raw material (coastal pebbles) are of poor quality, the frequency of 'exotic' tool material, procured from outside the study area, is generally of low quantities. Such material is more common in assemblages associated with scavenging. The hunting assemblages show a complete reliance on the local pebble sources (Kuhn 1993 and 1995).

These variances in the lithic assemblages are best seen from the perspective of the mobility of the two different animal exploitation strategies. Scavenging is carried out by targeting relatively dispersed resources with low returns per procurement event (Kuhn 1993) and is coupled with the archaeozoological evidence for small sized animals (Stiner 1994). Such subsistence strategies imply frequent movements over large areas, and are considered, from ethnographic evidence, to involve a greater reliance on transporting tool kits (Kuhn 1994 and Kelly 1988). The characteristics of the scavenging lithics supports this case with evidence for extensive re-sharpening and reduction, indicating prolonged use. The large flakes resulting from the radial preparation of the cores would have been ideal for carrying around in a raw material poor environment.

The archaeozoological evidence for Mousterian hunting shows a greater return per foraging event, and the evidence indicates that almost complete carcasses were taken to caves for consumption (Stiner 1994). The archaeological evidence suggests a relatively less wide ranging land-use and a more prolonged occupation at cave/rock shelter sites. Kuhn argues that more stable residential patterns would involve less reliance on transported tool kits. From this perspective it was therefore less beneficial to produce large tool blanks that could undergo extensive re-workings. Within the context of longer periods of occupation Kuhn suggests that it may have been possible to store the pebble raw material at residential sites and then make relatively more, but smaller flakes, for lighter and shorter term uses (1993 and 1995). By contrasting transporting tool kits (provisioning people) with provisioning places, Kuhn examines whether Mousterian hominids were capable of technological 'planning'.

Kuhn has therefore isolated two alternative responses to 'delivering' technology. One is to keep individuals supplied with a portable tool kit (provisioning individuals) and the second is to provision places. This requires a higher level of forward planning, especially in areas where raw materials are not common. Kuhn uses his Latium Upper Palaeolithic data to expand this theory (1995).

During the Upper Palaeolithic Epigravettian period 'exotic' raw materials were brought from inland areas to the coastal caves in larger quantities than in the earlier Mousterian periods. The Mousterian imports of raw material are considered by Kuhn to have related to the provisioning of individuals as 'fallout' from transported tool kits, and not from raw material being carried to the cave for use there. Provisioning of places took place on a smaller scale and used only local pebble material. The Epigravettian groups deposited larger numbers of 'exotic' retouched tools than during the Mousterian period, even though the Mousterian sites were short-term camps, when it would be expected that more curated tools would be present. The reasons for this can be seen in relation to different strategies of regional land-use. The Mousterian subsistence strategy is characterised as 'opportunistically organised mobility' of very frequent and unpredictable residential moves, and is used by Kuhn to explain the scarcity of 'exotic' items in the coastal caves. In contrast Epigravettian groups followed more 'logistical' and planned subsistence strategies (Kuhn 1995).

If the Mousterian groups were opportunistic, it would not be possible for them to predict when they would reach the coastal caves, and it would be difficult to prepare materials specifically to take to the coast. As they moved about the landscape fewer of the transported 'exotic' goods would survive long enough to reach the coast. In contrast, if the Epigravettian occupation of the coastal caves was seasonal, or planned in some other way, this would have enabled the hunters to equip themselves in advance to cope with the poor raw materials at the coast. Furthermore, if the journey to the coast was quick compared to the opportunistic movements of the Mousterian, a larger proportion of the transported tool kit would reach the coast sites, to be recorded in the archaeological sites.

The suitability of the alternative strategies of provisioning depends largely on patterns of mobility and the duration of occupation. Highly mobile groups who do not spend much time in one place must depend to a large extent on the tools that they can carry (e.g. Kelly 1988). Groups that spend more time at one location, such as residential sites, or task specific sites that are reused on a regular basis, enable tool makers to cache raw materials or tools in the anticipation that they will eventually be used. It is argued here that these two alternative strategies are not mutually exclusive, as hunters who may 'provision places' with raw materials (e.g. hunting stands) are likely to own curated 'personal gear' (e.g. their own antler hammers to make or repair projectile points). Chapters 4 and 5 will examine the evidence for the provisioning of places in terms of lithic quarry sites in the Trentino region, and how material was partially-processed before being taken to hunting sites, where there is evidence that equivalent worked flint was imported to the sites (only small quantities of raw material had cortex). Chapter 4 will also briefly contrast evidence for 'embedded' lithic procurement at the Aurignacian Early Upper Palaeolithic site of Monte Avena in the study area, with later evidence for specialised lithic extraction.

Nutrition and Animal Resources

Although the remainder of this chapter will consider faunal remains from the perspective of the management of the risk of dietary failure, it is necessary to briefly consider plant resources. It is argued here that a practical distinction has to be made between animal and plant resources within archaeological analysis. Although the study of prehistoric subsistence is progressed by integrating lithic studies with faunal analysis, as outlined above, it is not as easy to develop this approach from the perspective of plant exploitation.

During the same year that Jochim published his study on hunter-gatherer subsistence, David Clarke produced an essay that argued the case for Mesolithic plant exploitation (Clarke 1976). This study challenged the established stereotype of Mesolithic hunter-gatherers as primarily meat eaters. Clarke's paper was not a formal model as such, but a polemic against the growing trend to see Mesolithic populations as primarily hunters (e.g. Jochim 1976, papers in Higgs (ed) 1972 and 1975 and Binford 1968).

Clarke argued that microliths could have been used for plant exploitation rather than as projectile points. He cited harvesting knives from Columnata in North Africa and sickles from Shanidar Cave in Iraq as plant processing tools using a range of composite microliths (Clarke 1976). This study acknowledges that plant resources were undoubtedly important during the Mesolithic period, and that tools recorded in the assemblages in this study are likely to have been used for their exploitation. However, the bulk of archaeological evidence within this study and elsewhere, indicates that the lithic material including microliths were predominately associated with hunting. There is clear contextual evidence that the high mountain camps at Colbricon, which display a range of microlithic processing and use activities, are associated with hunting stands used to ambush large mammals. Furthermore, blades ready for processing into microliths are found as grave goods at Mondeval de Sora, and appear as part of a hunter's assemblage, rather than as part of a plant gatherer's tool kit (see Figure 2.2 and Alcati *et al* 1994). In Britain there is a good example from the Vale of Pickering in North Yorkshire of a Mesolithic arrow with a wooden shaft and resin adhesive holding seventeen highly symmetrical microlithic barbs (David 1986). Further finds suggest up to 35 microliths on one arrow (Myers 1989). Furthermore, from Britain and elsewhere in Northern Europe, there is direct evidence of microlithic projectile points embedded in animal bones (e.g. Jacobi 1980 and Noe-Nygaard 1974).

The archaeological record provides a strong case for microlithic technology being related to animal hunting, and processing, as seen from butchery traces. The case for association with plant gathering is not so clear because plant remains rarely survive. Although we may be able to reconstruct vegetational histories from pollen and plant macrofossils found in association with sites, we are no closer to confirming which of the recorded plant species were exploited, by how much, and how plant exploitation strategies may have changed through time. Moreover, the ability to demonstrate contextual data in terms of site function (e.g. hunting stands for animal exploitation) for plant gathering is highly unlikely. If this research focused on plant exploitation, at the expense of hunting strategies, the study would be very limited in scope.

In addition to the clear association of microlithic material with hunting, as opposed to plant gathering, the costs and risks of exploiting these two very different resources vary greatly, to the extent that microlithic technology can be seen largely as a response to the risks involved in animal exploitation (Torrence 1989). The mobility of animals introduces different risks through their ability to avoid capture and to migrate or move around their territories. On the other hand plants are not mobile and their abundance and location is easier to predict (e.g. Torrence 1983). Furthermore, because of their smaller unit size, plants are considered more expensive to procure. The primary constraint in plant exploitation will be the high amount of labour and its cost in collecting, processing and transporting the resources, relative to the risks involved with hunting.

Food Processing Costs

The costs of plant processing can go beyond picking or harvesting that Clarke focused on, and it is stressed here that he did not discuss processing costs in enough detail (1976).

The following section discusses the importance of diet in terms of reducing excessive imbalances of proteins from animal resources. Many plants also contain high levels of proteins and other substances, and if consumed in an unprocessed state, are dangerous to health, or result in an imbalanced diet. Such processing introduces added costs and time for plant procurement. In south-eastern USA, for example, hunter-gatherers often pulverised nuts and shells and then boiled them to skim off oils. The remaining broth was then consumed after discarding the solids. This was a method for extracting carbohydrates and leaving most of the proteins as waste (Speth 1991:174). An example of the costs of exploiting plants and seeds relative to other resources amongst the Alyawara in Australia, demonstrates that seeds are expensive to exploit relative to their nutritional value, and optimal foraging modelling predicts that seeds would only be exploited when the return from other resources are very low (O'Connell and Hawkes 1981).

Speth notes that many seeds, nuts, stems and roots contain poisons or potentially harmful substances such as tannins, phytates and other compounds that can lead to the blocking of the absorption of important nutrients such as calcium, iron, zinc and starches (1991). Processing of such plants would be costly, labour intensive, and in many cases may require technological solutions for such processing to be cost effective (e.g. pottery). In the later Mesolithic period, when, compared to the earlier periods, a greater range of plants were available, new processing technologies may have been introduced. Evidence for such technology is, however, more clearly visible in the Neolithic (e.g. pottery and grinding stones or querns) and it is argued here that the Neolithic period saw the real emergence of large scale plant production in the form of farming. The point made here is that despite a greater abundance of plants in the later Mesolithic, these resources may not have been as accessible as other writers have indicated (e.g. Clarke 1976), and hunting was probably still a very important subsistence strategy.

The following section considers the nutritional aspects of animals. It will demonstrate that high levels of protein in a diet are particularly dangerous, and that carbohydrates and fats are essential to human health. A prime concern of Mesolithic hunters must therefore have been to reduce the risk of dietary imbalance, as well as risks discussed previously with regard to hunting failure. It is likely that such risks were most severe in the late winter and early spring when animals were in poor nutritional condition (Speth 1983 and 1991) - when there were also fewer plant resources available.

Animal Resources and Nutrition

In recent years it has been noted that there is a widespread tendency for hunter-gatherers to selectively exploit fatty meat and marrow (Speth and Spielmann 1983, Speth 1983 and 1991). There are numerous ethnographic examples which show preferences for fatty meat (Jochim 1981 and Speth 1983). These range from the Kalahari bushmen to the Hidatsa of the North American Plains (Speth 1983:146-147 for references), as well as high latitude hunters such as the Nunamiut (Binford 1978a).

Although the fact that fats taste good and produce a feeling of 'well being' is well known, prior to the work of the above writers, practically all subsistence studies concentrated on meat as a general commodity, or on its protein value. Early faunal analysts ignored the nutritional importance of fats and carbohydrates (e.g. Jarman 1972). The so-called 'feel good aspect' of eating such foods is likely to be related to the fact that a deficiency in fats and carbohydrates can lead to serious malnutrition, and even death. Research has also shown that there is an upper limit to the total amount of pure protein that an individual can consume on a sustainable basis without serious health loss (Speth 1991).

It is therefore necessary to consider in some detail 'taste' (one of Jochim's "measures of performance" (1976:25)). Since 1976 there have been important developments in research into the dietary needs that are of relevance to hunter-gatherer studies (e.g. Jochim 1981, Speth 1983 and 1991). From the perspective of failing to meet dietary needs (i.e. risk), a full and balanced range of vitamins and calories is fundamental to the viability of any population. The small unit size of plants and their high collecting and processing costs, indicates that in temperate environments animals are likely to have been more important sources of nutrition, particularly in the winter months. Although taste is considered a significant resource attribute measurable in terms of fat content, this can be considered the *emic* (subjective) attribute (Speth 1983). The *etic* (objective) attribute, less measurable to a hunter-gatherer than to a food scientist, demonstrates the nutritional importance of fat.

The scientific literature on human nutrition demonstrates why a high balance of fats and carbohydrates in relation to proteins is so important (see references cited in Speth 1983 and 1991). Fat provides a very concentrated source of energy, supplying over twice as many calories per gram as either protein or carbohydrates in a diet. Fatty acids also carry important vitamins such as A, D, E and K and bone marrow contains Vitamin C, a vital nutritional source. Fatty meats, together with bone marrow can therefore provide a sustainable diet to populations that lack major plant foods. These dietary studies, together with experiments of eating high protein lean meat diets which can quickly lead to 'nutritional starvation' and death, demonstrate that fatty meat is an essential element within environments short in plant food (e.g. Stefansson 1944). Although high latitude Eskimo groups are often considered prime examples of groups with very limited plant foods and who survive largely on fatty meat (e.g. Binford 1978a, Speth 1991), it is suggested here that seasonal fluctuations in a much wider range of environments, particularly in the glacial and early post-glacial periods, meant that animal based diets represented a widespread subsistence strategy amongst late Upper Palaeolithic and Mesolithic hunter-gatherers. The winter months represented a time when populations would have needed higher levels of energy to sustain them through the cold conditions. The following examples of protein versus fat and carbohydrate consumption have clear seasonal implications with regard to dietary balances.

The 'specific dynamic action' (SDA) of foods relates to the rise in metabolism or heat production that results from food consumption. The SDA of fats and carbohydrates is 4% and 6% respectively, whereas for proteins it is about 30%. This means that for every 100 calories of protein consumed, a further 30 are needed to compensate for the rise in body metabolism (Speth 1983). From the perspective of SDA it is clear that a reliance on fat or carbohydrate depleted meats would result in a greater demand in quantities of food (by 30%) to support the population. This would represent a significant increase in the workload of hunters during a period, such as the winter months, when the animals are likely to have been depleted of fatty tissues (Speth 1991). It was also a time when hunters would have needed to exert more energy for carrying out hunting activities, than in summer months, when their nutritional levels would have also been higher. Such factors would have been of prime consideration for Mesolithic hunters minimising the risk of dietary failure (e.g. through the use of <u>reliable</u> and <u>maintainable</u> technologies - Torrence 1989).

Even if larger numbers of fat depleted animals were caught as compensation, the reduced levels of fats and carbohydrates relative to the proteins, causes further nutritional problems. Of particular importance to the effective metabolising of proteins is the 'protein-sparing' effect of non-protein energy (fats and carbohydrates). Proteins are complex substances comprising nitrogen-based amino acids. Because there is a constant level of nitrogen in the proteins, their metabolism can be studied indirectly by measuring the amounts of nitrogen ingested and then excreted (Speth 1983: 154-155). If the amount of nitrogen lost is lower than that consumed, there is a positive nitrogen balance and proteins are being metabolised. If nitrogen excretion is greater than that consumed, protein is being lost. Carbohydrates and to as lesser extent fats, exert a 'protein sparing' effect, and if either source of energy is increased the level of nitrogen excreted in urine declines.

It is therefore important to note that carbohydrates are a vital energy source for protein metabolism, and a decline or lack of carbohydrates would severely limit the utilisation of proteins.

Further to the 'protein sparing' effect, research has added to the case that fat and carbohydrates are more critical to the human diet than proteins. There appears to be an upper limit to the total amount of protein that an individual can safely consume on a sustained level without damage to health. This approximates 300 grams of lean meat or 50% of an individual's daily calorific consumption. Prolonged intake above this level may exceed the rate at which the liver can metabolise amino acids and the ability of the body to synthesis and excrete urea. This can lead to liver and kidney disorders, and ultimately death (Speth 1991). Speth argues that the effective safe limit of 300 grams may in fact be less when protein intakes fluctuate between very high and very low levels or where there is a marked seasonal fluctuation in food resources such as in the winter months (1991). This situation may have developed during the late glacial and early post-glacial periods.

Research also indicates that the safe upper limit for protein intake for pregnant women may be considerably lower than the 300g cited above (Speth 1991). Although low protein intakes by pregnant women can be damaging to the health of both the mother and baby (*c.*5-6% of calories), recent studies indicate that protein in excess of 20% of total calories (or 100-150g of protein) may lead to declines in infant birth weight, mortality and cognitive development (Speth 1991:170-171). It has been suggested that this is a reason why there is a widespread prohibition of pregnant women eating meat amongst hunter-gatherers (Spielmann 1989 and Speth 1991).

Although much of this research is controversial with regard to the precise tolerance levels of protein within a total diet, it is concluded that these results have important implications for hunter-gatherer studies. In order to remain healthy, adults are required to obtain well over half of their calories from non-protein sources (fats or carbohydrates) and pregnant women need considerably more (over 80%). Speth draws attention to the fact that Eskimo women may have found it very difficult not to restrict their animal diet, and suggests that such groups may have had greater access to plant foods through consuming the partly digested stomach contents of animals. Alternatively, it is suggested that these populations may have been physiologically adapted to consuming larger amounts of protein (Speth 1991:171). Very little research has been carried out to investigate the possibility that prehistoric hunters may have also been physiologically adapted to consuming higher levels of protein than human populations today. Even if this had been the case, there would have still have been a limit to the levels of safe protein consumption.

In terms of plant resources, it is important to note that the seasonal low points in animal nutritional levels is likely to have coincided closely with periods of low vegetational productivity, to the extent that from the perspective of procurement strategies, they are interrelated. It is argued here that nutritional balance, and in particular the need for fatty meats and marrow, needs to be considered as an element of managing the risk of dietary failure (in the same way that technology may be used to reduce the risk of hunting failure).

Animal Nutrition and Environmental Change

During the late-glacial and post-glacial periods, there were clearly major environmental changes taking place (see Chapter 3). These changes are likely to have affected variability in the nutritional quality of animal resources, particularly in terms of fat and carbohydrate levels. During the glacial periods large mammals such as reindeer, horse and red deer are likely to have contained higher levels of fat all year to provide protection against cold temperatures, as well as for overall nutritional needs (Speth 1991:172). Regardless of the season, these animals are likely to have contained fats and carbohydrates that were used by Palaeolithic hunters subsisting predominantly on an animal based diet. During the warmer post-glacial, animals such as red deer and ibex are likely to have had less fatty tissue (Speth 1991:172). Speth suggests that due to the sharper seasonal variations in climate, they are likely to have used a proportionately greater amount of their body fat reserves in the winter months in order to survive these low points in the year. As a result, animals hunted in 'low seasons' (late winter and early spring) are likely to have contained higher levels of lean meat.

It is argued that during the post-glacial period, the warmer and more seasonal climatic conditions resulted in greater fluctuations in animal resources (fat and marrow) that were critical to a balanced human diet. Reducing such nutritional fluctuations would have been fundamental to minimising the risk of dietary failure. Chapters 7 and 8 will examine faunal evidence from the Adige valley rock shelters for intensive bone processing such as marrow extraction. This is the most direct evidence to support the case that Mesolithic hunters were responding to specific nutritional requirements for carbohydrates and fats.

It is also proposed that relatively large-scale meat and bone processing could have taken place during the early Mesolithic, when the animals were in their prime: the late summer and early autumn. At this time large numbers of animals such as red deer and ibex would have occupied the higher altitude pastures. As the winter seasons approached they would have migrated to the lower altitudes for shelter. These animals would also have congregated at water sources, which were limited in extent due to the Karst geology of the area. Mountain hunting sites such as Colbricon (Chapter 5) would have only been occupied during these same months, coinciding with the time when animals were nutritionally in their prime. During the winter and early spring these site would have been inaccessible because of the snows. Their use for summer and autumn hunting is likely to have resulted in marrow processing as well as other butchery processes, and it is possible that these resources were then stored for the winter months, through drying, smoking or making marrow cakes at the base camps. Mass killing of red deer herds, by driving the animals into some form of killing enclosures, has been argued from the late Palaeolithic of northern Spain (La Riera - Clark and Straus 1983), from elsewhere in Palaeolithic western Europe (Straus 1993 and references within), as well as in Mithen's simulation models (1987). These faunal studies indicate that more animals were killed than could be consumed in a short time, and have been used as indirect evidence for hunter-gatherer storage strategies (Rowley-Conwy and Zvelebil 1989).

Chapter 3 will develop the concept that effective use of tools to hunt and process animals represents a means of avoiding the risks of failing to kill the animals, and to sustain the necessary dietary requirements, particularly through the winter months. This chapter will outline changes in climate and vegetation during the Atlantic period that are likely to have caused changes in animal behaviour, herd size and population densities, as well as migration patterns. These factors could have affected the ability to capture herds of animals at their nutritional prime (e.g. through intercept hunting during autumn migrations (Binford 1978a)). If migration patterns or herd sizes changed and there was more reliance on encounter hunting (Binford 1978a), where lower numbers of animals were killed at one time, this is likely to have resulted in different settlement systems.

Discussion

The first part of this chapter outlined some of the more significant contributions to the study of hunter-gatherer subsistence (e.g. Jochim 1976, Mithen 1990). One limitation of much of this work is that it models static behaviour - hunter-gatherer foraging at one period of time (Jochim 1976), and is not as appropriate for studying long-term changes, which is central to this study. Most simulation work is also limited from this perspective, although Mithen's (1987) work on red deer hunting strategies does examine change through time - but from different geographic contexts (Upper Palaeolithic Spain and Mesolithic Denmark). One of the reasons why most studies focus on one period is that they are based on anthropological models, which concentrate on short-term events. A second reason is that there are few databases that cover long timescale within single archaeological deposits.

Regional studies such as the Mesolithic in the Trentino will use more coarse grained data that cover longer-term archaeological processes. It is for this reason that a different level of abstraction is required for this study. As noted in Chapter 1, Gould has argued that archaeologists can get too specific in studying adaptations, and that we need to apply the right level of abstraction so that data and models can contribute to our understanding of long term change (1994).

It is for these reasons that the second part of this chapter examined a broad approach to model building that uses the management of risk as a central theme. This noted that minimising risk can be achieved through technological solutions (Torrence 1989), as well as through diet and nutrition (Speth 1983). As a result, two complimentary forms of data can be linked into a single broad analytical perspective.

A regional approach can examine changes in subsistence and mobility patterns, and how the wider study area was exploited over a given period of time. The fact that there is a direct link between tools (as a technological solution to hunting success) and the faunal material, which represents the end result of the hunting strategies, demonstrates that an inter-relationship between the two classes of data exits. Both provide complimentary evidence that allows the study to extend beyond the site-specific to being regional in perspective. A further dimension to the study is lithic procurement as a means of provisioning places with the raw materials needed to carry out subsistence tasks. This extends the scale of analysis to include areas that provided raw materials within the overall study of regional settlement patterns. Areas rich in raw materials can be related to areas rich in food sources which do not have lithic sources.

Lithic and tool procurement (Chapter 4)

↓

Tool manufacture and maintenance (Chapter 5)

↓

Hunting sites (Chapter 5)

↓

Residential sites (e.g. rock shelters) (Chapters 7 and 8)

↓

Other sites (e.g. temporary shelters) (Chapters 8 and 9)

Figure 2.3: The range of archaeological sites in the study

From a practical perspective, by using a framework that brings together these two data sets, it is argued that the combined analysis is greater than that which individual faunal or lithic studies alone can provide. Such an approach is necessary because the quality of the faunal and lithic data-sets are limited in terms of post-depositional processes and in sampling biases, as well as in the hunter-gatherer behaviour that created the assemblages. An example is the high altitude sites at Colbricon which provide good spatial patterning and behavioural information of lithic material - but do not contain faunal remains. This is due to butchered material being removed from the site by hunters, as well as the exposed nature of the site, leaving the animal remains to weather away. These sites were used to hunt the same animals recorded in contemporary sites elsewhere in the region (the rock shelters in the Adige valley). Both lithic material and faunal remains do survive from the rock shelter sites. These, however, represent truncated layers of which the talus deposits do not survive. Because of these weaknesses in the data, we need a generalised approach to archaeological study that can link both types of data together.

The previous sections have outlined a number of different perspectives that can provide a generalised framework for understanding of the data assemblages. As a set of principles into which the framework of risk management can be applied, it is recognised that hunter-gatherers were 'rational decision makers' (Jochim 1976) and all aspects of subsistence were planned to provide a certain degree of security or minimization of risk for the hunter-gatherers (Binford 1979, 1989 and 1991). It is considered that a main principle of this study is that the archaeological assemblages and distribution of sites across the region can be examined for patterns in planned and repetitive or routinised behaviour (Gamble 1996). If such repetitive patterning can be found, we can begin to understand hunter-gatherer settlement and subsistence based on these trends. The isolated events, as seen in the archaeological record can then further inform us of the broader patterns seen in the long term rock shelter deposits through a 'tacking' manoeuvre between the different levels of data (Gamble 1996).

Although this chapter has introduced elements of the data in the Trentino, Chapter 3 will develop in more detail a framework for understanding Mesolithic subsistence in this area of northern Italy.

CHAPTER 3

A FRAMEWORK FOR THE STUDY OF MESOLITHIC SETTLEMENT AND SUBSISTENCE IN THE TRENTINO

Introduction

This chapter develops a framework for interpreting the data from this regional study, and is divided into two sections. The first provides an environmental history of the study area. Environment is an important factor, as changes in climate and vegetation coincide with changes in hunting strategies. The second section examines aspects of hunter-gatherer subsistence models and nutritional information outlined in Chapter 2 from the perspective of the Trentino region, and to Mesolithic Europe in general. Chapter 2 discussed hunter-gatherer lithic procurement and technology. These were seen as a means of characterising the nature of lithic composition in terms of managing risk (Torrence 1989). By combining this perspective on lithics with the study of changing settlement patterns and faunal remains, we will examine how Mesolithic subsistence adapted to environmental change during the period prior to the adoption of farming.

With regard to Britain, Myers (1989) argues that changing environmental conditions resulted in Mesolithic hunting strategies adapting to greater levels of risk. His work has clear parallels with this study in that environmental change during the Boreal and Atlantic periods in the Trentino mountains (i.e. an extreme environment) resulted in changes to hunting strategies. Changes in settlement patterns in this region are also apparent. It is argued here that although Myers' interpretations for environmental change and corresponding changes in settlement patterns, are based on weak or inconclusive lines of archaeological evidence (e.g. lithic scatters), the data from northern Italy is stronger.

The view that a similar environmental perspective is applicable elsewhere in Europe is supported by Jochim (1989). His paper was written partly as an endorsement of Myers' research, in which he provides interpretative perspectives based on data from south-western Germany. Jochim agrees that changes in environmental variables can be used to explain changes in aspects of the subsistence, technological and settlement systems

(Jochim 1989:110 and 1998). During the earlier Mesolithic period settlements were numerous and widespread across the region of south-western Germany. Later settlements are, however, generally rarer and areas particularly rich in early Mesolithic sites lack settlement material altogether (Müller-Beck 1983 and Jochim 1989). There are several interpretations for these changes in settlement patterns, and all offer environmental causal factors. These include population declines (Taute 1974), geological and climatic conditions reducing site visibility (Hahn 1983) and that changing subsistence strategies resulted in different settlement patterns (Müller-Beck 1983). It is likely that several of these factors were inter-related as adaptations to changing environments.

This study of the early and later Mesolithic periods in the Trentino follows similar lines. By integrating aspects of lithic studies with the analysis of animal bone data from contemporary sites, the case for demonstrating strategies for overcoming risk of dietary failure is strengthened beyond studies relying heavily on a single class of data (lithics). Moreover, neither Myers (1989) or Jochim (1989 and 1998) recognise the potential that detailed studies of faunal remains (including butchery or fragmentation patterns) and the overall issues relating to palaeonutrition (Speth 1983 and 1991), can provide in relation to data such as lithic material and environmental information. Before this work is developed, it is necessary to present an environmental context for placing the hunter-gatherers of the Trentino region into. Apart from presenting information on changes in flora and fauna, it offers glimpses into evidence for human management of the environment in the form of fire.

<u>Environmental Change</u>

In order to assess hunter-gatherer adaptations during the Mesolithic period, it is necessary to consider how the climate changed from the end of the last glaciation, and in particular the period after the Alleröd interstadial at *c.*12500 BP and into the periods leading up to the Holocene (see Table 3.1). A fuller environmental history is given in Appendix 1.

It is also necessary to briefly consider the areas to the south of the study area. This is because Pleistocene environmental conditions within the Po Valley and Adriatic Plain were more attractive to both human and animal populations than the harsher conditions of the Alpine areas (Van Andel 1989), which were not so intensively occupied as in the

	Climate	Vegetation	Other Comments
Late Glacial Maximum *c.*18000 BP	Cool dry winters. Warm dry summers	Po Valley: pine, some oak, alder and ask Sub-Alpine: Artemisia steppe	Significant seasonal variation. Permafrost in Alps
Older Dryas *c.*14000BP	Wetter more temperate winters. Lower summer temperatures	Po Valley: pine, birch, alder Sub-Alpine: Open environment, juniper, dwarf pine	Large and fertile Adriatic plain
Alleröd Interstadial *c.*12500 BP	Rapid warming. Mediterranean temperatures similar to today.	Increase in deciduous trees. Sub-Alpine Pine and mixed oak. Isolated microclimates of beech, linden and hornbeam	Unstable / unpredictable climate. Loss of Adriatic plain, alluviation in Po Valley. Increased seasonality.
Bölling Interstadial	Not identifiable in pollen records		
Younger Dryas *c.*11000-10000BP	Dryer/cooler winters. Hotter summers.	Reduction in tree and non-tree pollen.	Reduction in rainfall and growing season. Resulting in reduced foraging for animals and humans. Evidence for occupation in Sub-Alpine region of study area.

Table 3.1 Summary of environmental change from the post glacial maximum until the beginning of the Holocene period

Holocene period (e.g. Broglio 1994). During the period from *c.*14000 BP to *c.*9000 BP the Adriatic was a fertile plain and one of the richest Pleistocene environments in the northern Mediterranean (Van Andel 1989). The area contained good stocks of fauna such as equids, large bovids and giant deer, as well as plant resources. However, the area was gradually inundated by sea level rises and by the end of this period, only the coastal plain around the Gulf of Trieste and Istria on the eastern side of the Adriatic survived (Bietti 1990). The Po Valley may also have been affected by the sea level rises. The flooding of the Adriatic would have resulted in population declines and extinctions of the fauna and as the environment changed in these southern areas, it is likely that sub-Alpine regions such as the Trentino became recipient areas for displaced animal populations, as well as human groups. The same hypothesis has been presented by Miracle and O'Brien (1998) for the eastern Adriatic area and Milliken refers to similar processes in south-eastern Italy and its littoral Adriatic plain (1998).

The Changing Environment in the Holocene Period

Pollen analysis represents the most accessible means for understanding the vegetational history of any region. Although pollen relating directly to sites discussed in the following chapters (e.g. Pradestel) provides information on local environmental conditions, peat and lake sediments offer longer and more detailed sequences of information that demonstrate how vegetation evolved from periods after the last deglaciation.

For the Trentino, Lake Hirschbichl provides one of the best pollen sequences for examining environmental change during the Preboreal to Atlantic periods (Oeggl and Wahlmüller 1994). This covers the timescale for the sites within this study. Austrian palynologists have examined lake deposits within this region, as most data comes from the northern parts of the Trentino, where there are better lake deposits. Lago delle Buse and Colbricon are two sites located further south (within the Lagori Chain) that have provided further, though shorter timescale, vegetational histories (see Figure 3.1 for location of pollen sites). Unfortunately, compared to Britain, detailed interpretation of pollen in relation to climatic change and variations in seasonality is poorly developed. This is partly due to the complexities of micro-environments and seasonality: Italian analysis is limited to vegetational changes. Table 3.2 summarises the vegetational history for the Trentino region from a range of different pollen studies.

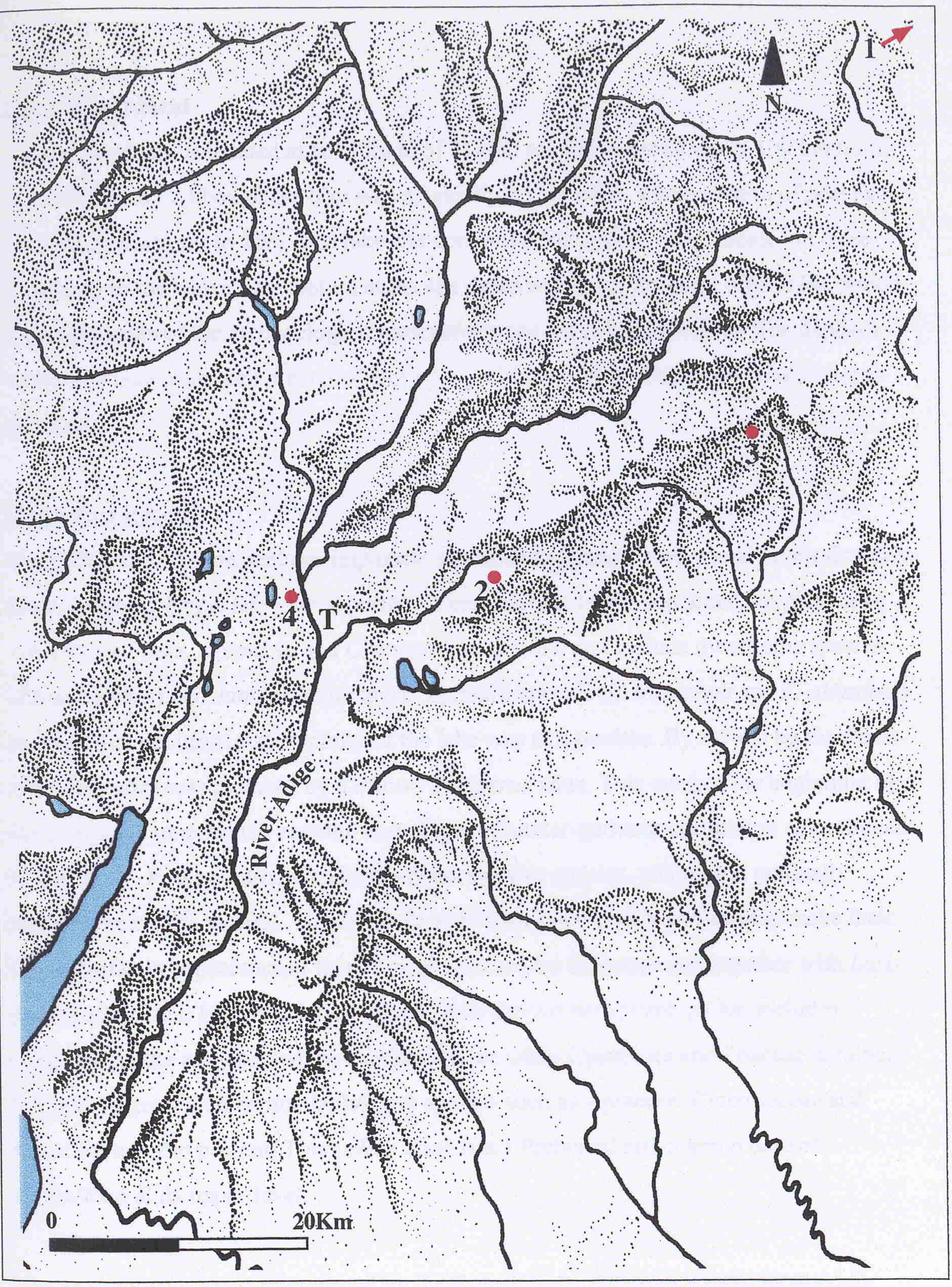

Figure 3.1 Sites containing pollen deposits

T Trento
1 Lake Hirschbichl
2 Lago delle Buse
3 Colbricon
4 Pradestel

Lake Hirschbichl

Lake Hirschbichl is located at an altitude of 2140m asl and approximately 100 km north west of Trento. Although the lake was originally *c.*50m wide, accumulation of peat has reduced its diameter to 10m. The lake site contains a Mesolithic camp located in close proximity to the water. Occupation at the site dated mainly to the early Mesolithic period. The full results of the archaeological excavations are yet to be published. The deposits within the lake were well preserved and both pollen and plant macrofossil material was sampled.

The Pollen Record

The pollen record represents an important sequence beginning at the basal levels that date to the Younger Dryas late glacial period. These earliest levels contained a typical open habitat of a *Pinus*, *Artemisia* and Chenopodiaceae zone and include dwarf pine species (*Pinus cembra*) and *Juniperus* (juniper). *Ephedra* species (*E. distachya* and *E. altissima*) indicate that the immediate vicinity of the lake was still treeless. By *c.*9400 bp the *Pinus-Artemisia* zone was replaced by a *Pinus* - *Juniperus* zone. This marked the beginning of the Preboreal zone, which sees the first stages of hunter-gatherer occupation as examined in this study. *Pinus* continues to be the dominant tree species, although it gradually declines from 60% to 50%. *Alnus, Larix* and *Picea* (alder, larch and spruce) make their first significant appearance at this stage. *Pinus cembra* increases and together with *Larix* (larch) attain their highest relative values. Non-aboreal herb/shrub pollen includes Artemisia in the early part of the Preboreal zone while Cyperacea and Poaceae dominate the later stages. Open habitat herb/shrub species such as Apiaceae, Cichoriaceae and Rosaceae are also present. This pollen stage has a Preboreal radiocarbon date of 9110±90bp at its upper level.

The next pollen stage is represented by the Boreal zone. This sees a large increase in *Picea*, particular in the second half of the period. A gradual rise in *Corylus* (hazel) and a decline in *Pinus* from 45% to 25% are also recorded. However, *Pinus* is still the dominant tree species. *Alnus* continues to rise in the Boreal period. Non-aboreal pollen fluctuates around *c.*15% of the pollen. Cyperacea and Poaceae as well as Apiaceae, Cichoriaceae and Rosaceae, *Sparganium* and *Thalictrum* attain percentage values. At

Age (bp)	**Pollen zone**	Rinderplatz-1780m	Seiser Alm 1880m	Colbricon-1980m	Schwarzsee - 2038m	Malshotscher Hotter- 2055m	Lago delle Bus- 2060m	Dura Moor-2080m	Hirschbichl-2150m
5000 6000 7000	Atlantic	*Picea-Pinus*	*Picea-Pinus*		*Picea- Pinus* *Pinus-Picea*	*Picea- Pinus*	*Picea-Pinus* *Abies-Fagus* *Picea-Pinus*	*Picea-Pinus*	*Picea-Pinus*
8000 9000	Boreal	*Pinus-Larix*	*Pinus-Picea* *-Larix*	*Picea-Pinus* [Mesolithic Occupation]	*Picea* rich *Pinus - Larix*	*Picea* rich *Pinus- Larix*		*Picea* rich *Pinus-Larix*	*Picea* rich *Pinus-Larix*
10000	Pre-Boreal	*Pinus-Artemisia-Cyperaceae*	*Pinus-Artemisia-Cyperaceae*		*Pinus-Artemisia-Cyperaceae*	*Pinus-Artemisia-Cyperaceae*	no data	*Pinus-Artemisia - Cyperaceae*	*Pinus-Artemisia - Cyperaceae*

Table 3.2 Composition of sub-alpine woodland in the mountains around the Adige valley during the early Holocene - based on Kofler (1994) and Oeggl and Wahlmüller (1994) and Seiwald (1980).

*c.*7900bp *Picea* (31-38%) becomes the dominant tree over *Pinus* (*c.*25%) and this broadly marks the transition from the Boreal to the Atlantic zone in this area of the Alps (Oeggl and Wahlmüller 1994). *Alnus viridis* and *Pinus cembra* (a dwarf species) drop to their lowest values. From this period *Fagus* (beech) shows a continuous presence and towards the end of the Atlantic *Abies* (fir) begins to establish itself. Non-tree pollen declines from 16% to 10% indicating denser woodland conditions as well as a rise in the altitude of the timberline. Table 3.2 confirms this general sequence from elsewhere in the Dolomite region (e.g. Dura Moor and Schwarzsee (Seiwald 1980)).

Plant Macrofossil Record

Plant macrofossil analysis has confirmed most aspects of the pollen study (Oeggl and Wahlmüller 1994). The advantage is that this material tends to reflect localised conditions better than pollen, as well as providing clearer anthropogenic evidence for fire.

The macrofossil evidence indicates that trees had reached the altitude of 2140m at Hirschbichl by 9370±170bp (VRI - 1137) and that pockets of trees were already close to the site during the Younger Dryas. A useful comparative example is Willis' (1997) data from the Klithi area in north-western Greece. The rapid (re)appearance of elm and lime in the pollen deposits at the site of Rezina, has been used to suggest the presence of micro-environmental refugia, in protected zones to persist in otherwise unfavourable climatic conditions. As soon as conditions warmed, these trees would have colonised quicker than in areas without these refugia (Willis 1997). It is argued that micro-environmental conditions could also have prevailed in sheltered areas of the Trentino, resulting in complex and patchy vegetational patterns as climatic amelioration took place.

By the close of the Preboreal the *Larix-Pinus* forest conditions had reached an altitude of at least 2200m. The forest comprised of *Pinus mugo*, *Pinus cembra* and *Larix decidua*. It is likely that *Alnus viridus* had already colonised wetter areas below and above the tree line. The forest floor included members of the ericaceous dwarf shrub community (e.g. *Rododendron* and *Vaccinium*) and was relatively open woodland due the presence of light demanding species including Caryophyllaceae and Chenopodiaceae. Alpine species such as *Saxifraga oppositifolia* further confirm open woodland. It is within this environmental context that we should consider early Mesolithic populations hunting red deer and ibex at sites such as Colbricon (see Chapter 5).

During the beginning of the Boreal period *Picea* colonises the *Larix-Pinus* woodlands and *Picea* needles, initially occurring in small numbers during the Preboreal zone, increase as plant macrofossils. This confirms that *Picea* was gradually colonising higher ground from *c.*9000bp on. This tree spread widely reaching its maximum distribution during the Atlantic climatic zone. During the Boreal the woodland became denser and this is shown as a progressive decline in non-aboreal pollen. This increased density of forest would have made hunting more difficult than in the preceding periods (Myers 1989).

Evidence for Human Activity: Fire

One important aspect of the Hirschbichl studies is that the cores were sampled at close intervals. This has resulted in the detection of intermittent falls in tree pollen, and in particular with *Pinus*. These falls are associated with minor increases in non-aboreal pollen including *Artemisia*, Caryophyllaceae, Chenopodiaceae, Gramineae and *Thalictrum* and suggests the opening of forest cover (Oeggl and Wahlmüller 1994: 81). The declines in *Pinus* occur abruptly during the middle period of the Preboreal and at the transition to the Boreal climatic zone. This dates to between 9200 and 9000bp-or the early Mesolithic (Sauveterrian) period.

There is convincing evidence that fire caused the drops in *Pinus* and the corresponding rises in non-tree pollen. Plant macro-fossil material contains carbonised pine wood and needles and fragments of *Larix/Picea* type wood. Oeggl and Wahlmüller consider that the size of the charcoal fragments are indicative of forest fires and not activity associated with the nearby Mesolithic site (1994:81). They support this interpretation by arguing that forest fires resulted in the occurrence of increased levels of Pteridophyte spores (including *Botrychium*, *Pteridium* and *Selaginella selaginoides*). In addition, the drop in *Pinus* at the Preboreal/Boreal transition and a rise in *Calluna* and *Betula* (birch) is then followed by the re-establishment of *Pinus*. Both pollen and macro-fossil records show a reduction in tree cover, and a corresponding rise in herbs such as *Artemisia*, Caryophyllaceae, Chenopodiaceae, and Gramineae. The decline in tree cover was thus allowing non-aboreal plants to increase as the tree canopy opened up.

There are occurrences of charcoal within the plant macrofossil cores throughout the Preboreal and Boreal periods, together with supporting evidence from pollen and spores. During the Atlantic period this evidence declines significantly. This pattern corresponds with a large-scale reduction in archaeological evidence for late Mesolithic (Castelnovian) activity within the mountain areas. Similar evidence for fire has been recorded in the early Mesolithic of northern England. This has been attributed to the maintenance of open vegetation to facilitate hunting by creating predictable places for animals such as red deer to browse (e.g. Mellars 1998 and Simmons 1996).

Although it may be argued that some of the fire indicators relate to occupation around Lake Hirschbichl, the evidence points to far more extensive activity. Camps would result in localised tree clearance and the use of mainly dead wood for fires. The environmental evidence suggests woodland management was taking place during the early Mesolithic period. This could have been a response to the growing density of forest cover and the effect that a reduced grazing area was having on populations of hunted animals such as red deer. By opening up the tree cover, herbs and grasses would increase and become attractive foraging areas for animals. Recent pollen analysis from Lago delle Buse has provided further evidence for fire activity in the Dolomite region (Kofler 1994). There is evidence for charcoal and reductions in tree pollen (mainly pine) during the late Boreal with a radiocarbon date of 8270±90bp (no laboratory references given). A further drop in tree pollen together with increases in charcoal is also shown for the early Atlantic period (6500±80bp - no laboratory references given). It is argued that this evidence for fire is comparable to that from Lake Hirschbichl.

As will be noted in the following chapters, the decline in forest fires during the Atlantic period coincides with a significant reduction in late Mesolithic occupation in the mountain zones. If hunters were not responsible for the fires, and it was the result of natural phenomena (e.g. lightning), there should be evidence for fire in the later periods as well. The following sections will explore further hunter-gatherer responses to increased densities of forest.

Environmental Change and the Archaeological Record

This section provides a framework for understanding subsistence and settlement change in the Trentino region by considering some of the aspects of hunter-gatherer adaptations discussed in Chapter 2. It combines examples taken from Britain and Europe as a means of providing a comparative perspective on Mesolithic adaptations. The Mesolithic in both Britain and Europe can be divided into earlier and later periods. This is based on changes in lithic styles and tool composition, as well as changes in settlement patterns. In northern Italy the cultural terms of the Sauveterrian and Castelnovian periods are applied to the early and later Mesolithic periods (Broglio 1962 and 1983) and broadly correspond with the Boreal and Atlantic pollen zones as outlined above.

Although developments in technology can be considered from the perspective of environmental change, post-glacial climatic processes were complex (Taylor 1975). In Britain detailed climatic analysis (of the kind that has not been carried out in the southern Alpine region), indicates that lowland temperatures rose from below 0^{0}C to 12^{0}C between 8000 and 6000bc (Myers 1989 and Taylor 1975). This period coincided with the transition from the Boreal to the Atlantic and resulted in longer autumn and spring seasons, and a reduction in duration and severity of the winter months. By *c.*5500bc these vegetational changes stabilised resulting in greater seasonal differences in resource availability (Simmons *et al* 1981). The corresponding vegetational changes resulted in birch and pine open woodland being replaced by a widespread mixed oak forest with a dense understory vegetation. The extensive nature of the mixed oak forest has been characterised by Myers as forming an increasingly <u>homogeneous</u> environment (1989). Mellars and Dark refer to the increasing densities of "monolithic" hazel woodland, with hazel nuts for a few weeks in the autumn, as a poor compensation for the dramatic loss of animal resources in the northern England (1998).

Vegetational changes in southern Europe developed differently compared to Britain. Evolving continental climatic conditions, together with increasingly warm Mediterranean influences (rather than the Atlantic influences that prevailed in Britain) resulted in greater vegetational diversity. Compared to the more limited geomorphological and topographical ranges in Britain, southern Europe also had a greater ecological diversity with regard to mountain zones, coastal zones and inland plains with river and lake systems (Jochim 1989 and 1998). These factors would also have contributed to an increased heterogeneous environment, that in the case of the mountains of northern Italy, has a vertical as well as spatial dimension. This is likely to have included greater levels of seasonality.

Unlike the British Mesolithic environment, in which dense woodland became more widespread (with little opportunity for new resources to colonise), the evidence for areas such as southern Europe and the Trentino, is that the warmer conditions resulted in the pine and birch woodlands being gradually replaced by mixed oak deciduous forests and large areas of hazel woodland. The growth of deciduous forests was confined to the valleys and lowlands, while pine and birch continued to dominate the uplands (e.g. Jochim 1989 and 1998). In the Trentino region, the higher altitudes were dominated by pine, spruce and alder in the wetter lake margins (Cattani 1994 and Oeggl and Wahlmüller 1994). As the region became environmentally more diverse or heterogeneous, the lower altitudes would have supported a greater range of edible resources, including populations of deer and pig. Woodlands are likely to have contained an increasing range of food resources including small mammals and birds, as well as hazel nuts and other plants. Rising temperatures in the river and lake systems would also have resulted in an increased diversity of species of fish, water fowl and river mussels, and it is likely that these become a more common food resource (Jochim 1989 and 1998).

Jochim argues that although there would have been an increase in overall resource diversity, big game would have decreased in density as grazing areas were reduced (1989:110). This view is supported by considering the evolution of the landscape from an ecological perspective. Greater heterogeneity is likely to have resulted in a more 'patchy' environment, with each area being relatively smaller than the earlier patches or environmental zones (Pianka 1983). The carrying capacities for large mammals within each zone would therefore have been reduced. During this process, for example, the mountain pastures of the Trentino region would have experienced a reduction in size. This was a result of the tree line moving higher in altitude and allowing pine and spruce to colonise the area, thus reducing the remaining pasture areas to the higher reaches of the mountains (e.g. Cattani 1983).

Changes in Animal Behaviour and Hunting Strategies

Animal behaviour would have adapted to these environmental changes, both in the Trentino region, and in Britain. During the earlier periods of open birch and pine woodlands, it is anticipated that animals, such as red deer, occupying the higher grounds of the uplands of northern Britain would have migrated down to more sheltered valley settings during the winter months (Myers 1989). The animals would then have returned at the onset of more favourable seasonal conditions. Such migration behaviour would have been predictable to maintain traditional hunting strategies, such as intercepting deer as they moved from the high ground to more sheltered areas in the autumn. Although such hunting had its origins in the earlier glacial periods, it is also well documented in the ethnographic literature (e.g. Binford 1978a).

Myers' model is largely based on Clark's (1972) reinterpretation of Star Carr, which has been examined with scepticism by more recent analysis (e.g. Legge and Rowley-Conwy's 1988 study of seasonality at this site). More recent support for Myers' use of Clark (1972) has been gained from the recent Star Carr investigations, in which there is support for at least some red deer migrations (Mellars and Dark 1998). Seasonal migrations are a basic premise of Myers' interpretation of early Mesolithic hunting. Due to the extremes of seasonality in the mountains of northern Italy the concepts of animal migrations and intercept hunting is probably even more applicable to this study than it is to Britain.

It is anticipated that populations of animals such as red deer, ibex and chamois would have responded to increased forest both in terms of density and the altitudinal range of the timberline. Some species may have adapted by shifting to higher and more marginal terrain (e.g. ibex). Chapters 7 and 8 will examine how ibex, and eventually chamois, disappear from the archaeological record by the later Mesolithic period. Populations of wild boar, an animal adapted to woodland environments, are likely to have increased. Other animals such as red and roe deer are likely to have adapted to a range of different environments, and in some cases, such as in closed woodland, are likely to have declined in overall population density (Jochim 1989). This is because the carrying capacity of forested environments, for large mammals, would have been much lower compared to the open woodland and pasture areas of the earlier Mesolithic periods (e.g. Legge and Rowley-Conwy 1988).

As a response to increasing forested conditions, there is evidence from the earlier Mesolithic of forest fires - perhaps to create openings in the woodland for animals to browse and facilitate better hunting conditions. No such evidence exists for the later Mesolithic (Oeggl and Wahlmüller 1994).

Behavioural studies of red deer offer an insight into how this animal is likely to have adapted to denser forested environments. A study of 26 red deer populations in Europe and north Africa shows that most are now adapted to woodland conditions and only four groups, all in Britain and Ireland, occupy open ground (Mitchell *et al* 1977). It is significant to this study that research indicates that red deer occupying open, mountainous areas form larger populations, while animals in woodland areas congregate in smaller groups (Legge and Rowley-Conwy 1988 and Mitchell *et al* 1977). We can envisage similar adaptations occurring in the transition from the Boreal to the Atlantic (or the early to later Mesolithic periods). The smaller woodland groups are usually represented by a hind and her young (2-3 animals), while in more open country red deer groups join to form large units (anywhere from 6-200 animals, but averaging at about 40).

In terms of later Mesolithic hunting strategies, the mixed oak forests and longer autumn and spring months, together with milder winters, would have made <u>anticipating</u> the movements or timing of animals congregating more difficult to predict. As large scale migrations ceased and population densities reduced significantly, it is likely that this resulted in alternative hunting strategies (and related technological solutions) as a means of providing the necessary nutritional levels. Myers argues that a shift in strategy took place in Britain and <u>intercept</u> was largely replaced by <u>encounter</u> hunting (1989). There is evidence to suggest that this happened in northern Italy and would have involved hunters following or stalking the prey, instead of waiting for the animals at predictable intercept points.

Encounter hunting is likely to have resulted in changes in the settlement patterns, as well as the organisational structure of the technology used by the Mesolithic hunters. If hunters were following smaller groups of animals with a less predictable foraging behaviour, than there would have been fewer opportunities to intercept groups of animals at key points in the landscape (e.g. water sources or migration trails). Instead, procuring smaller groups of animals in less predictable environments may have led to smaller hunting groups being dispersed across the landscape. Hunting may also have changed from a group to a more individual activity (e.g. Mithen 1987 and 1990). Such factors would have resulted in the formation of different types of archaeological deposits across the region or landscape.

There is evidence for a transition from intercept to encounter hunting strategies visible in the artefactual record, in terms of site densities and developments in lithic technology itself, both for the Trentino and in Britain (see below and Myers 1989). This study argues that we also need to examine animal bone assemblages for further evidence.

Nutritional Aspects and Hunting Strategies

The question of how changes in animal behaviour have affected hunter-gatherer nutrition is something that Myers (1989) and similar studies have not addressed (Rowley-Conwy and Zvelebil 1989, Jochim 1989 and 1998). New hunting tactics must have addressed problems associated with the threat of not satisfying nutritional requirements, particularly during the winter and early spring months (see Chapter 2).

We know from archaeological and ethnographic research that intercept strategies often involved killing significant quantities of animals at one time and in some cases selectively processing the carcasses (Clark and Straus 1983, Straus 1993, Speth 1983 and Binford 1978a). Binford's Nunamiut examples of late summer and early autumn intercept hunting took place during caribou migrations (1978a). This coincided with the period when animals were herding and in their physical prime. It represented the ideal time to obtain nutritionally rich meat and other resources in advance of the oncoming winter. We can envisage similar strategies during the early Mesolithic period when there is likely to have been a greater degree of animal migration taking place. The intensity of lithic deposits at sites like Colbricon, and elsewhere in the region, indicates that hunting focused on groups of animals rather than individuals.

If large mammals were the main sources of food and nutrition for the winter, any reductions in available resources caused by changes in animal behaviour, or population declines (so that intercept hunting was not possible), could have resulted in a greater degree of risk of securing appropriate dietary needs.

Mesolithic hunters would be aware that fat and carbohydrate levels fluctuated according to the season and the sex of the animal. Although it is possible that hunters were selectively targeting animals containing higher nutrient levels, instead of killing the first animal encountered, mass killings would also have allowed opportunities for selective processing at kill sites (e.g. Speth 1983). Some evidence exists for late Palaeolithic mass killing from northern Spain (Clark and Straus 1983), and in later periods this involved higher numbers of juvenile red deer and ibex.

Securing appropriate nutritional levels during encounter hunting may have been more difficult, particularly if animal populations were lower compared to the earlier Mesolithic period. Hunting may also have become more of a year round activity, with a significant reduction in the use of high altitude seasonal camps, resulting in increased levels of risk of failing to meet dietary requirements during the winter and early spring months. A less selective (or random) hunting strategy may have become more common, and this may have been offset by increased opportunities to exploit other food sources, as the environment increased in diversity (e.g. Jochim 1989 and 1998). It is likely that plants, birds, waterfowl and fish, located in the lower areas, provided new resources capable of being integrated into the later Mesolithic subsistence system, particularly as settlement during this period was more valley based.

The rock shelter faunal record can be examined for increased hunting of younger animals of both sexes to provide evidence for less selective hunting (Chapters 7 and 8). It is also likely that animal bones were intensively exploited for marrow and bone grease as well as for the meat itself. Such activities may have been practised at the residential sites.

From the perspective of archaeological data, it can be predicted that animal bones will be heavily utilised and fragmented in terms of bone processing for marrow and bone grease.

Although it is very likely that greater ranges of plant resources were available in the later Mesolithic, it is probable that they did not have the capacity to provide enough in terms of stored provisions for the periods outside their growing seasons (winter and spring months). Chapter 2 considered that processing costs go beyond picking or harvesting, and that although plants are rich in proteins, they have only limited levels of calcium and other important nutrients. Many plants that became more widespread during the later Mesolithic are likely to have had high processing costs to extract harmful toxins that can lead to the blocking of absorption of important nutrients such as calcium, iron and zinc (Speth 1991). It is argued elsewhere that although the later Mesolithic saw new opportunities for plant consumption, it was only in the Neolithic that processing costs were reduced by effective technology, and that the full potential of plants was realised only through plant domestication and farming. Prior to this, the knowledge to sustain a diet with a reduced level of meat consumption, may have been limited by the technology needed to extract toxins.

Site Densities and Settlement Patterns

Although the evidence for changes in settlement patterns in Britain is difficult to study in detail as most occupational evidence is limited to poorly preserved plough-zone lithic scatters (e.g. Clark and Schofield 1991), the Trentino data has the advantage that well defined lithic scatters appear in clear topographic positions which demonstrates they were used as intercept sites, probably for ibex and red deer. High altitude sites such as Colbricon date mainly to the early Mesolithic (Sauveterrian) period when the seasons were in sharper contrast compared to the later Mesolithic. It is likely that seasonal animal migrations did take place at this time. The altitudinal ranges of the Trentino mountain regions mean that the environments (or ecozones) are more mixed or heterogeneous compared to the homogeneous environments of Britain (Jochim 1989:110 Table 11.1) and there would have been more reason for large scale migrations. The degree to which animals were migrating is likely to have been greater compared to Britain.

An additional factor regarding early Mesolithic intercept hunting is that many of the sites are located near lakes. Surface water is a comparatively rare resource in the mountainous Karst geological environment (Lanzinger pers comm.) and would have helped determine the location of hunting camps. Animals would also have used these locations and the lakes therefore represented a predictable place to intercept animals. If animals such as red deer were migrating and congregating at predictable places and in significant numbers in the summer/autumn months, it is probable that game drives or intercept hunting strategies were employed. Autumn hunting could well have produced sufficient meat to last through the winter months. Such a strategy would have represented the optimum time to hunt animals carrying high levels of nutritionally important body fats (see Chapter 2). As the tree-line increased in altitude, the rising humidity of the Atlantic period resulted in many of these lakes turning into peat bogs, thereby reducing the accessibility of surface water during the later Mesolithic period.

Chapter 5 will examine how early Mesolithic sites were positioned in the mountain landscape, by using topographic features ('natural' facilities- Table 2.1), to intercept animals. The use of these high altitude site coincides with evidence for forest fires, which may have been used to facilitate hunting in increasingly wooded environments (Oeggl and Wahlmüller 1994).

If lower density animal populations were hunted throughout the year in the later Mesolithic, it is likely that settlement patterns changed accordingly. The general trend in the British settlement record is for a more widespread occurrence of smaller sites compared to the earlier period (Jacobi 1973) and coincides with a reduction in the numeric size of lithic assemblages. Myers (1989) suggests that this represents the change from intercept to encounter hunting strategies and is indicative of changes in subsistence from locationally based foraging (where sites may have been frequently reoccupied) to strategies reflecting a more mobile or generalised use of the entire landscape (e.g. encounter hunting strategies). This represents a transition from nucleated to dispersed settlement types. Smaller groups of hunters utilising a greater range of site locations would have replaced more seasonally based intercept strategies.

I suggest that there were new settlement patterns resulting from adaptations to encounter hunting. The British data, in which smaller density 'encounter' sites are seen in the later Mesolithic period is largely derived from plough-zone lithic scatters (Myers 1989). The Trentino in northern Italy has no comparable data, and instead the changes from intercept to encounter hunting need to be considered from the perspective of an increasingly heterogeneous environment, in which settlement focused in the lower altitude valleys. Rock shelters were occupied throughout the Mesolithic period, whereas the high altitude intercept sites were mostly abandoned by the later Mesolithic (e.g. Broglio 1994). It is argued that later Mesolithic occupation concentrated in the valley rock shelters, and that these residential bases were used, in part, for logistical task groups to operate from (see Chapter 8 and Jochim 1998 for a similar scenario in SW Germany).

The increased resource diversity in the later Mesolithic period, especially in the valleys, could have resulted in a reduced need to exploit the higher altitude zones. Denser forest in the Atlantic period would have also resulted in increased travel time, and hence added costs in reaching the high grounds. Subsistence activities are therefore likely to have concentrated closer to the river valleys. Logistical camps may have been located in the valley bottom areas, and evidence for such sites will be examined in Chapter 8.

Lithic Technology and Encounter Hunting

Compared to intercept hunting, encounter strategies are likely to have involved increased levels of risk, due to the more dispersed nature of animal populations. Hunters would have spent more time searching for animals with more limited guarantees of success (e.g. Binford 1978a). In order to respond to these new levels of risk, it is predicted that hunters invested in technology to minimise hunting failure (Torrence 1989).

The British earlier Mesolithic non-geometric lithic industries are characterised by a limited range of large microliths, as well as non-microlithic tools including transversely sharpened axes, steeply backed awls, end-scrapers and burins. Bone and antler tools were also commonplace (Jacobi 1987). In the later Mesolithic there is a replacement of the large non-geometric microliths with smaller geometric types including scalene triangles, rhomboids and rods, and a complete abandonment of bone and antler tools. In overall terms projectiles changed from being uniserial designs with limited numbers of components to bilateral projectile points with as many as 35 individual components acting as serial barbs (e.g. Readycon Dean in West Yorkshire). The later Mesolithic projectiles are likely to have been more accurate than earlier forms of arrow. This would have been important if hunting was largely practised in forested environments where a second shot at an animal may have been difficult compared to open conditions. Multiple barbs are also likely to have been more efficient at achieving greater muscle damage and severe bleeding than simpler forms of arrow. If hunting was more of an individual pursuit (both in terms of animal densities and hunters working the environment), the use of improved projectiles should have increased the level of hunting success. Such developments can be considered from the perspective of maintainable and reliable technologies. Myers suggests that these technological aspects came into play in Britain (1989).

The northern Italian early Mesolithic had already gained many of the technological advances that Myers argues for the later period in Britain. The British early Mesolithic does not share the range of microlithic material that is common to the Sauveterrian period in Italy. Although technological innovation obviously took place in the later Mesolithic (Castelnovian) period in Italy, in the form of trapezoidal projectiles and regular blades used as blanks for endscrapers and retouched blades, many of the attributes related to the British later Mesolithic, such as maintainable technologies were already established in the early Mesolithic (Sauveterrian) period (gearing up sites such as at Colbricon). It is possible that the trapezoidal projectiles represented a more accurate and effective cutting edge required for killing in forested environments. It is therefore tentatively suggested that Castelnovian technology shifted partly to reliable tools needed for more individual/forested hunting. Reliable projectiles would continue to operate if damaged (e.g. through deflection by trees in more wooded conditions) due to their 'stand-by' components.

Chapter 2 argued that it is almost impossible to distinguish between these two variables in the archaeological record, and it is likely that elements of reliable tools were in place in the earlier Mesolithic (Sauveterrian) period, and maintainable elements were in use in the later Castelnovian as well. This is to be expected. Both aspects of technology are considered as variables in which maintainable elements relate to the timing of risk and reliability to the severity of risk (Torrence 1989 and Chapter 2). It could, for example, be argued that due to the increased heterogeneity of the environment, severity of risk may have increased compared to factors relating to seasonal timing.

My view of Mesolithic technology is that although maintenance and reliability were important factors, the major innovation was the arrow. Arrows, throughout the Mesolithic, allowed greater accuracy in selectively hunting animals nutritionally in their prime in mass killing situations. It is also my view that the effectiveness of technology as an indicator for characterising the transition from intercept to encounter hunting (as Myers (1989) argues for the British Mesolithic), may not be quite so apparent as the settlement patterns for northern Italy. We need to consider the related aspect of how hunter-gatherers provisioned themselves with raw materials (Chapter 2 and Kuhn 1995). Changes in hunting strategies and settlement patterns are likely to have affected how raw materials were procured.

We will see in the first part of this regional study (Chapters 4 and 5) that intercept sites such as Colbricon were provisioned with partly processed raw materials. Such provisioning is likely to have been scheduled into the overall subsistence strategy. The provisioning of raw materials links with early Mesolithic maintainable tool kits located at specialised hunting sites. It is less certain how raw material procurement was provisioned in the later Mesolithic, when valley based hunting was more common. Clearly, we need to consider how lithic procurement changed with the transition to valley-based encounter hunting. If, for example, specialised lithic procurement from prime raw material resources was no longer taking place, were Mesolithic hunters using lower quality, more local, sources of flint?

An Interpretative Framework For Studying Regional Archaeological Data

The changing environment throughout the European Mesolithic is seen as an important backdrop to the archaeology. This study examines the changes in the regional archaeological record in the Trentino from the perspective of an increasing heterogeneous environment, as opposed to the homogeneous environments characterised for Britain (Myers 1989). Both studies demonstrate that there are a variety of types of evidence for organisational change common to both areas during the early and later Mesolithic periods. Characteristics observed by Myers will be seen to be visible in the Trentino - but operating in a different direction, or at a different stage or scale within the early/later Mesolithic divide.

Although it can be argued that the changes seen in the archaeological record are a coherent system of adaptations to environmental changes that operated throughout Europe, there was no single 'directional' mode for either environmental change or for the resulting archaeological record. Instead, evidence for changes in settlement patterns, lithics technology or animal hunting, need to be considered as variables that altered as responses to changing environmental conditions. One variable may have had a 'knock-on' effect on another variable: a change to encounter hunting could have affected settlement patterns.

In the later Mesolithic period, settlement patterns may have adapted to increased forested conditions by becoming more 'valley based', from which locationally-based hunters operated from (e.g. the Trentino). In other cases smaller groups may have used the landscape in a more generalised way, as the environment became more homogenous (in Britain). Changing settlement patterns may also have resulted in different constraints or opportunities with regard to the provisioning of raw materials, as well food resources themselves. There would, for example, have been no need to provision sites with raw materials if predictable intercept locations were not used in the later Mesolithic. The options for exploiting raw material sources may have changed with the transition to encounter hunting. If hunters were not using certain areas of previous territories, opportunities to obtain quality flint may have become too costly, and more local (and lower quality ?) material may have been used as a lower cost alternative. It would take longer to procure raw materials by travelling through forests than in more open landscapes. Provisioning of places may have been replaced by provisioning people, as hunting became a more valley based, individual / encounter strategy.

From the perspective of risk management and technology in the earlier Mesolithic of the Trentino, the timing of risk may have been greater than in later periods due to increased seasonality, the migrating movements of animals and less diversity in food resources, and aspects of maintainable technology may have been introduced (Torrence 1989). In the later period, the severity of risk may have increased with reduced densities of large mammals such as red deer. Obtaining key nutritional levels, on a year round basis, may have been harder to achieve. As a result, aspects of reliable technology could have been introduced to respond to increasing levels of severity of risk (Torrence 1989) 'Stand-by' redundant tool elements may have helped in the increased forested conditions of the later Mesolithic. However, as noted previously, I have reservations about the use of this twofold distinction between elements of technology, and instead consider them as useful concepts, but largely indistinguishable from each other in the archaeological record.

Although the environmental changes attributed to the Atlantic period resulted in greater vegetational diversity and a potentially enlarged range of food resources, subsistence strategies are likely to have experienced new difficulties. Larger and denser strands of forest could have made travel more difficult, and costlier in time. Potentially lower densities of animals, adapted to wooded environments, are likely to have required different hunting strategies, in which encounter hunting became more common. Although in some cases it may be possible to see evidence for a shift in hunting tactics through the tools used (e.g. Myers 1989), for this study it is more effective to examine changes in settlement patterns and animal species and age diversity as indicators of change. The use of fire, which is documented in the earlier, but not later Mesolithic periods of the Trentino, may have been a further human response to increasing forested conditions. Opening forests with fire would have been encouraged animals to browse in these areas, thereby providing better hunting opportunities.

The first part of this case study (Chapters 4 and 5) examines the early Mesolithic high altitude hunting sites, both from the perspective of how raw materials were procured in areas with no flint sources, as well as in terms of the specialised activities carried out at the sites. By studying raw material procurement, the scale of the regional study is extended beyond the sites relating to hunting. The hunting sites show two levels of information. The positioning of special purpose activity areas in relation to the surrounding typography provide good evidence for intercept hunting. Secondly, more detailed analysis of the lithic types (tools and microliths as well as residue) provide evidence for a range of activities including the 'maintenance' of projectile weapons.

The second part of the study (Chapters 7 and 8) examines the fauna, as well as aspects of the lithic material from rock shelters that cover both the early and later Mesolithic period. These sites provide the only record of how animal hunting changed with an increase in the forested conditions of the later Mesolithic. The study will also show that as the higher altitude sites ceased to be used in this later period, there is evidence for a wider range of site types in the valley bottom areas.

Detailed study of the faunal remains will also provide evidence for aspects of animal bone exploitation relating to age structure as well as marrow extraction. Most of the faunal data is of a generalised nature and provides evidence for broad trends in subsistence, Chapter 9 contains the study of a well preserved faunal assemblage from a cave. This chapter is considered as a "tacking" manoeuvre from the generalised archaeological record to a detailed event. It seeks to remind us of the human dimension to the information discussed in this study.

A further significant factor is that both the high altitude hunting sites and rock shelters show repeated forms of patterning in the assemblages as well as the positioning of sites within the landscapes. Such consistency in artefact scatters, their position in the landscape, and patterns in the faunal data, provides some degree of confidence in our interpretations of Mesolithic subsistence.

CHAPTER 4

PROVISIONING PLACES: RAW MATERIAL PROCUREMENT IN THE TRENTINO

Introduction

This chapter examines aspects of the archaeological evidence for lithic procurement in the Trentino region. Although little is known about the provenance of much of the lithic material found at open air and rock shelter sites, petrological studies are beginning to provide some indications as to where lithic sources were located (Benedetti *et al* 1994), and some late Upper Palaeolithic and Mesolithic flint extraction sites have been recorded (e.g. Val Lastari - Peresani 1994). As part of this overall study flint samples from Colbricon, Pian dei Laghetti and Riparo Villabruna have been compared to raw material samples taken from geological contexts (Benedetti *et al* 1994). This allows a broad model to be developed for linking raw material sites with subsistence sites elsewhere in the region.

This study is based on the fact that the flint from hunting areas such as Colbricon needed to be transported to the site, due to the lack of local raw materials (see Figure 4.1). Most of the high altitude hunting sites are located in metamorphic basement rocks with Permian Volcanic outcrops that do not contain flint. Hunters visiting these high altitude sites had to procure flint material from areas to the south, or elsewhere. It is therefore a good example of 'provisioning places' with raw material (Kuhn 1995). The first part of this chapter examines the evidence for provenancing the raw material recorded from sites like Colbricon. This is followed by examining archaeological evidence for lithic procurement quarry sites. Chapter 5 follows on from this study by examining the lithic assemblages from Colbricon. Colbricon shows clear evidence for the primary lithic procurement processes that are to be outlined in this chapter, from the perspective of a site receiving the raw material. The detailed study of the lithics in relation to the specific locations of activity areas within the Colbricon landscape provides a framework for interpreting site functions. Chapters 4 and 5 demonstrate a link, at a regional scale, between flint extraction sites and subsistence activities associated with high-altitude hunting.

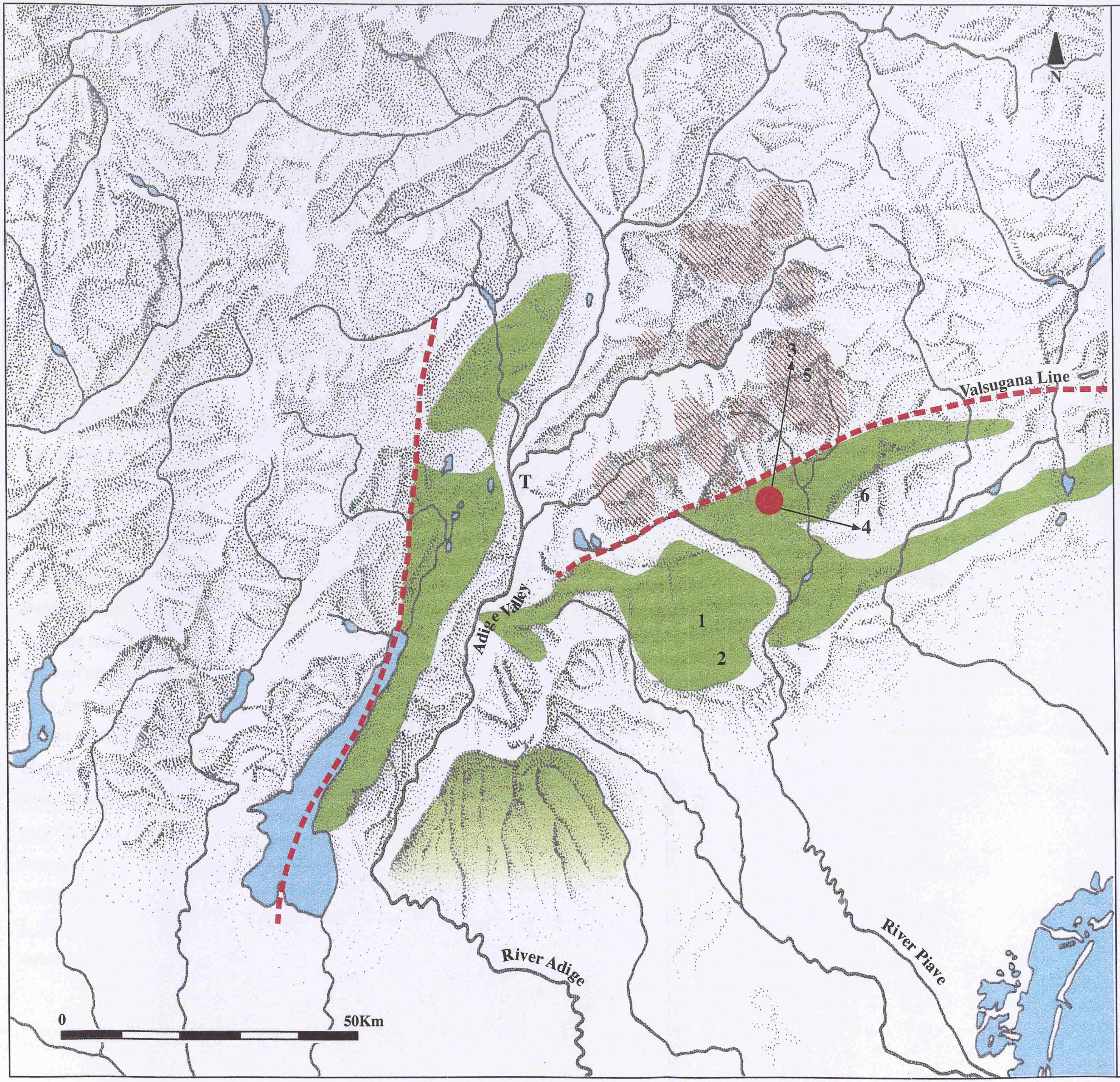

Figure 4.1

The relationship between late Upper Palaeolithic and early Mesolithic sites and flint sources

Jurassic and Cretaceous formations containing flint

Areas containing high concentrations of early Mesolithic sites

Malga Dotessa flint source

T = Trento

Sites mentioned in text:

Flint Extraction Sites

1 Riparo Battaglia

2 Val Lastari

Sites Containing Flint

3 Colbricon

4 Riparo Vilabruna

5 Pian dei Laghetti

(**6** Monte Avena)

Raw Materials

The study of raw material sources in Italy is well established. This is partly because flint is relatively common in the north Italian alpine regions due to the widespread outcrops of Jurassic and Cretaceous rock formations. The colouring and micro-organism inclusions within the flint make provenancing comparatively straight forward (Biagi 1981 and Barfield 1987). More recent geological and tectonic processes have convoluted and compressed many of these deposits. This has resulted in the fragmentation of flint nodules and their strata (Barfield 1987). These processes are particularly evident in deposits to the west of the Lake Garda fault line. To the east, in the area of the Trento Plateau, Jurassic and Cretaceous rock formations, particularly in the areas of Monte Baldo and Monti Lessini contain much better sources of flint (see Figure 4.1). These flint deposits are largely horizontally bedded and unfractured by tectonic activity. Moreover, the flint within these deposits is of a good quality for tool manufacture and likely to have been a valuable resource from the earliest periods of human occupation in this region. It is argued here that the relatively high numbers of late Upper Palaeolithic and Mesolithic sites in the Trentino region, compared to elsewhere in the southern Alps, could partly be due to the availability of these raw materials.

The closest sources of flint are located to the south of the Valsugana Line, a fault that divides the Triassic rocks outlined above (metamorphic basement rocks with Permian Volcanic outcrops) from the Mesozoic rocks to the south. Most of the high altitude intercept sites such as Colbricon are located to the north of the Valsugana Line and thus away from the good quality flint sources (see Figure 4.1). It is important to note that the limited sources of flint raw material found in the Dolomites (e.g. Marne del Puez and the Livinallongo Formation) are recorded in very small quantities at the Mesolithic hunting sites. This is largely due to the poor flaking quality of this material (Broglio 1994). It is very likely that Mesolithic tool technology required good quality raw materials, and these were located outside the high mountain areas. The main rock formations containing good quality flint are located to the south of this area and are as follows (Benedetti 1994):

I The Uppermost Jurassic or lowest Cretaceous 'Rosso Ammonitico' limestones. These outcrops are relatively poor and consist of flint and cherts that are beige, brown and red.

II Lower to Middle Cretaceous 'Biancone' limestones. These are widely distributed in the area. The flint is light to dark grey with some black, beige, brown and yellow flints in the upper levels.

III Upper Cretaceous 'Scaglia Rossa' limestones. This deposit outcrops widely with mainly red flint. Yellow, brown and black flint is also recorded.

Within the Trentino and the adjacent Belluno region to the south, the study of raw material procurement has followed two avenues of research - petrological and geochemical analysis of flint (Benedetti *et al* 1994) and the excavation of flint extraction sites (Broglio 1964, Broglio *et al* 1994 and Peresani 1994).

The Petrological and Geochemical Analysis of Flint

Petrological and geochemical analysis of flint from Colbricon, Pian dei Laghetti and Riparo Villabruna has been compared with postulated locations of raw material in the Val Cismon and Lagori areas (Benedetti *et al* 1994). This region is located 30 - 40 km south of sites such as Colbricon and represents the closest known areas containing flint raw material (see Figure 4.1). The flint from these sites comprises grey, red and miscellaneous coloured material. On all sites grey flint was the most common material used for tools (see Table 4.1).

Grey Flint

Grey flint occurs as nodules or discontinuous layers within the limestone of the Lower Cretaceous 'Biancone' Formation. Petrological analysis suggests that the grey flint can be subdivided into two groupings. The main group contains a homogeneous structureless matrix of microcrystalline quartz as well as diagenized radiolares (Benedetti 1994:41). This material is geologically rare, but has been found in the area of Malga Dotessa and is the most widely occurring grey flint at all three archaeological sites used in this particular study. The second group of grey flints is more mixed and heterogeneous, being richer in chalcedony spherules and bicameral and lensoid diagenised microfossils. These elements do not occur in the first grouping. Two of the seven flints sampled from Riparo Villabruna were from this group.

	Grey Flint	Red Flint	Miscellaneous	Total
Colbricon	72.8%	23.6%	3.6%	100%
Number of samples studied	5	4	2	11
Pian dei Laghetti	87.1%	10.9%	2%	100%
Number of samples studied	3	2	-	5
R. Villabruna	80.6%	17.6%	1.8%	100%
Number of samples studied	7	7	1	15
Total number of samples	14	19	5	38

Table 4.1 Percentages of flint types from full lithic assemblages at Colbricon, Pian de Laghetti and Riparo Villabruna and number of flint samples from the sites.

Geochemical analysis confirms the two distinct groups and shows the first group to be the purer flint material. The location of the source of the second is more difficult to ascertain, grey flint of this kind was found in all areas sampled except Malga Dotessa.

The conclusion is that the source for all grey flint sampled at Colbricon and Pian de Laghetti was Malga Dotessa: a comparatively rare geological source. Most of the Riparo Villabruna grey flint also came from this area. It is therefore suggested that the Malga Dotessa area had a long history as a flint source from later Epigravettian and Mesolithic periods and indicates a procurement strategy that selected grey flint with the best mechanical properties for tool use.

Although grey flint also occurs to the south of Trento, an area with Mesolithic rock shelters, no geological sources were studied from this area.

Red Flint

Red flint occurs as nodules or discontinuous layers within the limestone of the Upper Cretaceous 'Scaglia Rossa' Formation. This red flint is yellowish to brownish red with specklings and shadings. The Upper Jurassic levels contain further red flint, where brown and beige material is more common. The red flint is more heterogeneous compared to the grey groups, and geochemical analysis shows a much greater range of chemicals present including Al, Fe and Mg.

Multivariate analysis was undertaken on the chemical properties on the whole sample set, including the geological material and produced two sub-groups. One group consists of only geological flints from the Val Cismon area, and the second contains both geological and archaeological material. It is postulated that the archaeological flints were exploited from a common source. This, however, cannot be confirmed because this grouping also contained geological flint from Monte Avena, Arsei, Salsen, Tesino and Picco Ucceli. A more precise provenance has yet to be determined. Indeed, it is possible that the material came from elsewhere in the region not covered in this study. As a result, the analysis can only conclude that the red flint did not come from the Val Cismon area.

The red flint from Riparo Villabruna contains a higher Al content and is significantly different from red flint from Colbricon and Pian de Laghetti. This indicates that Riparo Villabruna red flint belongs to an unrelated source elsewhere in the region.

None of the geological sources examined in the Malga Dotessa region had direct evidence for Epigravettian or Mesolithic flint extraction sites. Such sites are rarely found because later flint exploitation and other quarrying activity are likely to have removed most evidence for their early use. There are, however, sites to the south, in the Asiago Plateau region, with direct evidence for hunter-gatherer lithic quarries.

Excavations at Lithic Procurement Sites: Val Lastari

The Asiago Plateau, located to the south of the Malga Dotessa region, contains flint material belonging to the Rosso Ammonitico, Biancone and Scaglia Rossa groups. Two sites are located in areas demonstrating that the three sources were being exploited by hunter-gatherers in both the Epigravettian and early Mesolithic periods. These consist of the quarry site of Val Lastari (Peresani 1994) and the rock shelter of Riparo Battaglia (Broglio 1964, Broglio *et al* 1994 and Lanzinger 1990). The analysis of these deposits provides a further perspective on lithic procurement strategies, and it is proposed here that the information from the Asiago Plateau can provide a general model for late Epigravettian and early Mesolithic flint exploitation for the Trentino region.

Val Lastari is a quarry site located in an ancient 'swallow hole' Karstic valley at an altitude of 1060m asl and contains archaeological deposits dating from the Epigravettian

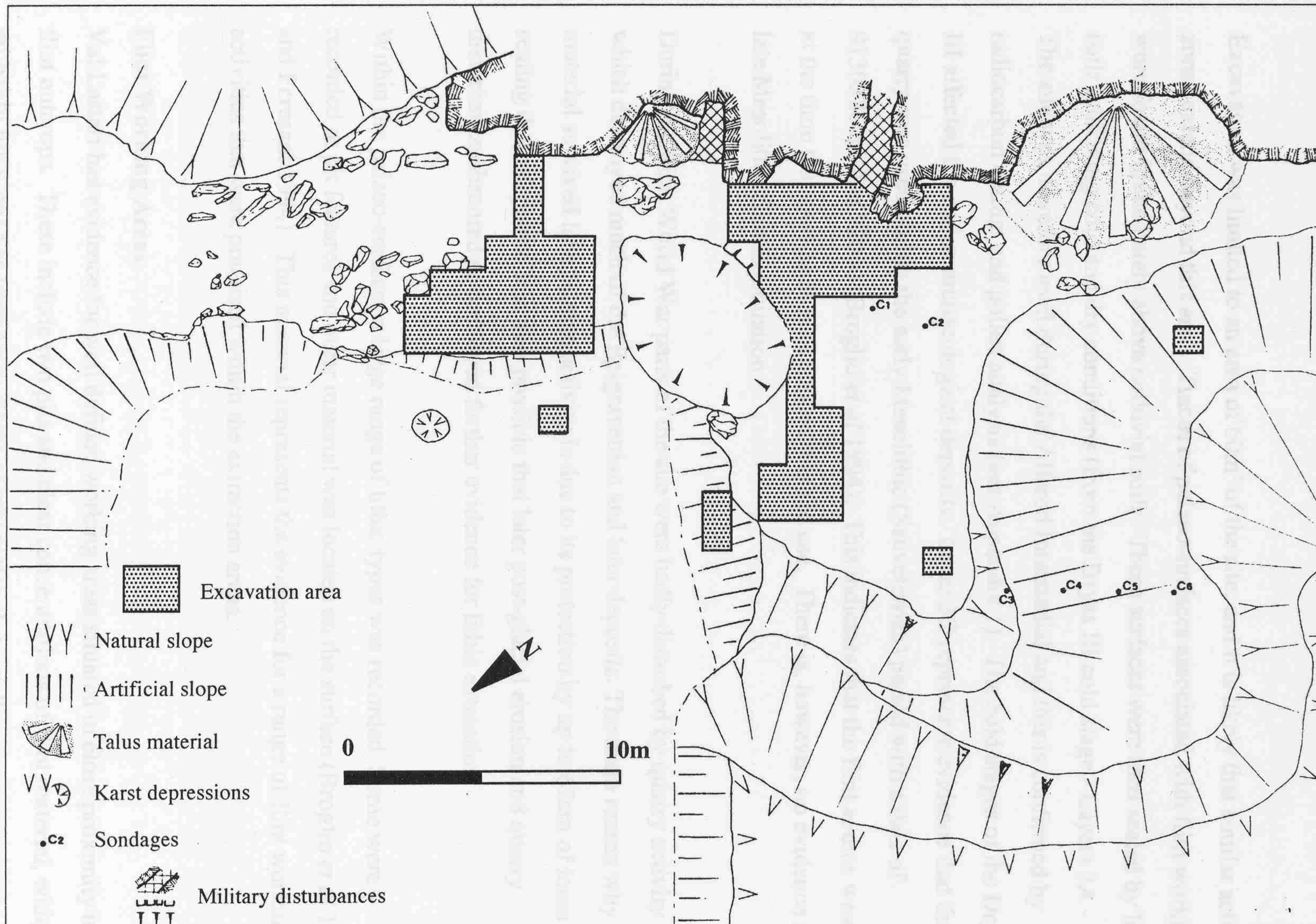

Figure 4.2 Val Lastari excavation area

period. The steep slopes of the narrow valley are rich in outcrops of Biancone and the valley bottom contains Scaglia Rossa and Rosso Ammonitico flint. The main flint source exploited was grey Biancone material (*c.*91.1%).

Excavation was limited to an area of 60m² of the site, and it is likely that similar activity zones extend beyond this area. Traces of palaeo-surfaces associated with flint working were found immediately above colluvial soils. These surfaces were then sealed by loess soils indicating cold and dry conditions (from the Dryas III cold stage - Layers 3A - 3B). The site was therefore used during the Alleröd Interstadial and this is confirmed by radiocarbon dating and pollen analysis (see Appendix 1). The cold stages of the Dryas III affected the earlier archaeological deposits. Layer 3C represents evidence that the quarry was used during the early Mesolithic (Sauveterrian) period with a date of 9130±80bp - UtC-2040 (Broglio *et al* 1994). This indicates that the flint source was used at the time that sites such as Colbricon were in use. There is, however, no evidence for late Mesolithic flint exploitation.

During the First World War parts of the site were badly disturbed by quarry activity which destroyed much of the Epigravettian and later deposits. The main reason why the material survived later human activity is due to its protection by up to 65cm of loess soils sealing these deposits. It is also possible that later post-glacial erosion and quarry disturbance obscured or destroyed further evidence for lithic extraction.

Within the palaeo-surfaces a large range of lithic types was recorded. Some were recorded in pit features and other material was located on the surface (Broglio *et al* 1994 and Peresani 1994). This material represents the evidence for a range of flint working activities that were practised within the extraction areas.

Flint Working Areas

Val Lastari has evidence for well defined working areas situated in close proximity to the flint outcrops. These include two pits and clear concentrations of flint material, which probably functioned as temporary stores of raw material, as well as processing areas.

Feature 1 is a pit that appears to have been a cache of raw material. The pit (*c.*65cm long, 25cm in width and 35cm in depth) contained 56 blocks and nodules of flint, together with three small flakes and a core. Forty of the flints show traces of breaking and 37 have between one and three flakes removed, a technique used to test for the quality of the raw material. Feature 2 contained 974 flints spread over an area of 12m². A total of 657 flints were concentrated in a small area (*c.*1m in length) and located against the rock wall. Calcareous stones and a limestone slab were found in association and are likely to have been used to cover or protect this cache of raw material. Beyond these stones the densities of flint decreased dramatically. As with Feature 1 the flints consist mainly of blocks and nodules with evidence for testing for flaking attributes. Pre-cores, cores, large cortical flakes and flakes and blades, as well as some tools including hammerstones indicate four possible working areas. A fifth area, listed as Feature 6 is also located in close proximity (Broglio *et al* 1994, Peresani 1994).

Feature 3 is a pit located in the same area as Feature 2, next to a rock outcrop on the edge of the excavation area. Apart from flint material, the pit (*c.*100cm by 40cm and 25cm in depth) contained charcoal and badly weathered animal bone, indicating that it may also have been used for food waste. A single radiocarbon date was extracted from this material - 11800±150bp - UtC-2087 (Broglio *et al* 1994). Appendix 1 provides detail of identified charcoal (based on Castelletti and Maspero 1994). The flint material comprised of two blocks, 49 cores, three pre-cores, 783 large flakes and 966 broken flake fragments, some of which conjoin with cores from the area of Feature 2.

These flint working areas indicate systematic production in which material that was not used, was cached for future processing. It is suggested here that three stages of activity are visible:

a) flint material was quarried,

b) material was then tested for quality by removing a series of flakes,

c) the flint was then prepared into cores and flakes ready for tool manufacture and export.

A fourth stage of activity can be considered, that of caching material for future use, and demonstrates evidence for forward planning (Kuhn 1995), and in some cases protected or 'hidden' under limestone blocks - perhaps from other users of the quarry.

The Lithic Assemblage

The raw material consisted primarily of dark grey flint from the Biancone deposits (91.1%). This was followed by red variegated flint from the base of the Biancone (6%), and reddish brown flint from the Scaglia Rossa (2%). Very small quantities of light grey flint from the Biancone (0.6%) and red Rosso Ammonitico flint were also utilised (0.3%).

The raw material included blocks and cores which were *c.*10cm in diameter with small flakes removed to test the quality of the flint. Rough-out cores were also recorded with evidence for similar testings. Finished cores included mainly lamellar, prismatic, sub pyramidal, globular and discoidal cores. The various stages of core processing indicate that many were exported from the site as rough-outs. Others were used at the site for tool production. Hammerstones (often reused prismatic cores) and sandstone pebbles represent evidence for tools used in extracting the flint from the quarry.

In addition to the raw material itself, a large proportion of the processed lithic assemblage consists of flakes with a wide range of sizes and shapes. These include test flakes chipped from raw blocks of flint, flakes with crests and natural edges, core rejuvenation flakes and blades and bladelets used for the production of tools and microliths. Although the largest were *c.*94mm in width and 50mm in length and 70mm in width and 77mm in length, most were in the size range of 20 - 40mm in width and 10 - 40mm in length (Fig 2 in Peresani 1994). A high number of utilised cores suggest that a large number of blades with regular shape and sections were exported from the site as half finished products, although some were also used for on-site tool production. A total of 523 tools and microliths were made on blade and bladelet blanks, while a total of 1179 un-retouched blade and bladelets with regular shape indicate that partially prepared blade / bladelets were exported elsewhere. This represents late Palaeolithic and early Mesolithic material that can be compared to lithics recorded elsewhere in this study.

It is argued here that this material represents good evidence that a large proportion of primary tool manufacture was carried out at the quarry. Rough-out cores and a range of flakes suitable for making particular types of tool were produced 'at source' and then exported as pre-formed components ready for final processing into tools. There are clear advantages to such a strategy, both in terms of convenience and time management. Mobile hunters-gatherers would be limited by what they could carry, and efficiencies were clearly made by keeping to a minimum the bulk and weight of material taken away from the procurement site. The next stages in tool processing would result in the kinds of lithic scatters recorded at sites like Colbricon (see Chapter 5). In terms of time management (e.g. Torrence 1983), the more time spent at the lithic processing site, the less effort would be spent in producing the desired implements at other sites within the hunter-gatherer subsistence schedule. Specialised lithic procurement skills are clearly an issue related to time management.

The evidence from Val Lastari shows a high degree of organisation with regard to lithic procurement. It indicates that the hunter-gatherers had extensive knowledge of the best raw material resources to exploit. This is supported by geochemical evidence for the use of rare, but high quality flint sources from the Malga Dotessa, as well as the spent time in terms of testing the specific qualities of each nodule. The evidence also indicates that these people planned in advance, both in terms of taking rough-out cores or flakes away to elsewhere in their subsistence rounds, as well as anticipating their return, by caching flint materials for future uses.

Riparo Battaglia

A second site with evidence for lithic processing is Riparo Battaglia, a late Epigravettian rock shelter (Broglio 1964). Although it was noted that cores and lithic waste far outnumbered tools and projectiles, the original publication did not consider the site in terms of lithic procurement. Riparo Battaglia is located in the Asiago Plateau at an altitude of 1050m asl and approximately 8km north-west of Val Lastari and occupies a similar location in that it is a short distance from outcrops of Biancone and Rosso Ammonitico flint (see Figure 4.1). When the site is considered in relation to these raw materials, it is possible to identify within the lithic assemblage aspects of procurement strategies similar to those recorded at Val Lastari (Peresani 1994).

Riparo Battaglia contains large quantities of blade cores (mainly prismatic) with one plane of percussion, other cores have two planes of percussion. The resulting products are represented by flakes, blades and bladelets, of which only a small proportion had been made into tools and projectiles. Although the lithic assemblage has yet to be studied in detail (from the perspective of lithic procurement strategies), it is clear that the main on-site activity was the production of flakes for the manufacture of tools, and not tool making itself.

The raw material consists of both residual waste material and flint from the limestone outcrops and was collected from close to the rock shelter. Preliminary re-examination of the block and nodules of flint shows that tiny flakes had been removed to check for flaking suitability, prior to being imported to the shelter and is identical to that recorded at Val Lastari (Peresani 1994). At the rock shelter the raw material was processed into cores and flakes ready to be made into tools. The activity at Riparo Battaglia therefore equates to the b) and c) activity at Val Lastari (see above). It is likely that the cores and flakes were then exported from the site ready for processing into tools. The material remaining at the site can therefore be considered as caches of raw material.

Discussion: Flint Procurement Strategies

The archaeological data from these sites are important for understanding flint exploitation in the general study area. Val Lastari is a quarry, while Riparo Battaglia is a rock shelter that functioned partly as a processing site in close proximity to raw material sources. Both belong to the late Palaeolithic Epigravettian period, with some evidence for early Mesolithic use at the quarry.

The study of lithic procurement based on petrological and geochemical analysis of flint from archaeological sites in relation to known geological sources is complementary to this excavation data. It demonstrates a link between Mesolithic raw material sources in the Malga Dotessa area (but not actual quarry sites) and Mesolithic sites included in this study (e.g. Colbricon). Based on the direct Epigravettian and Mesolithic quarry evidence from Val Lastari, and the inferred Mesolithic evidence from the geochemical analysis, we can begin to develop a model of how lithic exploitation may have been integrated into the subsistence schedule.

The geochemical study (Benedetti *et al* 1994) was limited to 31 archaeological and 38 geological sources of flints. Although this is a small sample, the combination of petrological and geochemical analysis does confirm clear patterning in the database. It demonstrates that the Colbricon and Pian de Laghetti early Mesolithic hunters obtained the bulk of their raw materials (grey flint) from a comparatively rare, but high quality, geological context in the Malga Dotessa area. This indicates that hunter-gatherers were very selective in their choice of raw material. It is assumed that this material had better physical qualities for tool manufacture than other grey flints.

Due to the complex chemical composition of the red flint it is not possible to isolate the precise source of this material. Red flint was less common on the three archaeological sites and suggests that it was more difficult to obtain, or poorer in quality. It is possible that it was imported from outside the geological sources considered in this study. The limited quantities of red flint and its uncertain provenance mean that it is not appropriate to consider this material in detail, with regard to provisioning sites with raw materials.

The evidence discussed above suggests a high degree of planning in terms of the procurement of raw materials for tools, and this is to be expected in terms of the technological sophistication of Mesolithic tools (e.g. aspects of maintainable and reliable tools - see Chapters 2 and 3).

Lithic quarrying at sites including Val Lastari quarry could have been a specialised activity undertaken by skilled workers and it is possible to contrast this with procurement strategies dating to the earlier Upper Palaeolithic periods. There is evidence for 'embedded' procurement of tools into subsistence strategies, so that time is spent hunting and not making specialised trips to quarry locations (Binford 1976 and 1979). Such a strategy may be visible from a site that predates Val Lastari and Colbricon by some 20000 years. The early Upper Palaeolithic Aurignacian site at Monte Avena in the Trentino is located at an altitude of 1450m asl (Lanzinger 1990). This open air site contained significant quantities of waste material associated with the primary processing of flint, where the first stages of reduction of the raw material was carried out. Blanks or cores were then taken elsewhere. The quality of the raw material was not good compared to other easily accessible sources in the area (Lanzinger and Cremaschi 1987). The location of Monte Avena suggests that hunters were using the site primarily for hunting ibex and that opportunistic exploitation of raw material was undertaken as part of an 'embedded' procurement strategy. Kuhn's (1995) characterisation of Latium Mousterian lithic procurement as 'opportunistic' provisioning people is comparable to the Monte Avena data and shows a similar contrast with later periods where provisioning places was the norm (the Epigravettian in Latium and in the Trentino).

The new weapons as seen in the Epigravettian and Mesolithic periods, such as composite arrows, are likely to have required better quality raw materials to be provisioned into the subsistence system. Large quantities of raw materials would be required particularly if significant numbers of animals were being killed at one time, or during one season, as might have occurred at intercept sites. Once hunters had provisioned a place, they would need the raw material to last for as long as they were hunting at the high altitude sites.

It is therefore possible to develop a generalised model of how late Upper Palaeolithic and early Mesolithic groups in the Trentino exploited quarry sites in the area of Malga Dotessa, such as that excavated at Val Lastari. They incorporated these types of sites into their subsistence system and transported the material to hunting sites outside the raw material zones. Flint was extracted, nodules tested and appropriate material formed into cores and flakes, ready to be taken to these sites. As the required function of most of the tools was known in advance, pre-formed flakes and cores (including some fully worked tools) were exported to hunting camps (as well as to other types of sites including rock shelters) for preparing into projectile points and other tools.

A simple way to test the above proposals is to assess the quantities of lithic material with and without cortex at sites such as Colbricon. It is anticipated that the relative quantities of material with cortex will be low, as transporting this material to mountain sites would waste energy and resources. Cortex would be the first material to be 'lost' in the process of lithic extraction.

It is proposed here that the secondary processing and maintenance of arrows and other tools, was carried out at the hunting sites. This would have been 'embedded' into a range of other subsistence activities. Chapter 5 shows that most raw materials (nodules and cores) at Colbricon were found in the camp areas in close proximity to the two lakes. The lakeside sites also show evidence for subsistence tools and fire-places. We can envisage that the raw materials taken from quarry sites were then further processed around the camp fires, while other activities were in progress. Apart from eating, these activities are likely to have included primary butchery of ibex and red deer, the processing of muscle tissue for sinew, marrow processing of bone, bone tool processing and the preparation of animal skins. For each of these activities it is likely that specialised tools would have been used.

There is no direct evidence for later Mesolithic flint exploitation within the sites I studied. Since subsistence strategies and settlement changed significantly during this period, it is possible that flint procurement strategies changed as well. It is, for example, possible that more localised sources, closer to the valley based residential sites were exploited. Such deposits are known to exist in areas to the south of Trento (e.g. Broglio 1994). As forested conditions increased during the later Mesolithic, the travel costs to more distant sources would have increased substantially.

CHAPTER 5

PROVISIONING PLACES AND LITHIC PROCESSING AT COLBRICON: A CASE STUDY OF EARLY MESOLITHIC HIGH ALTITUDE SITES

Introduction

We now tack from the region to the site. This study continues from Chapter 4 by examining a series of lithic scatters at the high altitude hunting site of Colbricon. Colbricon is within an area where there are no flint raw material sources. There is evidence that aspects of provisioning places with flint was an important element of Mesolithic subsistence at Colbricon. Partly processed flint was imported (and in some cases cached) in order to hunt large mammals. The study of the lithic tools and waste, in relation to the specific activity locations within the Colbricon topography, provides a framework for interpreting site functions.

The lithic scatters at Colbricon are also important to this study as they record a form of Mesolithic site that contrasts to the lower altitude Adige valley rock shelters that contain animal bones, as well as lithic material. Although animal bone is not preserved at Colbricon, the excavated areas provide evidence for hunting and subsistence activities within a group of inter-related sites.

Colbricon was the first of a large number of sites to be discovered at this altitude in the Trentino region (see Figure 5.1). Previously there had been little evidence for high altitude Mesolithic exploitation. Currently over 200 sites, mostly of early Mesolithic date are recorded (Lanzinger pers comm.). The location of many of these sites clearly relates to hunting strategies which used the local topography as a 'natural' facility (Chapter 2 and 3) to help intercept herds of animals. Colbricon is therefore used in this study as a model for demonstrating hunting strategies. Other sites with similar evidence will also be discussed. These include Lago del Montalon and Lago dello Buse (see Figure 5.1). Unfortunately only small scale excavations have taken place on these sites.

However, most sites are smaller in scale (e.g. Lago delle Buse - Dalmeri and Lanzinger 1994) or occur as isolated scatters of flint and have not been excavated in detail.

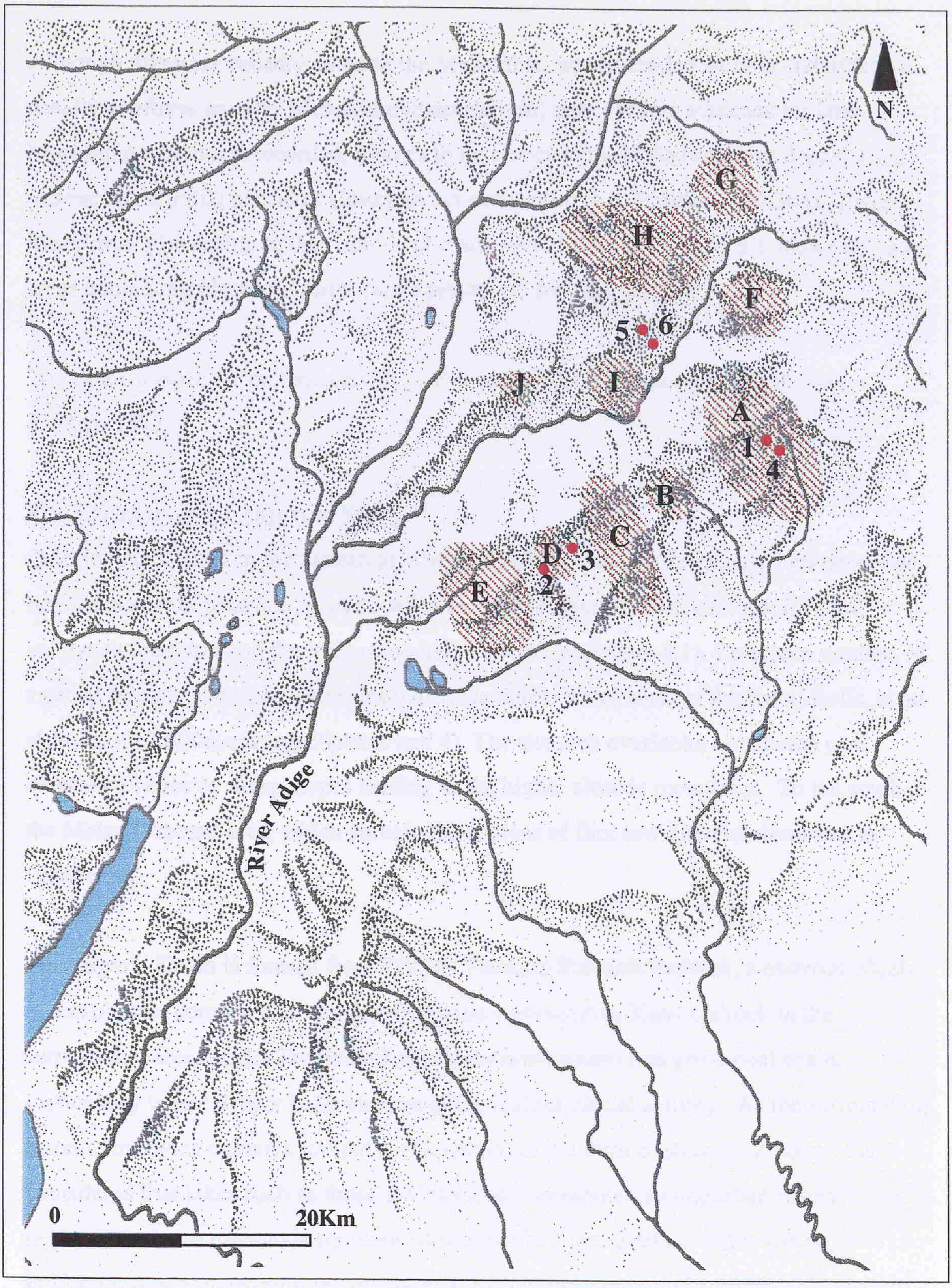

Figure 5.1 Distribution map showing high altitude hunting camps

1 Colbricon (see Figure 5.2)
2 Lago delle Buse
3 Lago del Montalon
4 Pian dei Laghetti
5 Val Duron (see Figure 5.3)
6 Val Dona (see Figure 5.3)

See Appendix 3 for a full list of sites in each area.

Although many are broadly dated to the Mesolithic, when detailed work is undertaken it usually confirms an early Mesolithic (Sauveterrian) date. Where evidence for later Mesolithic material is recorded, it tends to be associated with Sauveterrian deposits and represents an initial period of Castelnovian occupation (e.g. Broglio 1994:306). Later Mesolithic sites dating to the Atlantic climatic period are rare. Figure 5.1 shows the main areas containing Mesolithic sites (see Appendix 3 for site listings).

The first site-specific pollen analysis, at this altitude, was conducted at Colbricon (Cattani 1983).

Site Location and Context of Study

Colbricon is located in the eastern area of the Lagorai Chain, a large mountain range that runs from east to west and is set between the great ridges of the Fiemme and Fassa valleys to the north and the Valsugana in the south (see Figure 4.1). Colbricon consists of a group of early Mesolithic sites located close to two small lakes in the Passo Rolle, at an altitude of *c.*2000m asl (see Plates 3 and 4). The site area overlooks a sheltered pass between a series of steep slopes leading to the higher altitude mountains. To the south is the Malga Dotessa area, which contain the sources of flint raw material discussed in Chapter 4.

The Lagorai Chain is formed from Triassic Permian Volcanic bedrock, a material which is less porous compared to the more common carbonitic or Karst bedrock in the surrounding areas of the Trentino. Lakes developed within this geological chain, particularly where deeper hollows were cut by earlier glacial activity. As the surrounding Karstic limestone contains limited surface water in the form of streams or lakes, it is considered that lakes such as those at Colbricon, represented an important natural resource for large mammals and their Mesolithic hunters. Surface water was an important factor in determining the location of hunting camps and a predictable place to intercept animals.

Increased humidity during the Atlantic pollen zone resulted in many of these lakes gradually developing into peat bogs and it is likely that such deposits elsewhere were originally glacial lakes. Small scale excavation in mountain peat bogs have provided

Plate 3: Colbricon lake side environs

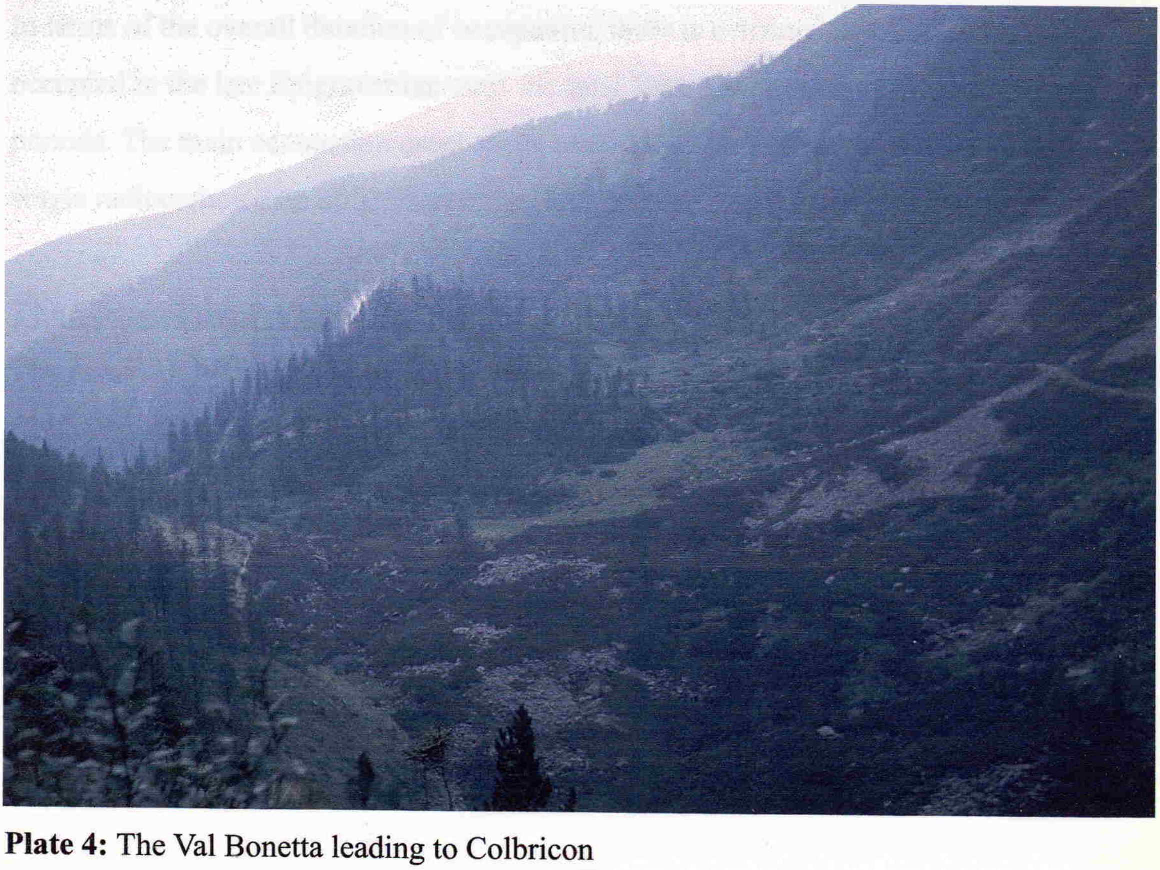

Plate 4: The Val Bonetta leading to Colbricon

evidence of Mesolithic occupation (Biagi pers comm.). The altitude of the mountains indicates that site occupation was restricted to the late spring and summer months. Snow and harsh weather conditions would have made occupation for the rest of the year impossible.

The exposed nature of Colbricon means that sedimentation rates were slow, and in most cases lithic material was found immediately below the top-soil. Although it is likely that some lithic scatters represent more than one episode of activity, most excavated material is not clearly stratified. Moreover, the soils are very acidic and no faunal or seed remains survive. Full economic interpretation is therefore not possible.

Colbricon consists of eight separate areas listed as Areas 1 to 9 (there is no Area 5). In some cases, through the composition of the lithic assemblages, the sites can be sub-divided into specialised activity zones within each area. Some of the areas were clearly stratified indicating reoccupation or multiple uses and fireplaces were a common feature. Although some sites in the region have produced evidence for post holes that could have supported temporary shelters (e.g. Lago delle Buse - Bagolini pers comm.) no structural features have been recorded at Colbricon.

In terms of the overall duration of occupation, there is evidence that Colbricon was occupied in the late Epigravettian until the final Sauveterrian or early Castelnovian periods. The main occupation dates to the early Mesolithic (Sauveterrian) period. A single radiocarbon date of 8370 ±130bp (R895a) confirms the Sauveterrian date.

The Scope of the Previous Studies

The results of the excavations at Colbricon have been published in *Preistoria Alpina* (Bagolini 1971, 1972, Dalmeri and Pasquali 1980). The final report was published as *Preistoria Alpina* 23 and presented a simple spatial analysis of the lithic material from all eight excavated sites without sophisticated computer processing of the data (Bagolini and Dalmeri 1987). Three broad site types were classed according to lithic types. Sites with a greater range of tools and debitage were associated with microlithic production. These sites also had a secondary function based on general subsistence and fireplaces were part of this complex. Sites located away from the lakes, with few tools, a lower proportion of debitage and a higher proportion of microliths are interpreted as ambush or intercept sites and formed the third site type. It is at these sites that the projectile points were undoubtedly used.

The central theme of the publications consist of detailed lithic analysis with a typology containing a lot of measurements. Very little consideration was given to the functional attributes of the sites, such as hunting strategies, and how such activity fits into a broader settlement model that might be used to compare the different areas at Colbricon with contemporary sites in other parts of the region. The sources of the lithic material or the specific types of activities practised at Colbricon were not discussed in any detail. This chapter complements this previous work, by examining these issues.

The tool and waste material from the excavations has been identified using a typology developed for the whole of northern Italy, and originally based on the Laplace (1964) scheme. This scheme was also applied in the lithic analysis at Romagnano and Pradestel (e.g. Broglio and Kozlowski 1983). A further method used to study debitage and other material with no retouch was developed by Bagolini (1968) and has been used in the main report (Bagolini and Dalmeri1987).

Although Bagolini and Dalmeri 's (1987) published analysis forms the basis of this study, this chapter will present the lithic information in the form of a series of tables. The data from each excavated area will be divided into three aspects: the total assemblage from each area including tool types, waste material and other materials like cores and flakes. Apart from microlithic material and other tools such as scrapers, a large proportion of the lithic assemblages consists of residue including debitage, microburins, trimming flakes, core rejuvenation flakes as well as blanks used for the production of retouched tools. The broad conclusions at the end of the study provide no further information other than the material demonstrates large-scale microlithic production and repair. Appendix 3 summarise this material for all the excavated areas and includes further tables illustrating the large quantities of residue in terms of its size and shape (see Tables A3.1 - A3.4).

Raw material in the form of cores and plates of flint are the final class of lithic material recorded at Colbricon. This is the sort of imported material was the subject of Chapter 4.

Presentation of Data

The following sections present the lithic information from Colbricon as a means of characterising the likely activities carried out within the various areas. Although the tables presenting the lithic data include information on the size of the areas excavated, in many cases each area was not fully excavated, and therefore do not indicate the full extent of the activity areas. Funding limitations and the need to preserve deposits for posterity were the reasons for selective excavations.

The excavated areas will be presented on the basis of their interpreted function. Some areas were primarily for lithic processing, while other areas were used for subsistence purposes as well. In addition, there is convincing topographic evidence that the sites located on higher ground, overlooking the Val Bonetta pass were used as observation posts and for <u>intercept</u> hunting. Figure 5.2 shows the location of the site areas in relation to the mountain topography and the two lakes.

The sites associated with lithic processing and subsistence will be discussed before presenting the data relating to the observation / intercept sites. Area 3 is the first site area to be presented as it produced the earliest evidence for occupation in the form of Epigravettian lithic material. Pollen from this lakeside area has provided an environmental context and vegetational history for Colbricon (see Appendix 1). The final stage of occupation is associated with Area 9 and produced very late Sauveterrian lithic material.

Before the data are presented, note that the eight areas represent occupation that lasted for *c.*1900 years, or one site for every *c.*240 years. On this basis the excavated areas at Colbricon do not represent evidence for intensive occupation. It is likely that further deposits are preserved elsewhere at Colbricon. The main principle for this study, however, is the evidence for <u>repeated</u> (or routinised - Gamble 1996) forms of site occupation and activity and demonstrates a clear pattern for human behaviour. The study of these trends in data serve as the basis for developing a framework for understanding high altitude settlement and subsistence.

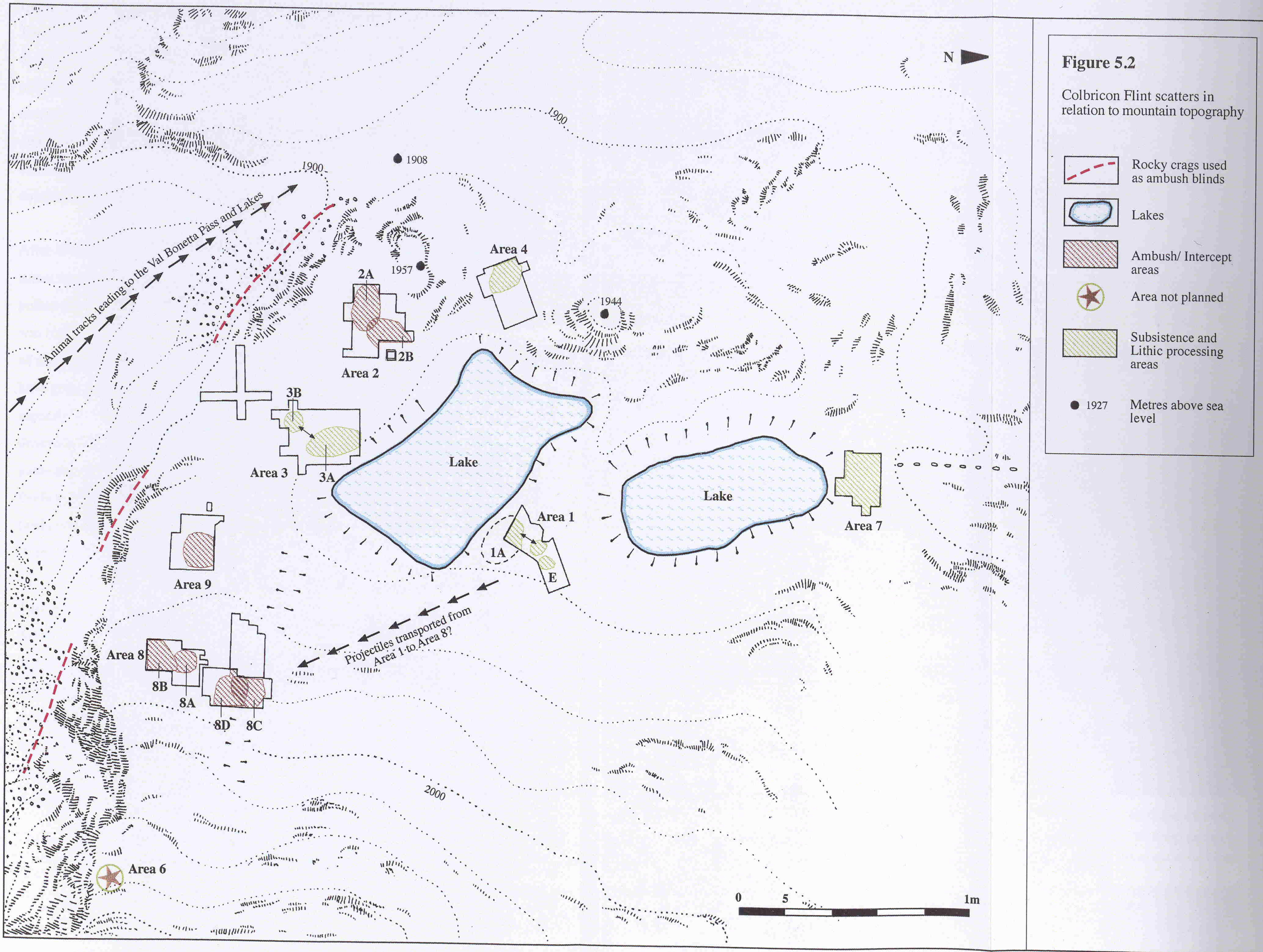

Figure 5.2

Colbricon Flint scatters in relation to mountain topography

Environmental Change at Colbricon

The pollen sequence from Colbricon can be broadly divided into three stages: before, during and after human occupation (see Appendix 1 for more detail). During the period prior to late Epigravettian occupation, pollen indicates a rise in the ratio of tree to non-tree pollen (from 40:60% to 60:40%). Human occupation at the site coincides with a dense deposit of charcoal material and some evidence for a decline in trees species for the site and general area. *Alnus*, *Corylus*, *Tilia* and *Picea* all drop, while *Pinus* and *Fagus* continues to dominate as the timberline increases in altitude (Cattani 1983).

After the Mesolithic occupation *Pinus* and *Fagus*, together with other trees including *Alnus* and *Betula* continue to re-establish themselves as dense woodland. Non-tree pollen also drops. This is characterised as the Atlantic pollen zone and the timberline was higher than it is today (Cattani 1983). It is likely to have caused a severe reduction of natural open woodland/meadow, where herds of red deer and other animals would have grazed. Chapter 3 suggests that this would have resulted in a lower carrying capacity for large herds at this altitude, as well as a possible reduction in population densities. Strategies would have concentrated on <u>encounter</u> hunting and possibly smaller game and are likely to have focused at lower altitudes. Evidence for this can be seen by the fact that rock shelters in the lower altitude Adige valley continued to be occupied (and probably more intensively (e.g. Riparo Gaban)) throughout the later Mesolithic (Castelnovian) period.

Tool Processing and Subsistence Areas

Areas 3 and 1 represent the main tool processing sites at Colbricon. These are considered as short term camps, as it is likely that they also had secondary functions relating to subsistence. Fireplaces are a main feature. The sites were located in close proximity to the larger of the two lakes and were positioned in order to take advantage of natural features such as rock outcrops which would have provided some shelter from the winds. It is likely that Areas 4 and 7 also served a similar function. Tables 5.1-5.3 summarise the data, and more detailed lithic information is given in Appendix 4.

Tool Working and Subsistence Sites	Area 3A	Area 3B	Area 3C	Area 4	Area 7
Size of Area	20 m^2	1.5 m^2	1m^2	14 m^2	-
Burins	9	-	-	3	-
Scrapers	7	3	-	-	-
Truncated blades	7	1	-	1	2
Points	1	-	-	1	1
Blades	21	3?	1	9	-
Blade/scraper	6	-	-	5	-
Blade + steep retouch	8	-	-	4	1
Denticulate	21	-	-	8	3
Flakes	2	-	-	-	-
Microliths(see Table 5.2)	233	8	-	45	24
Cores	17	1	-	1	2
Microburins etc	783	18	1	55	14
Identifiable tools inc microliths	315	15		76	31
Total identifiable material	1115	34	1	132	47
Splinters & other waste	920	80	-	99	-
Nodules and plates	c400	c500?	?	?	?
Total lithic material recovered	6746	518	63	1293	No info

Table 5.1: Tool Working and Subsistence Sites - Main tool types

Tool Working and Subsistence Sites	Area 1	Area 3A	Area 3B	Area 4	Area 7
Points	32 (42%)	86(64%)	-	-	10(66.8%)
Backed blades	20 (26.3%)	19 (14.2%)	*	8 (34.8%)	2(13.3%)
Truncated points	4 (5.2%)	15 (11.3%)	*	4 (17.3%)	1 (6.7%)
Symmetrical points	1 (1.5%)	-	-	-	-
Asymmetrical points	19 (25%)	9 (6.7%)	*	11(47.8%)	2(13.3%)
Total identifiable	76	134	5	23	15
Unidentifiable	36	99	3	22	9
Total	112	233	8	45	24

Table 5.2: Tool Working and Subsistence Sites - Microlithic material

Areas 3A, 3B and 3C consisted of three zones of activity and represent the earliest evidence for occupation at Colbricon (see Tables 5.1 and 5.2) . The sites were located on a slope a few metres south west the larger of the two lakes. Outcrops of rock to the north and west would have provided some shelter for the occupants. To the south the land sloped up to the high ground above 1900m asl. The maximum area of the excavation was 6m x 10m (this area included Areas 3A and 3B). 3A measured approximately 20m^2. Area 3A was closest to the lake and was completely excavated. Pollen samples were taken from this area.

Area 3B was located to the south west of Area 3A and the scatter was oval in plan (*c.*1.5m by 1.0m). Both areas had fireplaces. Area 3C was very small and consisted of a 1m wide circular concentration of lithic material, containing a total of 63 pieces. The excavation records do not indicate whether any natural features such as rock outcrops divided these into three inter-related concentrations, or whether they are three distinct groupings.

Areas3A

Area 3A contained 6746 lithic fragments. This included typologically identifiable material, as well as debitage and blocks or plates of flint that were imported to the site as raw material. A total of 1115 lithic fragments typologically identifiable. A further 920 chipped stone bladelets are measurable waste fragments with no retouch and likely to have been the result of microlith processing.

Although the majority of material belongs to the early Mesolithic (Sauveterrian) period, late Epigravettian backed truncated pieces are also recorded and represent the earliest dateable material from Colbricon. This material was found in small quantities and represents the only typological evidence for possible late Upper Palaeolithic occupation.

The nearby site of Pian dei Laghetti, at 1488m asl produced similar lithic material and confirms that late Upper Palaeolithic groups used the higher altitude zones of the Trentino (Bagolini and Dalmeri 1987). Chapter 4 confirms that this site used the same flint sources as Colbricon. Detailed measurements of the lengths of late Epigravettian triangles show a much wider degree of variation (up to 22mm) compared to more typical Sauveterrian lengths of *c.*13-14mm. It is suggested by Bagolini and Dalmeri (1987) that the narrower range of lengths associated with the early Mesolithic (Sauveterrian) period represents a greater degree of specialisation in the use of microlithic projectile points. It can therefore be argued that the Epigravettian points had a more generalised function. Chapter 2 and 3 suggested that the development of specialised microlithic technology represented a more flexible maintainable approach to lithic technology and that these represent strategies for risk minimization in hunting (e.g. Torrence 1989).

Eighty-two identifiable tools other than microliths are also recorded. These include nine burins, seven scrapers, seven truncated blades and further non-measurable fragments of blades, points, blade scrapers, denticulates and material with steep retouch. Further identifiable material consists of 17 core fragments.

Tool Working and Subsistence Sites	Area 1A	Area 1B	Area 1C	Area 1D	Area 1E	Total
Size of Area	3.8 m^2	$2m^2$	$1m^2$	$1.5m^2$	$1m^2$	$c9m^2$
Burins		2	3	1	-	6
Scrapers	9	5	7	-	1	22
Truncated blades, Points	*	*	*	*	*	*
Blades, Blade/scraper,	*	*	*	*	*	*
Blades w steep retouch &	*	*	*	*	*	*
Denticulates	*	*	*	*	*	*
(*all grouped)	19	16	6	9	2	52
Flakes	-	4	-	-	-	4
Microliths (see Table 5.2)	66	27	2	6	11	112
Cores	5	7	-	1	1	14
Microburins etc	193	32	1	11	74	311
Identifiable tools inc microliths (but not cores)	94	54	18	17	15	196
Total identifiable material	292	93	19	28	89	521
Splinters & other waste	739	530	70	95	114	1548
Nodules and plates	897?	?	?	?	?	c1250
Total lithic material recovered	2323	1080	212	257	293	4165

Table 5.3: Tool Working and Subsistence Sites - Main tool types

Approximately 400 pieces of nodules and tabular flint were recorded from Site 3A. Very little of this flint contained cortex material (6.6%) and is a clear indication that material was partially worked before arriving at the site. Evidence from the flint quarry at Val Lastari demonstrates that primary processing would result in raw material being exported to sites such as Colbricon with minimal amounts of cortex. Flint with cortex was rare at all of the Colbricon sites.

Area 3B

Area 3B was a smaller activity area with a correspondingly smaller lithic assemblage. A total of 518 lithic fragments are recorded of which 34 are typologically attributable and 80 consist of measurable splinters of waste. The small quantities of worked stone means that it is difficult to interpret the significance of each tool class. Microlithic remains total eight pieces and tools other than microliths consist of three scrapers and a truncated blade. A significant proportion of the remaining material consists of tiny flakes related to the manufacture or processing of microlithic material. Over 85% of this material was microlithic or smaller in size. Approximately 500 nodules of flint are also recorded suggesting that raw material was cached at this site.

Area 1

Area 1 contained five activity areas and included a fireplace. The site is similar in location to Area 3 and is close to the northern shore of the same lake. The land to the east slopes up to higher peaks of *c.*2100m, and the land to the south (and beyond the lake) forms the crest that overlooks the Val Bonetta valley. It is in this area that the intercept or ambush sites are recorded. Area 1 was sheltered by two rock out-crops and within part of this formation a fireplace was positioned. Area 1 was the first area at Colbricon to be excavated and most of the blade tools have been grouped as a single assemblage (Tables 5.2 and 5.3).

The five areas are represented by two main activity zones (Areas 1A and 1E), together with two intermediate areas (Areas 1B and 1D) and a fireplace in the middle (Area 1C). The structure of the lithic assemblage is very similar to Area 3 and it is likely that both were used for the same activities. The main lithic concentration (Area 1A) was oval in plan and measured *c.*5.8m x 4.3m. Area 1E was smaller with a diameter of *c.*1.5m. The size of the intermediate area was partly dictated by the surrounding rock typography.

Area 1C produced the only radiocarbon date for Colbricon (8370 ±130bp-R895a) and confirms an early Mesolithic (Sauveterrian) date.

Table 5.3 summarises the different tool types from each area. The total number of lithic fragments for the whole of Area 1 consisted of 4165 pieces and 81.7% of these are associated with Areas 1A and 1B. This data has been presented as a single assemblage (Bagolini and Dalmeri 1987). Where there is qualitative evidence for significant spatial variation in the areas, this is noted. Approximately 1250 flint nodules were recorded.

The variation in the lithic composition between Areas 1A - E shows similarities with Area 3. Bagolini and Dalmeri (1987) interpret Areas 1A and 1E as specialised lithic working areas. Area 1A contained the highest density of worked flint and was clearly associated with microlithic manufacture and or repair. Microburins and other notched flakes, together with rejected microlithic points dominate the assemblage. Once produced, the microliths are likely to have been 'exported' to hunting stands away from Area 1 (see Figure 5.2). The most convincing area regarding microlithic manufacture was Area 1E. Although the overall size of the assemblage was smaller than Area 1A, Area 1E consisted almost entirely of residue related to microlith processing (including microlithic size splinters). These were the by-products from blades that had been prepared elsewhere (at a quarry site ?). Complete microliths were scarce and only three tools other than microliths were recorded (Bagolini and Dalmeri 1987:179& 184). It is not surprising if few microliths were recorded from such sites, as this material would have been taken away for use elsewhere (probably to Area 8 - see below).

In contrast to the lithic processing areas, it is argued that Areas 1B, 1C and 1D were associated with subsistence activity. This is because tools form a higher percentage of the lithic material. Microlithic material and associated residue are low in numbers, particularly with regard to microburins and other notched flakes. Area 1C contained a hearth and the range of tools such as burins, scrapers and blades outnumber microlithic material by a ratio of 4:1. Areas 1B and 1D consisted of two intermediate areas between the hearth area and the two microlith processing areas. It therefore seems likely that the five areas were inter-related. Two hunters may have worked closely together at Areas 1A and 1E sharing the same fireplace. Alternatively, the deposits could represent two isolated events, but using the same fireplace area.

Cores and nodules were mainly in Areas 1A and 1E and are a common feature of such lithic working sites, and supports the case that lithic processing was kept away from subsistence based activity. The fact that cortex material is rare indicates that partially worked nodules were bought to the site.

The splinter residue from Area 1 differs slightly from similar material in the main Area 3 scatter. Area 3A contained similar levels of complete blade and flake splinters, whereas Area 1 has a trend towards more flake splinters and fewer complete bladelets. It is not clear whether this is because Area 1 has earlier Epigravettian elements within the assemblage and different types of projectiles were manufactured, or if it is due to a slightly different lithic processing activity. An alternative, although difficult to test possibility, is that the variation is the result of different tool makers leaving their 'signatures' on the residue. Although I know of no experiments that have been conducted, it is suggested that individual tool makers may process lithic material in very different manners and this is seen more in the lithic residue than in the tools themselves. Tools such as projectile points or scrapers are likely to have needed to have conformed to particular shapes and sizes due to their anticipated functions, whereas there would be no similar controls on the residue.

Area 4

Area 4 was located *c.*10 metres west of the main lake and between two gently sloping areas of high ground that peak at 1944m and 1957m. As a result, the site occupied more open ground away from the crags that overlook the Val Bonetta valley. The site is sheltered and has easy access to the lake and to the pass leading to the Val Bonetta. The site may have been used for primary butchery.

The lithic material appears as one large concentration with isolated fragments tailing off to a maximum diameter of 7m. The main concentration measured *c.*3.5m x 4m, with the greatest density of material central to it and roughly 1m in diameter. Records indicate that *c.*80% of the area was excavated. A relatively large number of burnt flints indicate that a fireplace occupied this central area.

Area 4 contained 1293 lithic fragments of which 132 were typologically attributable and 99 were measurable waste fragments (Tables 5.1 and 5.2). Out of 76 identifiable lithic types 45 are microliths and 31 are other tool types. Raw materials consisting of plate and nodule flint is also very rare and very little of this had any trace of cortex.

A factor indicating that Area 4 had a specialised function, other than as a subsistence base or tool production site, is that compared to all the other sites, there was a total absence of triangular projectile points. These usually dominate the microlithic assemblages. There were also a relatively large proportion of additional blade type tools that would have been used for activities other than hunting. It is suggested here that Area 4 was used for field butchery and that these could have been used for skinning and dismemberment. Moreover, it is likely that butchery was carried out at some distance away from the sleeping, eating and lithic production areas. It is unlikely that a lithic producing area, with large quantities of flint splinters, would have been a suitable place to process meat. The location of the site would also have provided a degree of shelter from the winds and it was relatively close to the lake site. Such factors may also have been important for butchery processing.

Area 7

Area 7 is the only site recorded near the smaller of the two lakes, and is located the north of the other activity sites at Colbricon. The site occupies the northern margin of the lake at an altitude of 1920m. During excavation Area 7 was vandalised and it is not certain how extensive the site was. Quantities of lithic material were stolen.

A total of 47 lithic fragments were recovered, of which 31 were identifiable. Twenty-four consist of microliths seven fragments comprise of other blade tools (see Tables 5.1 and 5.2). It is impossible to interpret the Area 7 with confidence due to the disturbances. The location of the site is similar to Areas 1, and 3 (close to a lake), and on this basis it argued that it represents a subsistence camp. The fact that projectile points dominate and that very few other tools were present could be the result of modern disturbances. It is likely that collectors took tools that were clearly diagnostic such as blades, burins and scrapers. This would bias the sample to the extent that it appears as a kill site rather than as a subsistence/tool processing area.

Intercept Sites

The second group of clearly defined activity areas consist of observation and or ambush/intercept sites. These are located away from the lakes on higher positions suitable for intercepting the movements of animals. These are largely defined by the composition of lithic types, as well as their proximity within the landscape. The Colbricon lakes were important watering sources for animals including deer and ibex, because surface water is rare in this region (Bagolini and Lanzinger pers comm.). The narrow trail leading to the Val Bonetta pass (and then to the lakes) can be characterised as a 'funnel' leading to the pass. The craggy rocks overlooking the area were ideal locations for ambushing or intercepting animals moving towards the water sources. The surrounding uneven terrain were ideal for intercept hunting, as the animals would have been unable to escape or disperse compared to more open conditions. The quantity and density of microlithic projectiles is taken to be evidence that significant numbers of animals were killed at one time, and may be indicative of the mass killing sites suggested by Clark and Straus for northern Spain (1983) and elsewhere in late Palaeolithic Europe (e.g. Straus 1993).

The best preserved area in terms of quantities of lithic material and evidence of successive re-uses is Area 8. This consists of two areas that were excavated and each has produced at least two clear distributions of lithic material. Some of these distributions were stratigraphically related. Area 8 is located south-east of the main lake on the crest overlooking the Val Bonetta valley. Bagolini and Dalmeri (1987) have postulated a spatial relationship with Area 1 as the source of projectile manufacture for the intercept / ambush site. Area 6 shared a similar location, although slightly lower in altitude. Areas 2 and 9 occupied similar locations and are also considered as observation or ambush sites.

<u>Area 8A</u>

Area 8A consists of an oval shaped spread of lithic material measuring approximately 3m x 2.5m. The central area contained a thick deposit of lithic material with burnt stones indicating a fireplace. Although Area 8A overlaps slightly with Area 8B there is no stratigraphical relationship to indicate which was the earlier deposit. Previous publications show Areas 8A and 8B to consist of three scatters (Bagolini 1980 and Clark 1989). Tables 5.4 and 5.5 list the tool and microlithic material (Tables A4.3 and A4.4 in Appendix 4 list the associated waste material for Area 8).

Out of a total of 2032 pieces 257 were typologically attributable, and most were microlithic projectile points (89% of the identifiable tools). Microliths numbered 105 and other tools types include 13 fragments. The microliths were dominated by triangular and asymmetrical points. Residue associated with the manufacture of microliths included 135 microburins and notched fragments. There were also 340 fragments of chipped stone with no evidence of retouch. The other tools included four scrapers and three burins.

Ambush / Intercept Sites	Area 8A	Area 8B	Area 8C	Area 8D
Size of Area	c7.5 m^2	c9m^2	c8m^2	c6m^2
Burins	3	1	15	7
Scrapers	4	6	20	6
Truncated blades	1	5	4	1
Points	-	-	2	-
Blades	3	5	11	6
Blade/scraper	-	1	2	-
Blades w steep retouch	-	2	2	6
Denticulates	2	5	12	6
Flakes	-	-	4	-
Microliths (see Table 5.7)	105	155	246	119
Cores	4	8	19	11
Microburins etc	135	220	218	98
Identifiable tools inc microliths (but not cores)	118	180	314	151
Total identifiable material	257	408	555	260
Splinters & other waste	340	453	462	272
Nodules and plates	?	?	?	?
Total lithic material recovered	2032	2457	6141	3083

Table 5.4: Ambush / Intercept Sites - Main tool types

Area 8B

Area 8B consists of a lithic spread overlapping and located immediately south of Area 8A. Area 8B is considerably larger than 8A, even though it was only partially excavated. This dense concentration of material occupies an area closer to the main crags overlooking the Val Bonetta. The excavated area measured *c.*4m x 3.5m and was at its most dense in the central area, with a fireplace, in which were a large number of burnt flints.

The lithic assemblage comprises 2457 fragments, the largest identifiable proportion are microlithic projectile points (mainly triangular and backed points). Microliths numbered 155 and other tools types totalled 25 fragments. A large proportion of the microliths are recorded as fragmented (Bagolini and Dalmeri 1987:187). This may have been the result of the maintenance and repair of projectiles for hunting. Other tools types consist of 25 fragments including one burin, six scrapers, five truncated blades and a series of 13 non-diagnostic blades with retouch. Eight cores are also recorded.

Area 8C

Area 8C stratigraphically seals Area 8D and both are located immediately north of Areas 8A and B. Area 8C consisted of a circular distribution of lithic material measuring *c.*4m

Ambush / Intercept Sites	Area 8A	Area 8B	Area 8C	Area 8D
Points	23 (43.4%)	51 (60.1%)	85 (59.5)	25 (39.7%)
Backed blades	1 (1.9%)	-	-	4 (6.4%)
Truncated points	2 (3.8%)	4 (4.6%)	14 (9.8%)	8 (12.7%)
Backed points	12 (22.7%)	21(24.7%)	27 (18.9%)	17 (26.9%)
Symmetrical points	-	-	-	-
Asymmetrical points	15 (28.3%)	9 (10.6%)	12 (8.4%)	8 (12.7%)
Others	-	-	5 (3.5%)	1 (1.6%)
Total identified	53	85	143	63
Unidentified	52	70	103	56
Total	105	155	246	119

Table 5.5: Ambush Sites/Intercept Sites- Microliths

in diameter and the central area was densely packed with lithic material and burnt stone associated with a fireplace.

The lithic assemblage comprises 6141 fragments of which 462 are measurable and 555 typologically attributable. Microliths total 246 of which 143 were identifiable. These consist mainly of triangular projectile points (85). Other tool types include 20 scrapers and 15 burins, as well as truncated blades and blades fragments which were too damaged for clear identification. Nineteen cores and four large flakes are also recorded.

Area 8D

Area 8D was partially sealed by the later Area 8C and both are located immediately north and away from the hill crest overlooking the Val Bonetta. Sample excavations indicate that 8D was roughly oval in shape and measured *c.*3-4m in width. The deposit consisted of a dense central concentration of lithic material in which were located quantities of cores and tools. Much of this material was burnt, suggesting the location of a fireplace.

The lithic assemblage for Area 8D consisted of 3083 fragments of which 260 were typologically attributable. Microliths were represented by 119 fragments (dominated by triangular and backed points), and 32 fragments of other tools included burins and scrapers as well as fragments of blades and cores.

The location of Area 8 indicates that it functioned as an ambush/intercept site and was used on at least four separate occasions. The high proportion of fractured microliths, particularly in Areas 8A, 8B and 8D, indicate that a prime activity at the site consisted of maintaining and 'gearing up' of projectiles. These activities would lead to waste material being generated as well. It is argued here that this is precisely the sort of lithic material to expect in such archaeological contexts when considering maintainable lithic technologies as outlined in Chapter 3.

The high degree of microlithic material and a low number of cores has lead Bagolini and Dalmeri (1987) to suggest that microliths were transported from Area 1 which was close to the lake. The basis of this argument is the high quantities of waste associated with microlith processing, with relatively low number of microliths found at Area 1, and too little debitage at Area 8 in relation to the high numbers of microliths.

As quantities of scrapers are recorded from Area 8A, and also from the other parts of Area 8, the ambush/intercept sites may well have doubled up as a site for carrying out field butchery. Alternatively, these tools may have been used in the preparation and repair of the arrows (e.g. cutting and trimming of the wooden arrow shafts).

Area 2

Area 2 is located *c.*10-20m south-west of the main lake and occupies a prominent position overlooking the Val Bonetta valley at 1950m asl. The site lies on the edge of a rocky crag and represents an ideal hunting observation / intercept post, similar in location to Area 8.

Area 2 is divided into two overlapping concentrations of flint material and it appears likely that fireplaces were associated with both areas. A large proportion of each area was excavated. Area 2A contained the highest concentration of flint material whereas 2B was slightly larger in dimension. These measured approximately 4m and 5m in diameter respectively. Both concentrations appear densest within the areas interpreted as fireplaces and the material spreads out forming an overlap between Areas 2A and 2B. There was no evidence as to which area was stratigraphically the earlier (see Tables 5.6 and 5.7 for lithic details).

Area 2A

Area 2A contained 1080 lithic fragments of which 106 are typologically attributable (see Table 5.6). Out of 39 clearly identifiable tools, 28 are microliths, and 18 of these are

Ambush / Intercept Sites	Area 2A	Area 2B	Area 6	Area 9
Size of Area	-	-	-	-
Burins	1	-	4	7
Scrapers	3	2	2	7
Truncated blades	2	-	6	6
Points	1	-	-	3
Blades	-	-	1	5
Blade/scraper	-	-	-	3
Blades w steep retouch	2	3	-	-
Denticulates	2	-	-	5
Flakes	-	-	-	1
Microliths (see Table 9)	28	23	25	137
Cores	3	3	-	20
Microburins etc	64	39	58	163
Identifiable tools inc microliths (but not cores)	39	28	38	173
Total identifiable material	106	70	96	356
Splinters & other waste	92	41	55	582
Nodules and plates	?	?	?	?
Total lithic material recovered	1080	667	874	2124

Table 5. 6: Ambush/Intercept Sites- Main tool types

Ambush / Intercept Sites	Area 2A	Area 2B	Area 6	Area 9
Points	8 (44.3%)	7 (41.1%)	12 (70.6%)	42 (50%)
Backed blades	1 (5.6%)	-	-	2 (2%)
Truncated points	2 (11.2%)	2 (11.8%)	1 (5.9%)	12 (14.3%)
Backed points	1 (5.6%)	6 (35.3%)	3 (17.6%)	17 (20.2%)
Symmetrical points	-	-	1 (5.9%)	-
Asymmetrical points	6 (33.4)	2 (11.8%)	-	8 (9.5%)
Trapezes	-	-	-	3 (4%)
Total identified	18	17	17	84
Unidentified	10	6	8	53
Total	28	23	25	137

Table 5.7: Ambush / Intercept Sites - Microliths

typologically identifiable (mainly triangular points - Table 5.7). Eleven tools other than microliths were recorded including three scrapers, two truncated blades, a single burin and five less clearly diagnostic fragments with steep retouch and denticulation.

Three cores are also identified. Flint with traces of cortex is rare (5%) and nodules and plate flint were numerically insignificant. However, about 350 pieces of flint had flake scars to indicated that they had been used for cores.

Area 2B

Area 2B contained 667 lithic fragments of which 70 were typologically attributable. Out of 28 clearly identifiable tools 23 are microliths. Seven fragments are classed as triangular points and six as backed points. Five tools include two scrapers and three undiagnostic pieces with steep retouch and denticulation. Three cores were also identified. Flint with traces of cortex were rare (8.7%) and plates and nodules of flint were absent. Flint fragments used for cores were fairly low in number (*c.*200). Nuclei were also scarce and consisted of 3 fragments and represented 4.3% of the typologically identifiable assemblage.

The two areas that form Area 2 have slightly different lithic characteristics. Area 2B is almost entirely made up of microlithic projectile material and complete bladelets ready for 'gearing up' to make composite projectiles. Area 2A also consists predominantly of microlithic projectile points. However, a number of scrapers and burins suggest that other activity may have occurred in this area. Unlike Area 8, there are fewer broken microliths that are considered to be evidence for repair or maintenance work.

The fact that the two areas overlap indicates that they were in use at different times, but that they both functioned as hunting observation posts, or as hides from which to ambush animals as they were moving or driven up the valley.

<u>Area 6</u>

Area 6 was a relatively small concentration of lithic material and is the highest site at Colbricon (2050m asl). The site is located on the crest overlooking the Val Bonetta valley and has a commanding view of both sides of the pass. Area 6 is located the greatest distance away from the lakes than the other areas. There are no site plans for this area.

Area 6 contained 874 lithic fragments. Thirty-eight typologically definable tools comprise of 25 microliths and 13 other tools types including four burins, two scrapers and six truncated blades. No flakes or cores were recorded. Seventeen of the microliths were identifiable. These consisted mainly of triangular projectile and backed points (see Tables 5.6 and 5.7). From the quantities of waste material and the absence of raw materials and cores, it appears that very little lithic processing was carried out at Area 6.

<u>Area 9</u>

Area 9 represents the final stage of occupation at Colbricon, due to the very late Sauveterrian/early Castelnovian lithic material recorded. Area 9 is located west of Area 8 on the crest overlooking the Val Bonetta valley at 1920m asl. The site measured *c.*5 x 4 m and a large sample of the area was excavated.

A total of 2124 lithic fragments were recorded, of which 356 were typologically attributable. The central area of the site produced a high density of lithic material and burnt stone, and two fireplaces occupied the area. Spatial distribution of the lithics showed that cores and projectile points are concentrated within the central area of the site, while other tools tend to occupy the peripheral parts of the site. Of the 356 fragments that were identifiable, 163 comprise residue such as microburins associated with the manufacture of microliths. Twenty cores are also recorded. The remaining material consists of tools (173). These include 137 microlith fragments and 36 other tools types (see Tables 5.6 and 5.7). The 36 non-microlithic tools consisted of six truncated blades, seven burins and seven scrapers. In addition 16 fragments of non diagnostic blades, blade scrapers and denticulates were recovered from Area 9. Twenty cores and a single flake were also recorded.

Raw flint consisted of very limited quantities of plate and nodule flint. One nodule of a flint core has been partly reconstructed. There were a low number of flints of nuclei (*c.*100), but a large presence of cores.

Discussion: Site Interpretation and Regional Context

Colbricon consists of eight lithic areas that provide a framework for understanding the large number of similar sites that have been recorded in the Trentino (see Figure 5.1 and Dalmeri and Pedrotti 1994).

The specific locations of these sites confirms their prime function as hunting sites (located to intercept animals in key topographic positions in the landscape). Figure 5.3 shows examples of similar sites in relation to intercept points near passes or access points in the mountains in the Cresta di Siusi and Val di Dona areas. These landscape features would have acted as 'natural' facilities to control the movement and limit the dispersal of animals during intercept hunting. The density of archaeological material and the fact that it is highly likely that animals such as red deer formed herds in these open mountain landscapes (Legge and Rowley-Conwy 1988 and Mitchell *et al* 1977) is used here as

Figure 5.3 Location of ambush/ intercept sites in relation to mountain passes - Val Duron (Cresta di Siusi) and Val Dona area

evidence that significant numbers of animals were intercepted and killed at one time. This was an early Mesolithic hunting strategy, that, due to seasonal weather constraints, took place in the summer/early autumn, when animals were nutritionally in their prime (e.g. Speth 1991). Animal bone frequencies from La Riera indicate that such hunting strategies took place in the Upper Palaeolithic in northern Spain (Clark and Straus 1983). At Colbricon and elsewhere in this mountain region, the proximity of the sites in relation to the surrounding topography and the nature of the lithic assemblages, represents the supporting evidence for such hunting strategies. It is also suggested that the animal products, taken from these intercept sites, would have included marrow and bone grease, as well as meat and would have provided the key nutritional element to safeguard populations through the cold winters of the Trentino (see Chapters 2 and 3).

This section also summarises the range of activities that can be ascertained from the Colbricon data, in order to gain an understanding of how the mountains zones were exploited. It follows from Chapter 4, which examined lithic procurement strategies and aspects of how sites may have been provisioned with processed raw materials (Kuhn 1995 and Benedetti *et al* 1994). It is also necessary to examine previous interpretations of the Colbricon lithic scatters (Bagolini and Dalmeri 1987). This allows us to develop a clearer understanding of the activities that were carried out and how these fit into the interpretative frameworks outlined in Chapters 2 and 3. Occupation at Colbricon also needs to be considered in terms of an increasingly forested environment, which ultimately resulted in its abandonment during the later Mesolithic (Castelnovian) period (Cattani 1983).

Provisioning Places with Raw Materials

Most high altitude sites, including Colbricon, are located to the north of the Valsugana Line, where there are no quality flint sources (Bagolini pers. comm.). Clearly, rich hunting territories do not always have raw materials for weapons and tools and Mesolithic hunters would need to provide such material for their camps. By examining how sites such as Colbricon obtained their raw materials, it is possible to extend the regional scale of analysis.

At quarry sites, raw material was tested for mechanical properties and partly processed into 'rough outs' or blocks before being exported to other sites (Chapter 4). Colbricon provides supporting evidence that partly processed material was imported. These consist of blocks and nodules of flint with very little cortex (some had been cached at the site for future use). This is good evidence for forward planning, and a key factor to the concept of provisioning places with raw materials (Kuhn 1995).

Chemical analysis of small samples of lithic material from Colbricon (5 grey and 4 red piece) indicate that grey flint (the main source) was imported from the Malga Dotessa area to the south, and that red flint (a comparatively minor raw material) was also from this general area (Benedetti *et al* 1994). Although it is demonstrated that some early Mesolithic hunters has contact with the Malga Dotessa areas, it is also possible that further sources came from the Adige valley to the south of Trento. This area contains similar grey flint and more evidence than is currently available from the Malga Dotessa area for Mesolithic occupation during periods when occupation was not possible at the high altitude sites (e.g. in the winter). It is possible that southern Trento material was not included in the small chemical sample analysed.

Site Functions

This chapter has presented the Colbricon data by sub-dividing the site into lithic or tool processing areas (with evidence of subsistence) as distinct from ambush or intercept sites. The processing sites were located closer to the lakes, while the ambush sites were strategically positioned at intercept points on the higher ground overlooking the Val Bonetta: from where animals would have moved up the valley to the lakes at Colbricon.

The 1987 report produced a diagram to graphically illustrate the proposal that three forms of site type can be seen from the lithic data: ambush sites, subsistence and lithic working areas (Bagolini and Dalmeri 1987: Figure 137 and Figure 5.4a). The percentage of microliths to tools were plotted against the percentage of microliths to microlithic debitage. It is clear from their plot that most of the ambush sites stand apart from the other sites. The presentation of this data does, however, show ambiguities in using a three-fold distinction. Figure 137 also included a mistake in the plotting of Area 1C.

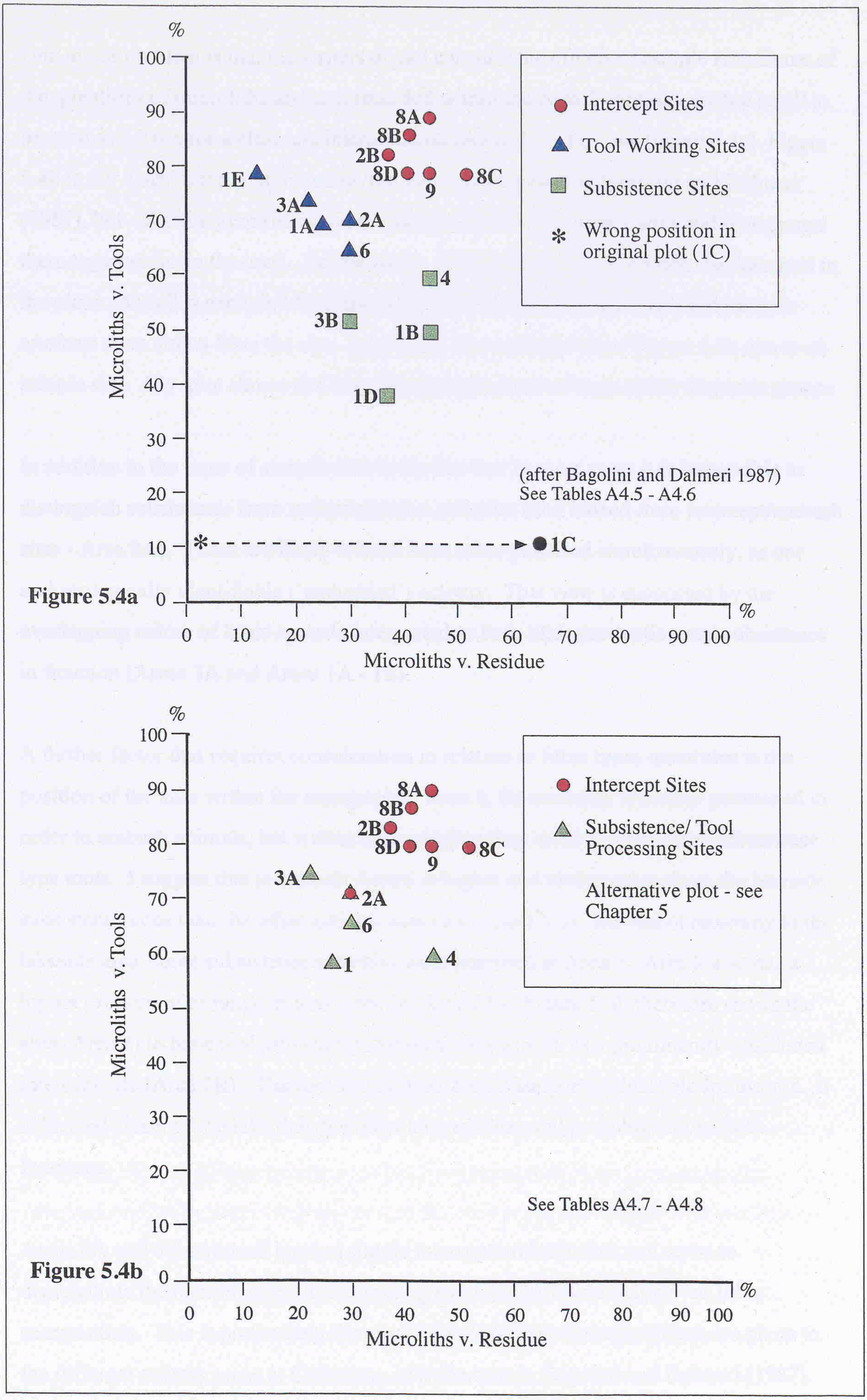

Figure 5.4 Scatterplots showing percentages of microliths v tools against microliths v debitage (see Chapter 5)

One major problem is that the writers do not consider the effects of sample size. Some of the quantities of microliths and tool recorded within the Area 1 complex are too small to be used as a basis for a clear site interpretation (Areas 1C - 1E - see Figure 5.4a). Figure 5.4b is my distribution plot, based on the same criteria used by Bagolini and Dalmeri (1987), but takes into consideration the sample sizes of the Area 1 sites and thus groups them together (as in the text). Tables A4.5 - A4.8 in Appendix 4 provide the data used in the plots. Area 7 is excluded from the plots due to its small sample size and because artefacts were stolen from the site. Area 3B is also excluded from Figure 5.4b due to its sample size. My plot shows two broad grouping instead of three rather disparate groups.

In addition to the issue of sample size, is the fact that in most cases it is impossible to distinguish subsistence from tool production activities (and indeed from intercept/ambush sites - Area 2A). These are likely to have been often practised simultaneously, as one archaeologically identifiable ('embedded') activity. This view is supported by the overlapping nature of lithic spreads interpreted as both lithic production and subsistence in function (Areas 3A and Areas 1A - 1E).

A further factor that requires consideration in relation to lithic types quantities is the position of the sites within the topography. Area 6, for example, is clearly positioned in order to ambush animals, but it does have a higher than usual proportion of subsistence type tools. I suggest this is because Area 6 is higher and further away from the lakeside subsistence sites than the other ambush sites (see Figure 5.2). Instead of returning to the lakeside area, some subsistence activities were practised at Area 6. Area 2 also has a higher proportion or range of tool types (in Area 2A). Figure 5.4b therefore shows the area (Area 2) to have tool processing characteristics as well as a prominently positioned intercept site (Area 2B). The location of Area 2A/2B supports a duel role for the site. It is located closer to the lake than the other ambush sites and probably served both functions.

Areas 2A and 6 functioned beyond simple intercept/ambush sites and serve to demonstrate the complexities of interpreting site function based entirely on lithic composition. This is particularly the case if single function interpretations are given to the different activity areas at Colbricon, as is the case in Bagolini and Dalmeri (1987).

Moreover, it is argued that the three-fold site function interpretations may be an over-simplification of the range of activities practised at Colbricon. Animals were intercepted and killed, probably in significant numbers, and primary or field butchery clearly took place. Would animal processing have taken place close to the ambush sites or at the lakeside sites? One clue that some areas were used for butchery is the relatively large numbers of scrapers recorded at the ambush / intercept site Area 8C (20 scrapers). Cores and the general level of lithic tools and waste indicates that primary processing of animal hides may have occurred in this area. Alternatively, these tools were used to prepare arrows, or to consume food. Fireplaces were common to intercept sites as well as to the subsistence sites, and may have been integral to tool production (e.g. Jochim 1998:205).

A second site possibly used for butchery is Area 4. Blade type tools could have been used for hide processing and dismemberment and the area is sufficiently away from the main subsistence area to avoid contamination with lithic processing or other activities. It is, however, likely that butchery areas would not leave high density lithic scatters as the main material to be left would be animal remains and not lithic residue.

The range and type of activities carried out at Colbricon is also likely to have depended on the social units present at the site. If entire families, including children were present, then it is likely that a greater range of activities other than hunting based work were carried out. Binford (1991), for example, characterised a wide range of activities within mobile camp sites for the Nunamiut hunting groups.

Maintainable Technologies and Tool Preparation

The complexity of activity can also be seen within areas that appear to have a single function. Intercept/ambush Areas 8A, 8B and 8C contained quantities of badly damaged microlithic material (from projectile points) indicating that repair or <u>maintenance</u> activities had taken place. It is argued that this represents some of the best available archaeological evidence for <u>maintainable</u> tool activity (Bleed 1986, Torrence 1989 and Chapters 2 and 3). Although the concept of maintainable tools is ethnographically based, it has been used to characterise Mesolithic tools, but with little direct evidence (e.g. Myers 1989, Zvelebil 1984 and Jochim 1998). It is suggested that these intercept sites were used to maintain and repair arrows largely from material taken from the lithic processing areas elsewhere. The low number of projectile points compared to the high level of debitage at Area 1 has been related to Area 8, where projectile points are common, but little associated waste material (see Figure 5.2). This highlights that intra-site relationships were an essential subsistence component at Colbricon.

Area 2B offers an alternative perspective. This intercept site contains complete microliths with no evidence for maintenance or damaged artefacts and may represent a different stage of hunting activity, where repairs were not taking place, but arrows were being 'geared up' ready for use. The evidence from the intercept sites should therefore not be taken to indicate single event uses or activities. These specific locations were chosen for their strategic positions to kill animals and would have been re-used probably over long periods of time. A single lithic scatter may therefore represent a multiple occupation. Due to the slow sedimentation rates that would seal such deposits it is likely that intercept lithic scatters represent multiple events.

The End of Occupation and Changing Subsistence Strategies

By the beginning of the later Mesolithic (Castelnovian) period, occupation at Colbricon had ceased. This corresponds with a higher density of trees, which gradually increased during the Boreal and into the Atlantic pollen zone. By the Atlantic stage the tree line in the mountains had increased in altitude, as well as creating a denser undergrowth (Cattani 1983 and Oeggl and Wahlmüller 1994). This resulted in a depletion in open woodland and natural meadow areas and is likely to have had a diminishing effect on population numbers of animals such as ibex and red deer. We noted in Chapter 3 that red deer may have adapted to these conditions by living in smaller population groups. Ibex and chamois may have been forced to live in marginal territories due to the increased altitude of the timberline. It is also argued that large mammal adaptations could have resulted in lower animal population densities, and movements of the sort that provided opportunities for <u>intercept</u> hunting at Colbricon were less predictable or no longer took place. It is possible that animals were not migrating or congregating in large groups and that the lakes, such as at Colbricon, no longer attracted these animals. It therefore became uneconomic to exploit the high altitude territories and later Mesolithic hunting focused in the lower valley areas.

There is evidence from pollen and plant macrofossils that early Mesolithic hunters were using fire to open up clearings in the encroaching forests (e.g. Oeggl and Wahlmüller 1994). Such activity could have been a response to these increased forested conditions in an attempt to encourage animals to browse in the opened areas. This is likely to have been a short-term measure as the increased density of forest would also have added to the time and costs for travelling through such environments. As lower altitude areas became more heterogeneous in available resources, it is likely that the high altitudes became less attractive due to these added travel costs. This may be the reason why there is no evidence for fire management during the later Mesolithic period.

As most high altitude hunting sites were not used in the later Mesolithic evidence will be presented in the following chapters for a greater use of the valley bottom areas during this period. In terms of the visibility of later Mesolithic subsistence evidence, if <u>encounter</u> hunting was more common than the earlier <u>intercept</u> strategies it is likely that the distribution of archaeological material will be less visible and more difficult to predict in terms of specific locations. Intercept sites near mountain lakes or passes are a common feature in the earlier Mesolithic period and it is relatively easy to predict their locations (Bagolini pers comm.). During the later Mesolithic rock shelters may have been the main residential focus for encounter strategies, with hunters undertaking logistical expeditions without the need for extended visits to the higher altitudes. There is no clear framework for predicting the location of site types relating to later Mesolithic <u>encounter</u> hunting. Such sites are likely to have left less visible 'signatures' in the archaeological record, due to encounter hunting resulting in a more generalised use of the landscape.

The following chapters will explore the evidence for late Mesolithic site types that were not used in the earlier periods, as well as examining patterns within the main rock shelter deposits. The resulting information will provide a framework for understanding the transition from high altitude seasonal hunting sites to subsistence strategies focusing in the valley bottom areas.

CHAPTER 6

THE ADIGE VALLEY ROCK SHELTERS
INTRODUCTION AND METHODOLOGICAL APPROACHES

Introduction

As a background to the rock shelters included in this study, the following sections outline a methodological framework for the analysis of faunal and lithic material from Pradestel, Romagnano III, Vatte di Zambana, Riparo Gaban and from a series of smaller shelter sites. The information is presented in Chapters 7-9. This introduction also considers the main sites in their landscape context by examining issues relating to their location, as well the circumstances relating to their discovery.

In this regional study I examine two broad categories of archaeological sites - open air sites (see Chapter 5) and rock shelters. There are a number of factors that might affect the visibility and recorded distribution of these sites. The exposed nature of the high altitude open air sites and the low rates of soil sedimentation, together with the fact that few development pressures affect them, means that they are relatively easy to locate. Many are found in predictable locations such as close to mountain lakes. As rock shelters represent such different forms of settlement, factors relating to their survival and visibility differ significantly. Their riverside locations are likely to have undergone major alteration in the intervening 6000 years (e.g. alluviation, agricultural and building development).

This chapter examines landscape factors that determine rock shelter visibility and location, and also provides a background to the presentation of the data in the following chapters. Site formation processes, relating specifically to rock shelter deposits, were examined in the earlier stages of this study (e.g. Gorecki 1991). Gorecki's ethnoarchaeological studies examined the spatial dimension of rock shelters in Papua New Guinea, and it was decided that this data was not relevant to the rock shelters examined in this study. The Adige valley sites provide good indicators for broad trends in faunal and lithic data, through time, but not for specific events or occupational episodes. In addition, processes relating to artefact movements within rock shelters were examined (e.g. Van Noten 1978, Villa 1982), but found to be more relevant if this study had focused entirely on lithic analysis from rock shelters.

In terms of gaining a 'first hand' understanding of the problems of interpreting rock shelter deposits a programme of excavation in the Trentino was undertaken (Clark *et al* 1992). The Pre Alta excavations, near Lake Garda, were also seen as an opportunity to provide further data relevant to the main issues of this regional study. Although the excavation details are published elsewhere, a site interpretation, in relation to late Mesolithic subsistence, is included in Chapter 8.

The Distribution of Rock Shelters

The distribution of rock shelter sites relates largely to the circumstances of their discovery, and to factors relating to landscape evolution and urban development in historic periods. In a mountain area like the Trentino, a large number of processes were responsible for forming the modern landscape which contains the rock shelters. Apart from recent settlement construction and the terracing of the hillsides for agricultural purposes, the main agents responsible for burying or distorting the rock shelter deposits consist of hill wash and alluvial processes.

The Adige valley contains a series of rock shelters around the city of Trento (see Figure 6.1). One of the most important characteristics of these sites is the depth of deposits. For the main rock shelters there is a chronological span that covers the entire Mesolithic period, as well as extending into later prehistory. Until recently no other northern Italian Alpine region had produced a concentration of sites with such a long time-span of occupation.

The discovery of rock shelters is often the result of road construction and quarrying at the base of the limestone cliffs in the valleys. In Trento there has been a tradition of archaeologists looking for such sites to monitor quarrying activity. Renato Perini discovered the first sites in the 1960s and early 1970s (Perini 1971). Other areas of the north Italian alpine region were not so fortunate and many of the locations with the potential to contain rock shelters had already been lost though quarrying and construction work (Biagi, Bagolini and Perini pers comms.). Survey work elsewhere in north-east

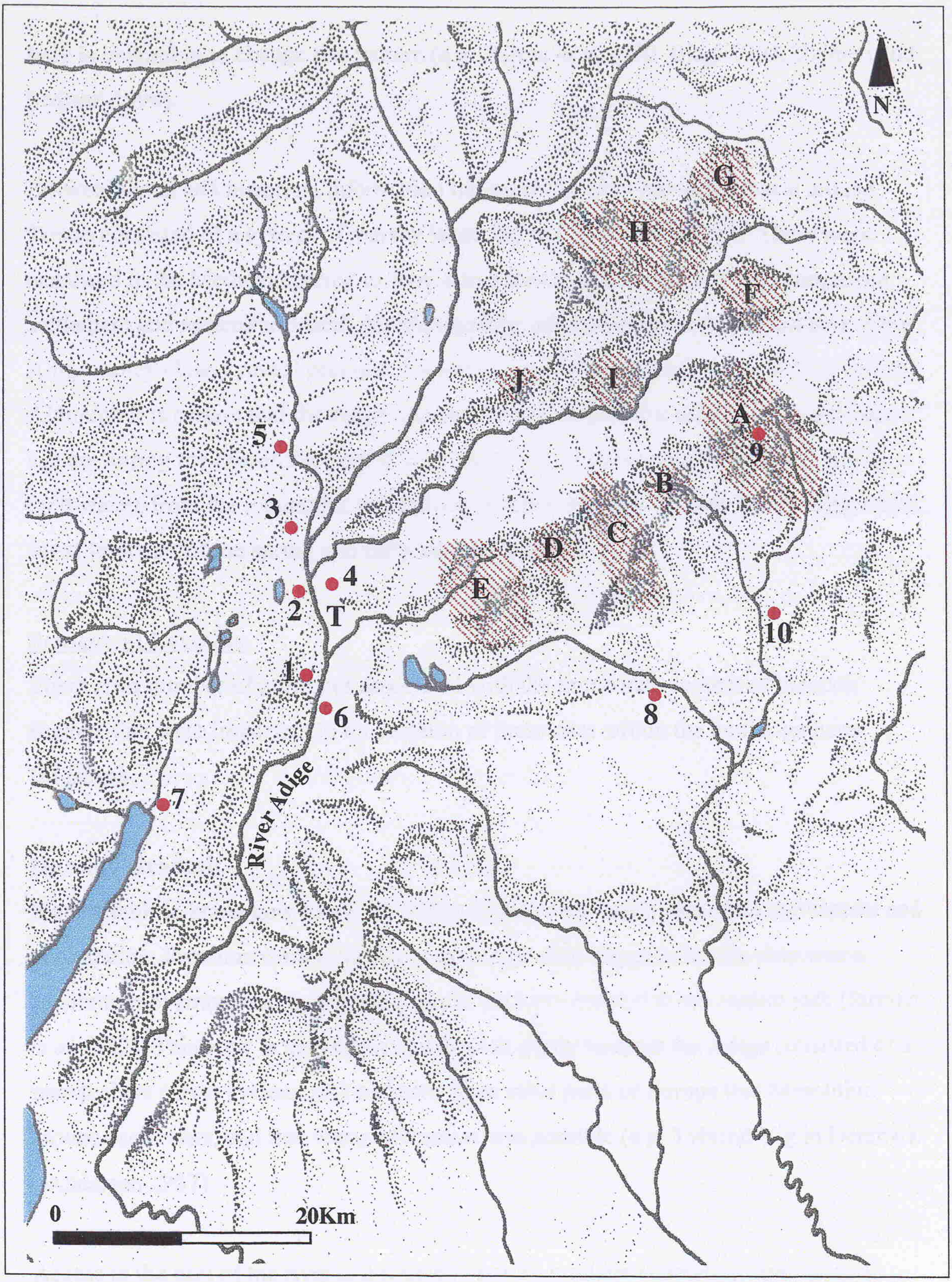

Figure 6.1 Map showing the main Mesolithic sites discussed in the text

High Altitude Hunting Sites (see Appendix 3)

1 Romagnano III
2 Pradestel
3 Vatte di Zambana
4 Riparo Gaban
T Trento
5 Dos da la Forca
6 Paludei di Volano
7 Pre Alta
8 Grotta d'Ernesto
9 Colbricon
(**10** Riparo Villabruna)

Italy is beginning to change this pattern (e.g. Baroni *et al* 1990 Biagi 1994, Dalmeri and Pedrotti 1994).

Environmental and historical information indicates that the river Adige basin around Trento consisted of a system of marshy lakes and braided river courses. These were canalised in the Medieval period to form a free flowing river and to provide improved settlement and agricultural land. Air photography and mountain views of this part of the Adige valley clearly reveal previous braided courses of the river (Lanzinger pers comm.). Although it is certain that the Adige around Trento comprised a marshy river and lake system during the Mesolithic period, it is reasonable to assume that during the spring, melt waters from the mountains would have swollen the river to form free flowing water, for at least part of the spring and early summer months.

<u>Settlement Location</u>

There are a number of attributes associated with the immediate context of the rock shelters that were important to the location of these sites within the hunter-gatherer landscape.

Hunting Grounds

It is difficult to know how much the Adige river system was a obstacle to movement and exploitation. Previous work referring to the Adige sites suggest that the river was a barrier to movement and that hunters would not have crossed to the eastern side (Jarman *et al* 1982). This view is not shared in this work partly because the Adige consisted of a marshy lake / river system and we know from other parts of Europe that Mesolithic groups used boats, and that water navigation was possible (e.g. Tybrind Vig in Denmark - Andersen 1987)

Access to the east of the river is discussed because it relates to hunting strategies. A common feature of the location of two of the rock shelters (Romagnano III and Pradestel) is that on the opposite side of the Adige valley there are river tributaries (e.g. rivers Avisio and Brenta) which flow into the valley. Extensive glacial and alluvial fan deposits were formed at their junction with the Adige, and these formed fertile areas that are now important for agriculture. Figure 103 in Jarman *et al* (1982), for example, demonstrates that the two hour exploitation territory from Romagnano contained high quality pasture on the eastern side of the Adige river. This alpine pasture within the alluvial fan deposits would have been the best area within the site's catchment for hunting animals such as red deer.

The tributary valleys of the rivers Avisio and Brenta also lead up to the Lagori Chain, which contains the high altitude hunting sites (Chapter 5).

This is in contrast to the areas immediately to the west of the rock shelters, which consist of steep sided valleys that extend into the mountainous regions of Monte Bondone (see Figure 6.1). Land here was less fertile and more difficult to reach. This is reflected in the lower density of Mesolithic sites in this area. It is therefore argued that land on the eastern side of the valley was more accessible and offered a better and wider range of resources. These included the early Mesolithic hunting grounds of the Lagori Chain.

Raw Material Sources

Although no studies of the raw material sources for the rock shelter sites have been undertaken, such as those carried out for the Malga Dotessa region (Benedetti *et al* 1994), there are flint deposits in the area around Trento (see Figure 4.1). It is highly likely that these local sources were exploited (Broglio 1994). Easily accessible raw materials would have been important, particularly if the rock shelters were residential sites used for long term occupation.

Aspect

Related to the hunting territory on the eastern side of the river Adige is the physical setting or aspect of some of the rock shelters within the valley (including Romagnano III, Pradestel and Vatte di Zambana). The fact that these shelters are located on the western side of the valley may not be coincidental. The western side of the valley receives more direct sun light than the eastern side, particularly in the winter months. Moreover, the wider and open nature of this part of the Adige valley (together with the proximity of the hill slopes on the eastern side) allows more natural light (and heat) to enter the western side of the valley than if the sites were located in more enclosed parts of the Adige valley (e.g. the area to the south of Romagnano).

The eastern side of the valley, particularly in the winter months, is much darker and likely to be cooler in temperature. Legge (1972) has studied microclimates in cave and rock shelter sites in north-western Greece and demonstrated that the thermal properties of the walls boosted the night temperatures by releasing stored heat from the day time. The sites could also have maintained a more comfortable living environment throughout the day. White (1985) has also discussed the location and aspect of cave and rock shelters for the Upper Palaeolithic of southern France from a similar perspective.

It is difficult to assess how important the above factors were in the location of the Adige valley rock shelters. Location and aspect are increasingly being recognised as important settlement features, both in terms of rock shelters and caves (e.g. Straus 1993) and with more open sites (e.g. Star Carr - Mellars 1998). The fact that these rock shelters were used for several thousand years suggests that they were preferred locations, and if they were occupied in the winter months, factors such as increased sunlight and warmth, are likely to have been significant factors for site location.

The Basics of Rock Shelter Site Formation Processes

Although a basic understanding of the principles of site formation processes is necessary before the interpretation of cultural behaviour can be presented with confidence, a detailed consideration of these factors is outside the scope of this study and only the main issues will be briefly discussed. These relate to cultural as well as natural processes.

Rock shelters represent multiple occupations, and the resulting activity from one occupational event to another is not always of a uniform nature. Two successive occupations may have consisted of a short overnight camp followed by a hunting and butchering event lasting several days. Both would leave archaeological deposits relating to the particular activities, such as different tool types or different types of food remains. Later activity is also likely to disturb previous deposits. Gorecki's ethnoarchaeological work in rock shelters in Papua New Guinea has demonstrated these cultural processes at work (1991).

Work by archaeologists has demonstrated how flint artefacts can 'move' within stratigraphy, through the analysis of conjoinable flint flakes, from the Lower Palaeolithic site of Terra Amata in France (Villa 1982) and the Mesolithic site of Meer II in Belgium (Van Noten 1978). Ethnoarchaeological work by Yellen (1977) and Gifford and Behrensmeyer (1977) have also shown how trampling can cause small fragments of bone or stone to penetrate further into deposits than larger fragments.

More natural processes such as freeze-thaw and other weathering processes (e.g. Gifford 1981), differential transport of bone material due to bone densities (e.g. Voorhies 1969), as well as carnivore and scavenger activities (e.g. Brain 1981 and Binford 1981) may all have contributed to the formation of rock shelter deposits, but are issues too complex to be discussed here. Instead, relevant aspects will be examined further in Chapter 9, which presents the faunal assemblage from Grotta d'Ernesto, a cave with direct evidence for some of these processes.

A Framework for Interpreting Rock Shelter Deposits

Due to the factors outlined above, it is considered impossible to study individual occupational episodes, or to ascribe flint or bone to particular events with any degree of confidence. The interpretation of detailed stratigraphy is considered optimistic for understanding the activities that occurred in the rock shelters. This principle is fundamental not only of the rock shelters, but to the study in general. Such a view forms the basis for a method of study that groups layers together into more meaningful analytical units. In particular, the concept that material can move down through the deposits forms the basis for a different approach to the stratigraphic interpretations than Italian archaeologists have presented (e.g. Broglio 1983).

Closely related to this view is the fact that most rock shelter excavation was carried out through digging spits, which in many cases were 10cm in depth and dug irrespective of the stratigraphy, or at least until clearly definable levels were identified (Biagi 1981, Bagolini pers comm.). In some cases spit excavation was undertaken regardless of the slope of the rock shelter deposits (Bagolini pers comm., Biagi 1981). An example of the shortcomings of this technique is the Romagnano III 'floor' level with a post hole and other possible features in Layer AC8 (see Figure 7.2). This surface had the same slope inclination as the underlying natural deposits. Layers further up in the stratigraphy should have had correspondingly similar slopes, but appear as level deposits due to this excavation techniques. Moreover, stratigraphy was often only recorded once a section through the deposits was visible.

The spit method of excavation is likely to have presented problems in interpreting the lithic sequences (Biagi 1981 and Bagolini pers comm.). This resulted in the different interpretations of the lithic material for Romagnano III that have been published by Broglio (1971, 1972, 1980) and Broglio and Kozlowski (1983). Such issues also affect the faunal material, and are a further reason why the layers recorded by the excavators are amalgamated into larger analytical units.

Through careful examination of section drawings and layer descriptions, for clear stratigraphic boundaries, as well as data on the lithic typologies and radiocarbon dates, a method was devised in which it was possible to examine broad trends in subsistence data, rather than individual 'events' associated with single layers or phases. By grouping layers together, the sample sizes are enlarged to show clearer patterns with regard to variation within the assemblages. Without such groupings the numbers of animal bones in each layer would have been too small to document any clear changes in bone types. This approach to the faunal analysis is considered fully justifiable because the main issue of this study is to document subsistence change through time, rather than to examine the spatial characteristics of the assemblages.

Rock Shelter Data

The data from the main rock shelters shows that each of the sites has its own particular characteristics of archaeological information. All document changes in faunal and lithic material throughout the Mesolithic period. Romagnano III has an important lithic sequence that has been used as a type series for the Adige Valley and beyond (Broglio and Kozlowski 1983). It also contains a relatively good faunal sample. Pradestel has a larger faunal assemblage with a greater range of species present. However, less than 33% of the bone fragments were identifiable to bone type and animal species.

The faunal remains are an important aspect of the cultural material from these rock shelters, and the first full analysis of this material is presented here. Boscato and Sala (1980) presented an overview of the main characteristics of the faunal remains from Romagnano III, Pradestel and Vatte di Zambana. No information on bone types or butchery fragmentation was presented and no further work on the large mammal bones had been conducted prior to this work. This faunal data offers a contrasting perspective to the high altitude hunting sites, as discussed in Chapter 5, in which only lithic material survives. It is likely that the animal species recorded in the rock shelters show subsistence patterns that relate in some way to the occupational evidence at Colbricon.

As lithic material was crucial to the typological analysis of the rock shelters, all the excavated material was sieved. This resulted in samples of animal, bird, fish bones and micro-fauna being extracted (e.g. Bartolomei 1974). Pradestel also produced an important pollen sequence taken from the occupational deposits (Cattani 1977 and 1994). This shows good evidence for vegetational change through the Preboreal, Boreal and Atlantic pollen zones, and can be related to changes in the faunal assemblages.

Vatte di Zambana contains smaller assemblages of both faunal and lithic material, and occupies a similar location to Pradestel and Romagnano III . These sites have a series of radiocarbon dates that provide a detailed chronological sequence for the Adige Valley (Alessio *et al* 1983 and Appendix 2).

Riparo Gaban differs from the above three sites in that it is not in the main Adige Valley, but in a sheltered tributary valley, located to the north of Trento. It contains the largest faunal assemblage, but there are no details of the Mesolithic flint industry and radiocarbon dates are not presently available (Bagolini, Lanzinger pers comm.). The sheltered location has meant that more of the deposits survive than sites such as Pradestel or Zambana. A collection of 'prehistoric art' is also reputed to belong to the late Mesolithic and early Neolithic levels at Riparo Gaban (Bagolini 1980, Clark 1989).

Dos de la Forca, Paludei di Volano and Pre Alta are three rock shelter sites that provide evidence for late Mesolithic animal bones, that provide contrasting perspectives to the earlier Mesolithic deposits.

Understanding Rock Shelter Data: Lithic Material

In contrast to the faunal remains, where information is presented for each species, all the lithic material will be discussed as a single assemblage, and the level of presentation will depend on the available information. There are two reasons for this. Firstly, the primary data for this part of the study is animal bones. Secondly, animal bones can be objectively divided into different species, whereas lithic interpretation depends largely on a subjective classification scheme that does not necessarily relate to function. It is argued that a too detailed level of analysis could assume a misleading level of accuracy with regard to the function of different tools. We can have more confidence in interpreting lithic material from sites such as Colbricon because this clearly relates to known types of subsistence activity -such as hunting. The context of individual areas (e.g. intercept sites or lithic production areas) provides more confidence in interpreting tool types.

In terms of the overall interpretation of lithic sequences in the study area, a detailed study of the Romagnano III assemblage has formed a framework (supported by a sequence of 17 radiocarbon dates) for the study of all Mesolithic flint material in the Trentino region (Alessio *et al* 1983 and Broglio and Kozlowski 1983).

The main lithic report for Romagnano summarises the information under a series of artefact headings (Broglio and Kozlowski 1983). These include categories such as end scrapers, burins, retouched and backed blades. The writers sub-divided most of these categories into even more specific tool types. End-scrapers, for example, consist of long end-scrapers, short end-scrapers, circular end-scrapers and nosed end-scrapers. Blades are sub-divided into those with straight truncation, with oblique truncation and concave truncation. However, Broglio and Kozlowski (1983) fail to discuss the meaning of their sub-divisions, possibly because such detailed typologies do little to further our understanding of how and what the tools were actually used for. Therefore no sub-division of the lithic assemblages will be presented in this study.

Biagi (1981) provides further insights in the lithics from the Adige Valley sites. His study included Pradestel and Vatte di Zambana, as well as Romagnano III and provides a 'midway' classification scheme between Broglio's main artefact classes and the detailed sub-divisions. His classifications are used for Pradestel and Vatte di Zambana.

Understanding Rock Shelter Data: Faunal Assemblages

Although the animal bones were fragmented, they were in relatively good condition because of the calcareous soils. The fragmentary nature of the assemblage is likely to be due to several reasons, including intensive marrow processing. The excavated areas were close to the wall of the shelter and it is anticipated that small 'dropped' fragments would be incorporated into these deposits, rather than the larger material which was 'tossed' away from the main activity areas (e.g. Binford 1978b and 1983).

Due to the fragmented nature of the bones it was decided that it was inappropriate to attempt Minimum Number of Individual counts (MNI), apart from in exceptional circumstances (e.g. Grayson 1984). There were several reasons for this. The units of analysis do not represent individual occupational events, but in most cases are amalgamations of layers and deposits, that render MNI information meaningless. Furthermore, as the sections closest to the rock wall of the shelter are the main deposits under study, this is likely to result in a bias toward smaller bone fragments being deposited at the back of the shelter. The bones more suitable for MNI quantification would not be present, at least in the numbers needed to do accurate bone counts. For these reasons analysis will focus on aspects like the approximate age of the animals exploited and the butchery patterns and quantification will be limited to the numbering of individual bone specimens (NISP - Binford 1978a). It is also questionable whether MNI interpretations are really appropriate if animal carcasses were being transported to the rock shelter sites as 'packages' of meat rather than complete animals (e.g. Binford 1981).

The main focus of this study is the butchery evidence that can help interpret the activities that were carried out at the rock shelters. Fragmentation of the bones is seen as a fundamental aspect of the human processing of the faunal material (see Plates 5 and 6). Evidence for this derives from the fragmentation patterns, as well as chop and cut mark traces. Cut and chopmark identification is based on Binford's (1981) ethno-archaeological butchery analysis and my previous butchery studies (Clark 1985 and Gamble and Clark 1987). This involved a detailed butchery study of the Bronze Age lake settlement of Fiavé, which produced exceptionally well preserved animal bone.

Comparative material in the Museo Tridentino di Scienze Naturali in Trento assisted in the identification of ibex, chamois and roe deer bone fragments. A difficulty in determining roe deer bones was due to their similar size to chamois, ibex and young red deer. This made their identification difficult, especially as the bone assemblage consisted of small fragments. Identification of ibex bones was aided by the complete skeleton of a male ibex of approximately 12 years old. This was obtained from the Gran Paradiso National Park in northern Italy.

Smaller mammal and carnivore identification was assisted by the comparative material held by the Museum in Trento, and by detailed sketch drawings taken to Italy. These were based on the comparative collections held by the Department of Archaeology, University of Southampton. Hand lenses and spot lights helped identify butchery marks.

A relatively high proportion of the faunal assemblage consisted of unidentifiable bone and it is anticipated that much of this material belongs large mammals such as red deer. Into this category must be included teeth and skull fragments. Skull material was highly fragmented and it was very difficult to distinguish red deer skull material from that of ibex and other large mammals. This was due both to inexperience and the limitations of the comparative collections. However, the quantities of skull fragments were very low, and I would suggest that very little skull material had entered the archaeological record. Teeth were also rare.

Within Chapters 7 - 9, the animal bone, in the form of body part representation, is summarised in table form from each group of layers, together with detailed descriptions of the main attributes of the assemblages. Issues relating to unidentifiable bone fragments and sample sizes will be discussed at the end of the chapters. Table 6.1 illustrates the format for the main Tables in Chapters 7 - 9, with a column for each animal present. The column listing of bone types starts at the feet end of the animal (phalanges), with maxilla (skull) and antler at the bottom of the table. Where two related bones are listed on the same row (e.g. radius and ulna), the quantities of each bone are shown against each other (e.g. 0/1).

Plate 5: A typical sample of animal bone from Pradestel

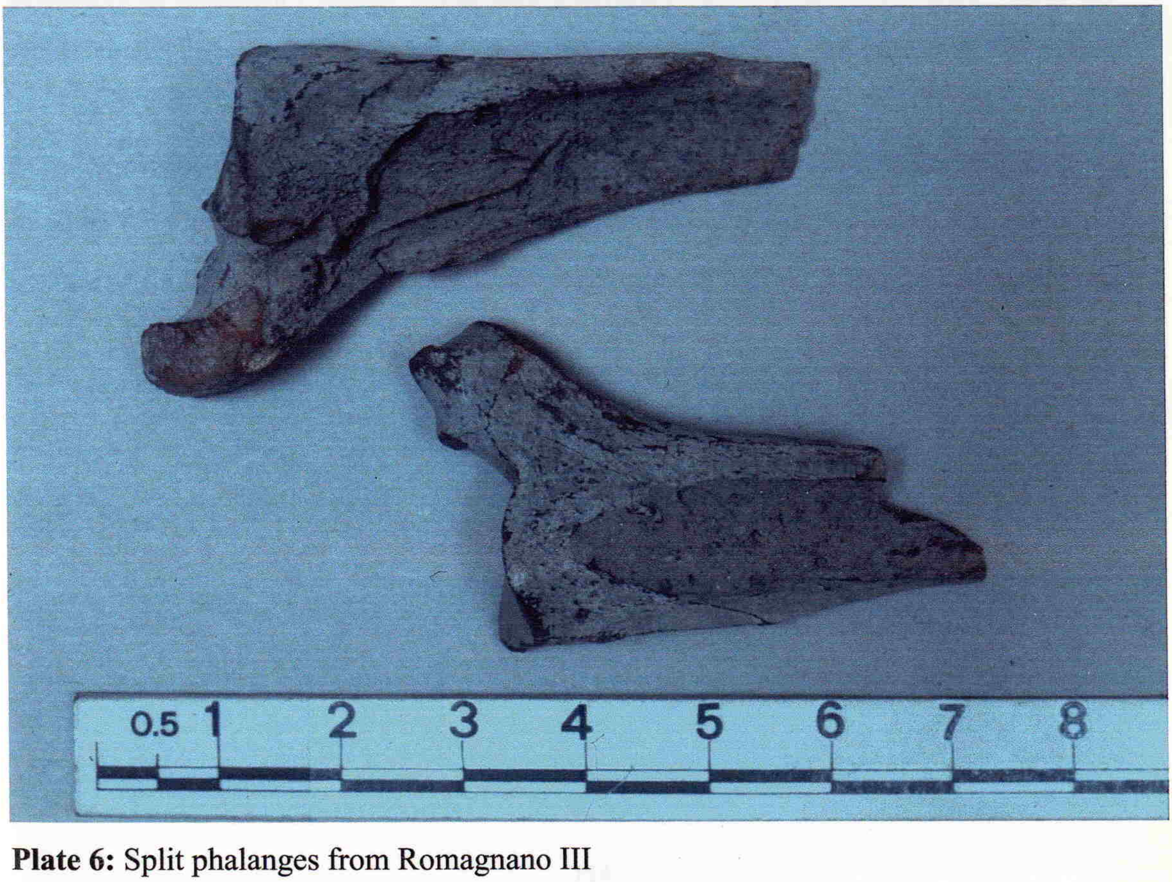

Plate 6: Split phalanges from Romagnano III

Bone type:	Animals
Phalanges	10
Metapodials	4
Carpel/Tarsals	1/0
Radius/Ulna	0/1
Tibia	1
Calcan/Astrag	1/1
Humerus	1
Femur	2
Scapula	1
↓ ↓	
Maxilla	1
Antler	2
<u>TOTALS</u>	<u>26</u>

Table 6.1 Format of animal bone representation tables in Chapters 7 - 9

A computerised project archive holds all the relevant data on bone size, fragmentation, age, sex, side of body, condition of preservation and butchery codes. An example of the database, from Grotta d'Ernesto is given in Appendix 7.

<u>**Summary**</u>

This chapter has provided an introduction and a methodological framework for studying the faunal and lithic data from a series of rock shelter deposits. The data itself will be presented in Chapters 7 and 8. It has also examined the location of the sites within the Adige river valley system in relation to the hunting territories and raw material sources

Post-depositional processes have been briefly discussed, and will be addressed in more detail in Chapter 9. This provides a study of the Grotta d'Ernesto cave. Animal activity, as well as other taphonomic processes are more clearly visible in this faunal assemblage.

CHAPTER 7

THE ROCK SHELTER DEPOSITS AT ROMAGNANO III AND PRADESTEL

Introduction

This chapter presents the faunal and lithic information from Romagnano III and Pradestel, both located in the Adige Valley near Trento. Faunal data from Vatte di Zambana, Riparo Gaban, and Dos da la Forca will be presented in Chapter 8, together with material from Paludei di Volano and Pre Alta. Romagnano and Pradestel contain the larger and best documented lithic and faunal assemblages from this area. The information from these two sites forms the basis for the main discussions relating to the Mesolithic rock shelters. Each of the other rock shelter deposits has further characteristics that add to building a fuller picture of Mesolithic subsistence strategies.

Romagnano III

Romagnano III is located near the village of Romagnano Loc, 12 km south of Trento at an altitude of 210m asl (see Plate 7). It is one of a series of sites identified on the top of the cone debris of the Rio Bondone, a tributary of the river Adige. The cone debris was the result of alluvial material deposited by the melt waters of the river Bondone during the early post-glacial (Lanzinger pers comm.). The name of the village (Romagnano Loc) refers to the fact that at some time in the past there was a lake in the vicinity. This follows earlier comments about how the Adige valley had been canalised to form a free flowing river. In the Mesolithic periods it is likely that the flood-plain was a very marshy lake and therefore a good habitat for water fowl and fish, as well as larger animals.

The site has a long sequence of occupation, beginning in the early Mesolithic, with final layers dating to the Iron Age (see Figure 7.1). The maximum depth of the rock shelter deposits was almost 6 metres. The Romagnano III data presented here is limited to the Mesolithic and earliest Neolithic deposits. The later levels will not be discussed as they are outside the scope of this work. Romagnano III attracted the interest of both archaeologists involved in hunter-gatherer studies as well as those researching the later Neolithic and Bronze Age periods. As a result a series of collaborative excavations were conducted with Perini (1971) excavating the Neolithic and later layers and Broglio

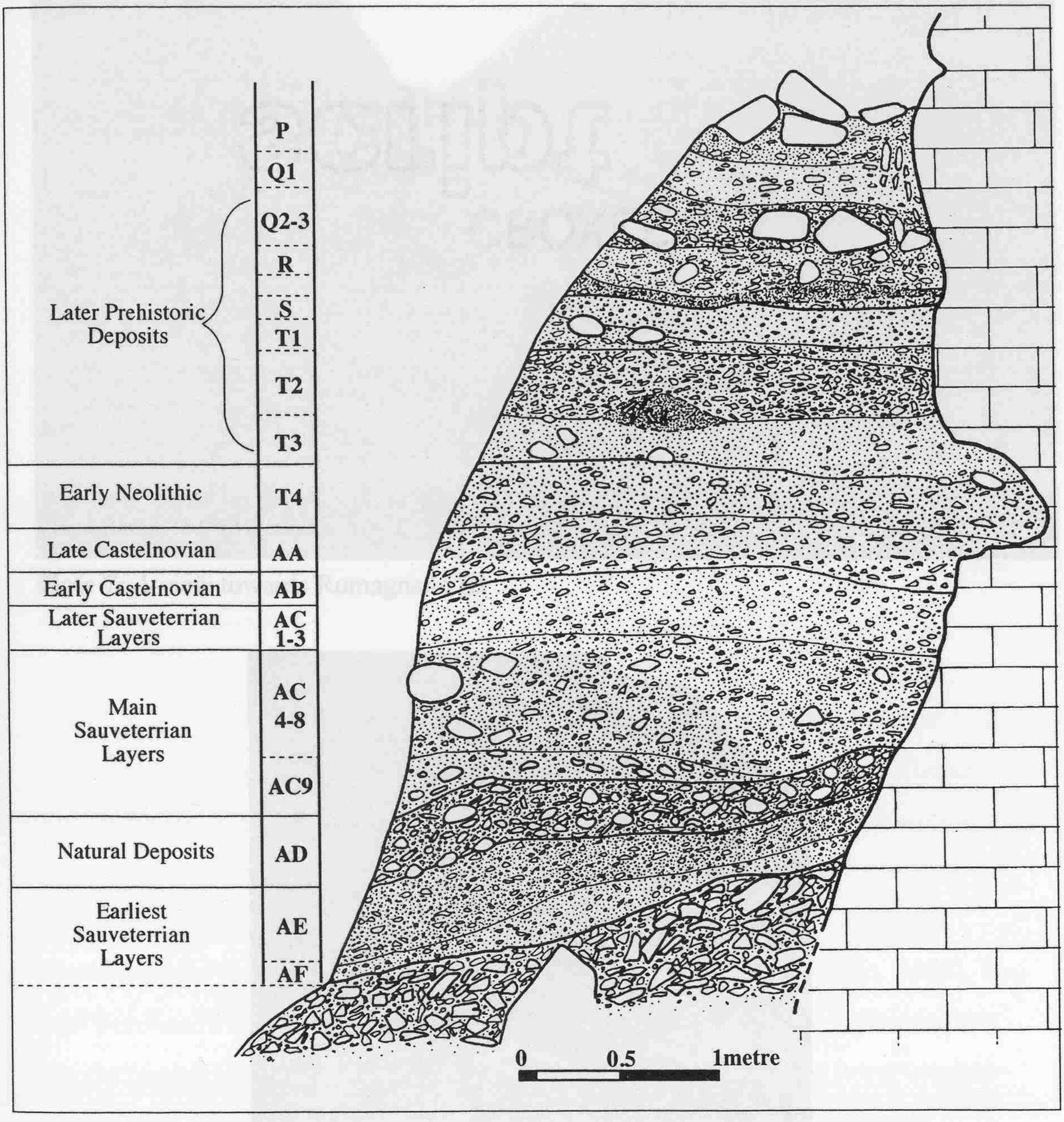

Figure 7.1 Romagnano III
section through rock shelter deposits

Plate 7: A view towards Romagnano III

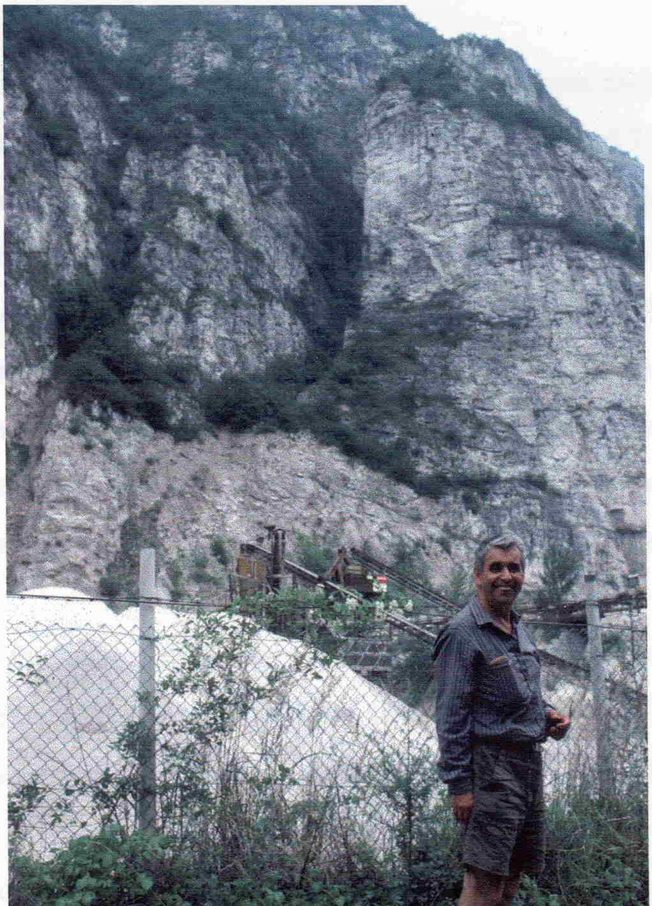

Plate 8: The quarry site of Pradestel

(1980) excavating the Mesolithic and 'transitional' deposits containing the earliest Neolithic impressed pottery. The crucial late Mesolithic and early Neolithic layers were therefore the boundary not only between two different subsistence and probable socio-economic groups, but also between two individual approaches to archaeological research (Bartolomei *et al* 1972).

A large proportion of the faunal remains came from the stratified levels that were the subject of the detailed lithic analysis (Broglio and Kozlowski 1983). Further levels were also recorded (Area 4). Animal bones recovered from this area are presented in this study.

Excavation Methods

In all the excavation records there is no record of the total area excavated. One published plan does reveal that an irregular area approximately 8m by 2m was excavated, and one small plan shows a single occupation level - Layer AC8 (see Figure 7.2). Broglio and Kozlowski 1983 indicate four areas of excavation and that the deposit was uneven. A large part of the site was eroded and damaged, but the main area did contain a complete stratigraphical sequence.

The main level of information, the number and types of tools and microliths from each layer is presented in table form for each of the sites (Tables 7.1 and 7.2). For Romagnano III each group of layers has a description of the pertinent aspects of the lithic material. The study of the lithic assemblage from Romagnano III demonstrates a high degree of continuity throughout its long Mesolithic sequence. The variation in the tools and microliths were the subject of statistical analysis by Broglio and Kozlowski (1983). They used Robinson's Index of Similarity between the various artefact types to demonstrate that the material fell into two clusters, one of which corresponds to the lower sequence from the site (Sauveterrian) and the other to the upper sequence (Castelnovian).

The raw materials for making these tools were also studied. Pre-cores, (core reduction ?) that is small blocks of flint with flaking lines which were not fully utilised, show similarities in shape with a range of core types that have been identified. Most of the core types appear to have been used throughout the occupation at Romagnano III. Some types, however, do reflect the changes that occurred in the tool types. For example, oval

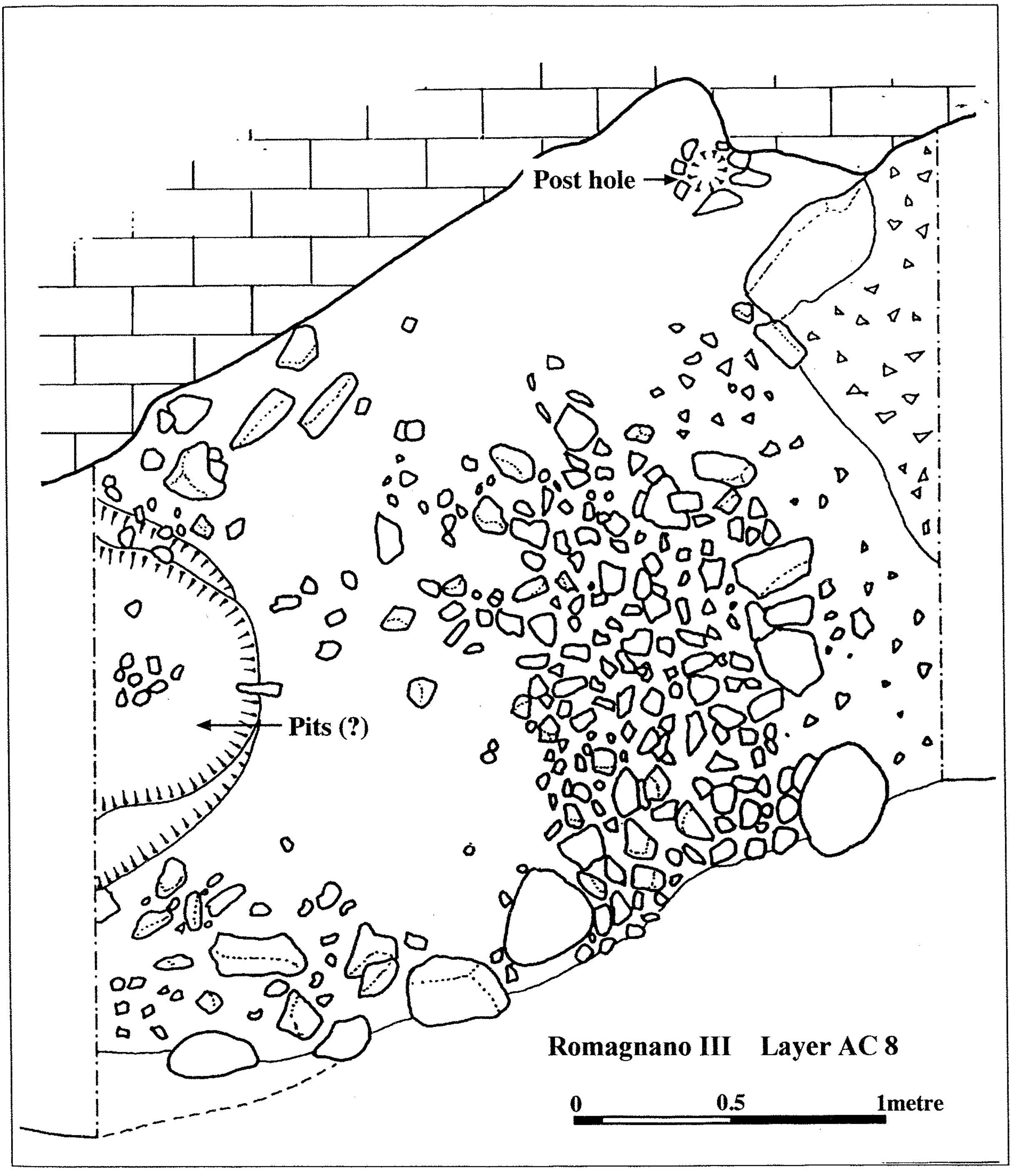

Figure 7.2 Early Mesolithic site plan
showing pit and post holes features (Layer AC 8)

Romagnano Lithics: Microlithic Material	AF-AE	AC8-4	AC3-1	AB3	AB2-1	AA2-1
Points	11	100	53	7	11	7
Backed points	3	31	48	7	1	-
Segments	12	131	47	3	2	2
Segmented back points	13	10	10	4	6	-
Triangles	44	209	213	50	18	4
Double backed points	17	198	82	26	17	5
Trapezes	--	-	-	19	88	135
Marginally retouched points	5	23	9	3	1	-
Others	1	-	1	-	-	-
Total Microliths	**106**	**702**	**463**	**119**	**144**	**153**
Fragments	37	124	115	24	18	-
Total inc. Fragments	**143**	**826**	**578**	**143**	**162**	**153**

Table 7.1: Romagnano III- Microlithic material

Romagnano Lithics: Tools	AF-AE	AC8-4	AC3-1	AB3	AB2-1	AA2-1
Endscraper	4	184	83	33	44	49
Retouched blades*	7	143	49	10	12	11
Burins	2	51	23	3	7	6
Truncated blade	8	38	13	8	11	10
Retouched blade	7	36	13	10	33	42
Borers	2	10	3	4	6	2
Backed blades	1	17	6	1	-	-
Points	1	-	1	1	2	1
Pezzi scagliati	-	1	2	1	-	-
Composites	-	2	3	-	3	1
Others	-	1	-	-	-	-
Total	**32**	**483**	**196**	**71**	**118**	**122**
Fragments of Tools	30	139	64	23	12	4
Total Tools	**62**	**622**	**260**	**94**	**130**	**126**

Table 7. 2: Romagnano III- Tool fragments

cores with flakes and thin sheets of flint are common in the Sauveterrian levels, while there is an increase in blade cores in the Castelnovian levels.

Animal Bone from Romagnano III

Excluding the small assemblage from Area 4, the faunal material consisted of 1066 fragments of bone and 427 teeth fragments. Out of the 1066 bone fragments 732 were identifiable to animal species and bone type.

Fish and fresh water turtle are also recorded from the main assemblages. None of this material was available for the present study.

Romagnano III	AF-AE	AC8-4	AC3-1	AB3	AB2-1	AA2-1
Bird	yes	yes	yes	yes	yes	yes
Fish	yes	yes	yes	yes	yes	yes
Fresh water turtle	no	yes	yes	yes	yes	yes

Table 7.3 Presence / absence of bird, fish and marsh turtle bones at Romagnano III

Early Mesolithic: Earliest Sauveterrian Period (Layers AF - AE)

The earliest Romagnano III deposits consist of layer AF with a radiocarbon date of 9830±90bp, and belong to the early Mesolithic (Sauveterrian) period. This deposit is represented by a small assemblage consisting of a single backed-blade and a backed-point with retouch on both sides: a classic early Mesolithic arrow point. Five further microlithic fragments were also recorded, but the layer contains so few lithic fragments to be of little significance in interpretation. It is likely that the layer was truncated by the later, more extensive deposit, Layer AE.

Layer AE produced a slightly larger range of tools and microliths. Radiocarbon dates ranged from 9580±250bp to 9420±60bp. Truncated blades, retouched flakes and retouched blades were the most common tools and microliths consisted mainly of triangles and other retouched points. Layers AF to AE are Early Sauveterrian and the quantity of material excavated must be regarded as a result of a smaller volume of soil excavated. This is because the wall of the rock shelter slopes out reducing the size of the deposit, and it is also likely that erosion, caused by later activity and natural processes truncated these deposits.

The earliest deposit to produce animal bone was Layer AF and contained two fragments of ibex. A metacarpal and a second phalange belonged to mature animals. According to Boscato and Sala (1980), the following layer AE contained 31 bone fragments, of which 15 belonged to beaver, seven to ibex, three red deer and three roe deer, together with two pig and one bear bone fragment. None of these were found in my study of this assemblage.

Early Mesolithic: The Main Sauveterrian Period (Layers AC8 - AC4)

Layers AD consisted of a natural deposit with no cultural material, but with evidence of rock collapse of large boulders. Resting above this was a lens of anthropogenic material, AC9. The excavators were only able to see this once it had been excavated and the section recorded. The lithic material was therefore grouped with the overlying Layer AC8. This group of layers represents the beginnings of the main Sauveterrian period and contains relatively high quantities of lithic material. The tool descriptions outlined below also refer to the later Sauveterrian levels (Layers AC3 - AC1).

Tools are dominated by end scrapers and retouched flakes together with small numbers of burins, borers and blades. Microliths consist of scalene and isosceles triangles, segments and other backed points. The quantities of lithic material, particularly the tools indicate that specific subsistence activities were being practised. The relatively high number of end-scrapers might, for instance, suggest that animal skins were being processed.

Layers AC7 through to AC1 can also be grouped into the main Sauveterrian period and radiocarbon dates range from 9100 ± 90bp for layer AC8 to 8220±80bp for AC1. If we include the date from layer AC8 (9200 ± 60bp) this gives a chronological duration of *c.*1000 years for the Sauveterrian and the accumulation of approximately 1m of rock shelter sediments. Throughout this long period there is evidence for rock falls within the shelter deposits, but a build-up of only 1m of material during 1000 years may not be indicative of intensive activity within the shelter. There are a relatively high number of lithic artefacts from these layers (Tables 7.1 and 7.2) and this material suggests that a similar range of activities were conducted throughout the long period. As with layer AC8-9, the tools consist of end scrapers, retouched flakes, truncated blades and burins, while the microliths are dominated again by scalene and isosceles triangles and other points.

Only layer AC5 shows any differences with the rest of this deposit. An increase in double backed points corresponds to a large reduction in single backed points and segmented backed blades. It is difficult to know how significant this is as the sample size is relatively small. Broglio and Kozlowski (1983:148) regard this as a change in cultural tradition. It could simply represent a different activity being conducted where double backed points were necessary. There is no evidence from the faunal remains to indicate that a specific activity relating to animal processing was taking place.

Based on the lithic evidence, the main Sauveterrian period at Romagnano is represented by Layers AC8 - AC4. It is during this period that the main human occupation begins, with significant numbers of red deer, roe deer, ibex, chamois, pig and smaller animals. A total of 290 identifiable and 407 unidentifiable bones (including teeth) are recorded from these layers.

<u>Large Mammals</u> (see Table 7.4)

Red deer (*Cervus elephus*)

Red deer first appear in the archaeological record in level AC8 and a total of 107 bones belong to this grouping. The majority of bones consist of phalanges and other lower feet bones (metapodial, calcaneus and astragalus fragments). The three remaining bones consist of two mandible fragments, one of which belonged to a relatively young specimen and a distal tibia that had been chopped immediately above the distal end. This bone, together with 23 of the feet bones were burnt. A large proportion of the phalanges (62) had traces of butchery. Practically all the first and second phalanges and metapodial were split open either longitudinally or across the bone, presumably for marrow extraction. A calcaneus had traces of fine cutmarks associated with dismembering the lower feet bones from the leg bones (TC1/ TC3 in Binford 1981:120). A further calcaneus was badly gnawed by either a dog or wolf. The gnawing, also noted on some of the phalanges, indicates scavenging behaviour.

The majority of red deer bones are fully fused and belonged to mature animals. Two mandible fragments and two metapodial fragments are from a young animal. All these bones were from one single layer (AC6) and were possibly from the same animal.

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	88	24	49	12	12
Metapodials	11	6	7	7	5
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	-	4 / -	-/ 1	1 / 1	-
Tibia	1	2	2	1	-
Calcan/Astrag	4 / 1	1 / 6	1 / 1	- / 3	- / 1
Humerus	-	-	-	-	-
Femur	-	-	1	-	-
Scapula	-	1	1	1	-
Pelvis	-	2	-	-	-
Vert/ribs	-	-	-	-	-
Mandible	2	1	-	1	-
Maxilla	-	-	-	-	-
Antler / horn	-	-	-	1	-
Teeth	-	-	5	-	-
Totals	**107**	**47**	**68**	**28**	**18**

Table 7. 4: Animal bone body part representations from Romagnano III Main Sauveterrian (Layers AC8 - AC4)

Roe deer (*Capreolus capreolus*)

A total of 47 bones belong to the main Sauveterrian period. These include phalange, metapodial and astragali fragments, together with a burnt calcaneus. These lower feet bones show a similar butchery pattern to the red deer bones and indicate marrow extraction. An astragali fragment had been chopped in half longitudinally. Butchery evidence suggests that radii and tibia fragments were also chopped open- probably for marrow. A radius fragment appears to have chop mark below the proximal articular end (below RCp5 in Binford 1981:125). Two of the radii bones were from the right side and probably belong to the same bone. In addition to the leg bones, two acetabulum fragments, possibly belonging to the same animal were recorded. A single mandible fragment is recorded, it contains three teeth and belonged to a mature animal. A scapula fragment was chopped through the neck of the bone below the navicular cuboid (S1 Binford 1981:122) and could relate to dismemberment of the front leg bone.

Two of the phalanges had traces of tooth marks which were probably the result of dog or wolf gnawing.

The age range for these bones seems a little broader than those of the for red deer. Metacarpals, a radius fragment and an acetabulum fragment belong to youngish animals of approximately 18 months old.

Ibex (*Capra ibex*)

The main Sauveterrian period contained a total of 68 ibex bones of which five were teeth. The majority consisted of phalanges (49) and most belonged to mature animals. Layer AC8 itself produced eight ibex bones, four of these consisted of teeth and four were phalange fragments. It is possible that these were from one individual, a young ibex, as they all came from the same area of the site, and from the same layer. Only one of these bones, a first phalange had any traces of butchery and was chopped in half for marrow. Further phalange fragments showed evidence that they had been split open for marrow and traces of burning were also common. One distal metacarpal end had been chopped longitudinally, probably to extract marrow.

Five mandible teeth (two from a young animal) and a young adult mandible fragment were recorded from these levels. Although the teeth were found in the layer below that of the jaw bone, they could belong to the same animal.

A single astragalus from a mature ibex revealed clear dismemberment marks across the surface of the bone and are identical to those illustrated in Binford (1981:120-TA1). These marks are the result of dismembering the distal tibia from the tarsals when the leg is outstretched or straight (Binford 1981:119), and are common in bone assemblages from the Upper Palaeolithic through to historic periods. Further bones included a calcaneus, distal fragments of an ulna and femur and a scapula fragment with a chopmark around the glenoid cavity (S1 in Binford 1981:122). This is quite a common butchery mark used to dismember the scapula from the distal humerus. According to Binford (1981:121) butchery marks around the glenoid cavity are most likely to be seen at sites where meat is consumed, or where there is processing for drying meat. A distal tibia fragment contained a chopmark across the surface of the bone above the distal end. A second tibia fragment was an unfused proximal end from a relatively young animal.

Chamois (*Rupicapra rupicapra*)

Chamois are also present in the main Sauveterrian phase and 28 bone fragments belonged to this animal. Twelve bones consisted of phalange fragments that were burnt and/or split open for marrow. Longitudinal chopmarks splitting the bone along its length suggest that the metapodials had been split open for marrow or for making bone points.

Long bone fragments consisted of single proximal ends of a scapula, a radius, an ulna and a distal fragment of a tibia. The scapula had a possible cutmark on the blade of the bone (S3 in Binford 1981:98). However, this could have been a trample or natural mark of some kind. A radius had a cutmark below the proximal medial side of the bone (below RCp5 in Binford 1981:125). Both marks may be the result of stripping the meat from the bone. This group of 28 bones suggests that chamois of all ages were being hunted in the Sauveterrian period.

Wild boar (*Sus scrofa*)

These layers produced a total of 18 wild boar bones consisting mainly of phalange and metapodial fragments. None of the phalanges appeared to have been split open for marrow, as was often the case with the other large mammal species. All but one first phalange were from mature animals and the bones were very large compared to domestic pig. The metapodial fragments were also large as would be expected from fully mature wild boars. Two metatarsals appear to have been chopped longitudinally. It is unclear whether this was due to marrow processing or the manufacture of bone points.

<u>Carnivores and Smaller Mammals</u> (see Table 7.5)

Brown Bear (*Ursus arctos*)

Seven fragments of bear were found within the main Sauveterrian layers (Layer AC7). These consisted of four second phalanges and a single first phalange. One second phalange had been chopped in half, probably for marrow extraction. A single humerus and metacarpal bone were also recorded. Both had been butchered. The humerus had chopmarks on the distal frontal end of the bone suggesting dismemberment from the radius and ulna. The metacarpal had been chopped longitudinally, possibly to extract bone marrow. It is likely that all these bones belonged to the same animal.

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

Six beaver (*Castor fiber*) bones were recorded from the main Sauveterrian layers (AC7 and 6). These consisted of four phalanges. A metacarpal and a metatarsal were also recorded. All except the metatarsal were complete bones with no traces of butchery. Although the beaver bones were probably more fragile than the large mammal bones they

	LayersAC8 - AC4	Layers AC3 - AC1	Layer AB3
Beaver	x6 (see text)	Ulna, metapodials x2	Humerus, phalanges x2
Pine Marten	x 8 (see text)	Humerus	Skull x2, metatarsals x2, phalange
Brown Bear	x 7 (see text)	Phalange	-
Fox	Mandible	-	-
Total	**22**	**5**	**8**

Table 7.5: Smaller mammal and carnivores from Sauveterrian period

were clearly not so fragmented. This supports the interpretation that most of the bone fragmentation of the larger mammals was the result of human activity. Eight pine marten bones were recovered, these include four first phalanges and all the bones belonged to mature animals. A mandible fragment with teeth was burnt and a mandibular hinge was also recorded. A fragment of a femur and a metatarsal were also recorded.

A single fragment of a mandible of a fox (*Vulpes vulpes*) was recovered from AC4.

Early Mesolithic: The Later Sauveterrian Period (Layers AC3 - AC1)

Layers AC3 - AC1 are classed as broadly Late Sauveterrian in date. This interpretation is based on both the lithics and radiocarbon dates. The density of occupation continues, although the time period is probably a lot less than for the main Sauveterrian period (8590± 90 to 8220 ±70bp).

A total of 138 identifiable and 135 unidentifiable bone fragments (including teeth) are recorded from Layers AC3 - AC1.

<u>Large Mammals</u> (see Table 7.6)

Red deer (*Cervus elephus*)

Red deer comprise of 59 fragments and show a similar pattern to the earlier deposits and consist of phalange and metapodial fragments. Two metacarpal fragments were distal epiphysial ends that were unfused and therefore probably belonged to an animal less than 18 months old. A radius fragment had been chopped through below the proximal end.

A calcaneus had two small cutmarks on the distal end (TC 3 Binford 1981:120). These would appear to relate either to skinning or dismemberment. Binford (1981:119-120) discusses similar cutmarks that are often interpreted as the result of cutting the tendon

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	44	29	18	1	2
Metapodials	12	5	1	4	-
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	1 / -	2 / -	-	-	-
Tibia	-	-	-	-	-
Calcan/Astrag	2 / -	- / 3	2 / 1	-	- / 1
Humerus	-	1	-	1	-
Femur	-	-	-	-	-
Scapula	-	-	-	-	-
Pelvis	-	-	-	-	-
Vert/ribs	-	-	-	-	-
Mandible	-	-	2	1	-
Maxilla	-	-	-	-	-
Antler	-	-	-	-	-
Totals	**59**	**40**	**24**	**7**	**3**

Table 7.6: Animal bone body part representations from Romagnano III
Later Sauveterrian (Layers AC3 - AC1)

attachment of the gastrocnemius muscle of the posterior end of the calcaneus. Binford's ethnographic experience with the Navajo (Binford and Bertram 1977: 92-93) and Nunamiut (Binford 1981) offers an alternative observation. In cases where the complete upper leg is hung on drying racks, the tissue between the tibia and the posterior end of the calcaneus is cut with a knife to help insert a hanging rope to facilitate further butchery. Binford (1981) cites evidence from bison and antelope bones to suggest that it is a relatively common occurrence in faunal assemblages.

Practically all of the red deer bones were feet bones and out of 59 fragments, 39 were processed for marrow extraction. Almost all of the bones belonged to mature animals.

Roe deer (*Capreolus capreolus*)

The Later Sauveterrian layers contains 40 bones consisting mainly of phalange and other feet bones. Butchery traces relate mainly to marrow extraction processes on the phalanges and metacarpals. The three remaining bones consisted of two radii fragments and a distal humerus. The radii fragments were also chopped below the proximal end and one fragment was also burnt.

With the aid of a hand lens it was possible to see striation marks of some of these bones suggesting that trampling and compaction processes had worked on this component of the bone assemblage.

Ibex (*Capra ibex*)

The later Sauveterrian phase contained 24 ibex bones. These consisted mainly of phalange fragments and the majority belonged to mature animals. Some were chopped open for marrow and in some cases were also burnt. One calcaneus had a cut or chopmark reminiscent of the illustration in Binford (TC3 in 1981:120). This mark reflects the same dismemberment activity as noted on the astragalus in the earlier Sauveterrian levels. It is possible that a burnt astragalus fragment could have articulated with this calcaneus. Two mandibles and a metacarpal fragment are also recorded. These belonged to mature animals.

Chamois (*Rupicapra rupicapra*)

The later Sauveterrian phase produced seven bones identified as chamois. These included three distal metacarpal fragments that had been chopped open longitudinally.

Wild boar (*Sus scrofa*)

The later Sauveterrian levels produced three wild boar bones. Two consisted of third phalanges and the third was a burnt fragment of an astragalus. All belonged to mature animals.

Smaller Mammals and Carnivores (see Table 7.5)

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

Three beaver bones are recorded from the later Sauveterrian levels. These consist of an ulna and metacarpal, which were both complete bones, and a distal metatarsal fragment. None showed traces of butchery or any other attritional processes. A single marten distal humerus fragment was also recorded. This was burnt and belonged to a mature animal.

A badly burnt first phalange of a brown bear was found within layer AC3.

Early to Late Mesolithic: The Final Sauveterrian and Early Castelnovian Transition (Layer AB3)

The succeeding layer, AB3 has been described by Broglio as a Sauveterrian complex with trapezes (Broglio 1971) (and also as Epi-Sauveterrian (Broglio 1976)). He is therefore suggesting a transitional phase between the Sauveterrian and Castelnovian Mesolithic periods. This is based on the fact that both Sauveterrian triangular microliths and later Castelnovian trapezes were found together. However, by creating extra chronological categories Broglio is complicating the archaeological database and is partly the result of a poor excavation methodology under difficult circumstances. The technique of excavating the site in 10 cm spits means that it would be easy to mix material from two layers. This transitional layer must therefore be considered with caution and the material will therefore be presented as a single layer.

Based on the above evidence, the transition between the Sauveterrian and the Castelnovian Mesolithic occurred somewhere around 8130±80bp. From the lithic data Layer AB3 does seem to have the character of a transitional microlithic assemblage. The triangular points drop in number compared to earlier levels, while a small number of trapezes also appear. These include scalene, isosceles and rectangular trapezes. Dorsal points also drop in quantity so that the microlithic assemblage is almost completely dominated by trapezes. Other tools remain similar to previous levels, with scrapers being the most common instrument. Retouched flakes follow a trend that started in layer AC3 in becoming progressively less common.

A total of 65 identifiable and 59 unidentifiable bone fragments (including teeth) are recorded from this single layer. No ibex were present in the assemblage.

<u>Large Mammals</u> (see Table 7.7)

Red deer (*Cervus elephus*)

Layer AB3 produced 29 red deer bone fragments consisting mainly of phalanges (18). Most were first and second phalanges and were chopped fragments with traces of burning. Proximal ends of a metacarpal and a metatarsal had been longitudinally chopped through the articular surfaces. Two proximal tibia fragments, one left and one right side

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	18	14	-	4	1
Metapodials	2	2	-	5	1
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	-	-	-	-	-
Tibia	2	-	-	-	-
Calcan/Astrag	-	- / 1	-	-	-
Humerus	-	-	-	-	-
Femur	-	-	-	-	-
Scapula	-	-	-	-	-
Pelvis	-	-	-	-	-
Vert/ribs	-	-	-	-	-
Mandible	-	-	-	-	-
Maxilla	-	-	-	-	-
Antler	7	-	-	-	-
TOTALS	29	17	-	9	2

Table 7.7: Animal bone body part representations from Romagnano III
Later Sauveterrian (Layer AB3)

were possibly from the same animal and belonged to a young red deer. Seven antler fragments were all small and could have belonged to one antler tine. There were no cut or work marks and the condition of the material was poor compared to the animal bone.

Roe deer (*Capreolus capreolus*)

Layer AB3 contained 17 roe deer bones and were feet bones with traces of butchery and burning. These belonged to mature animals.

Chamois (*Rupicapra rupicapra*)

Nine chamois bones were recorded from layer AB3 and consisted metapodial and phalange fragments. Butchery evidence suggests that the metapodials were split open for marrow, or alternatively, for the manufacture of bone tools such as points.

Wild Boar (*Sus scrofa*)

Layer AB3 produced burnt fragments consisting of a chopped metatarsal and third phalange.

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	18	8	2	10	3
Metapodials	7	2	-	1	-
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	1 / 1	-	-	1 / -	-
Tibia	1	-	-	-	-
Calcan/Astrag	-	- / 3	-	-	-
Humerus	-	1	-	1	-
Femur	-	-	-	-	-
Scapula	-	1	-	-	-
Pelvis	-	-	-	-	-
Vert/ribs	-	-	-	-	-
Mandible	-	-	-	-	-
Maxilla	1	-	-	-	-
Antler	-	-	-	-	-
TOTALS	29	15	2	13	3

Table 7.8 Animal bone body part representations from Romagnano III Later Sauveterrian (Layers AB2 - AB1)

Small Mammals and Carnivores (Table 7.5)

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

Three beaver bones were recorded. These consisted of a second and a third phalange and a distal fragment of a humerus. Five fragments of pine marten bones comprise of two skull fragments, two metatarsals and a first phalange fragment.

The Late Mesolithic: Main Castelnovian Period (Layers AB2 - AB1)

The layers above AB3 have been grouped together as AB2 and AB1 and have three radiocarbon dates ranging from 7850±60bp to 7500±160bp. Trapezes, of the forms described above are more common. These Layers are regarded as classic Castelnovian. With regard to other tools, scrapers still dominate the assemblage with short end scrapers becoming more common. Backed blades appear less common in these later levels. Backed points also appear in very small quantities.

A total of 76 identifiable bones and 95 unidentifiable bone fragments (including teeth) are recorded from this group. The eastern sector of Romagnano III contained further deposits of broadly Castelnovian date. This area is listed Area 4 on the site plan. Recording details are limited because this area did not have the same length of chronological sequence and was regarded as less important for understanding the development of the lithic typology. According to the limited records, the excavations in this zone relate to the Castelnovian levels AA, AB1-3. The excavated units were sub-divided into spits and m² units, but it was not possible to locate any records relating them to the stratigraphical units in Area 1. The animal bones will therefore be treated as belonging to the main Castelnovian assemblage and the description of the animal bones will follow after the main stratigraphical sequence of AB1-2 have been presented.

Large Mammals (see Table 7.8)

Red Deer (*Cervus elephus*)

Twenty-nine bones belonged to red deer and consist mainly of phalange and metapodial fragments. One metacarpal had been split longitudinally on its distal end. Two proximal metatarsal fragments were also recorded and one had been split open for marrow. Eighteen phalange fragments contained evidence of chopping and burning. Together with one of the metatarsal fragments, two of the phalanges had been badly gnawed by either a dog or wolf. In addition, a fragment of skull may have been gnawed. Unfused distal fragments of a radius and a tibia are also recorded. A distal fragment of an ulna appears to have a polished point and is similar to bone awls found in late Neolithic and Bronze Age sites like Fiavé. These tools are interpreted as used for piercing leather skins (Perini pers comm.).

The bones from AB1-2 contain more evidence, than previous layers, that younger red deer were hunted (e.g. unfused material).

Roe deer (*Capreolus capreolus*)

Layer AB1-2 contained 15 roe deer bones consisting mainly of lower feet bones. Only one phalange had clear evidence that it had been chopped open. Three astragali together with two metacarpal fragments, one of which belonged to a young animal are also recorded. Gnaw marks were also evident on some of these bones. A humerus fragment was one of the few bones from this layer with clear evidence for butchery activity. This had been chopped above the articular end (above Hd2 in Binford 1981:123).

Ibex (*Capra ibex*)

The main Castelnovian levels AB1-2 were the final deposits to contain ibex bones and comprised of two phalange fragments. A first phalange had been chopped open for

	Layers AB2 -AB1	Layer AA	Area 4
Beaver	x4 (see text)	Radius, phalanges x2	X 11 (see text)
Pine Marten	x10 (see text)	x 8 (see text)	Femur, humerus, mandible
Brown bear	-	-	X 5 (see text)
Fox	-	Teeth x2 (+2?)	-
Total	**10**	**13**	**14**

Table 7.9: Smaller mammal and carnivores from the Castelnovian period

marrow. Ibex gradually disappear from the archaeological record and by the beginning of the Castelnovian they cease to be an important animal at Romagnano.

Chamois (*Rupicapra rupicapra*)

Thirteen chamois bones were recorded from layer AB1-2 consisting mainly of phalange fragments. Seven were chopped either in half or longitudinally for marrow.

Wild boar (*Sus scrofa*)

Three wild boar phalange fragments belonged to mature animal(s).

Small Mammals and Carnivores (see Tables 7.9)

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

The main Castelnovian layers contained four beaver bones. One was unavailable for study as it is now held at Ferrara University. The remaining three bones consisted of three phalanges. These belonged to mature animals and were in good condition. Ten pine marten bone fragments were also recorded. Four consisted of phalanges, three were metatarsal fragments and, in addition, single fragment of a mandible, a humerus and a femur were also recorded. All belonged to mature animals and were in good condition. A metatarsal and mandible fragment were burnt.

The Late Mesolithic: Late Castelnovian Period (Layer AA)

The following layer AA marks the final Castelnovian period and has a radiocarbon date of 6480±50bp. This layer has caused controversy because Broglio (1971) regards it as 'Epi-Castelnovian' with the first evidence of pottery. Biagi (1981) argues that this pottery material is intrusive from the layer above containing Gaban type early Neolithic pottery. It is likely that the same processes discussed above for lithic material in Layer AB3 may

	Layers AA				Area 4		
Bone type:	**Red Deer**	**Roe Deer**	**Chamois**	**Wild Boar**	**Red Deer**	**Roe Deer**	**Wild Boar**
Phalanges	37	26	5	7	46	18	2
Metapodials	5	2	-	-	5	7	-
Carpal/Tarsals		-	-	-	-	-	-
Radius/Ulna	1/-	-/ 1	2 / -	-	3	1 / 1	-
Tibia	-	-	1	-	3	1	1
Calcan/Astrag	2/2	1 / 4	1 / 1	-	7 / 5	3 / 2	-
Humerus	1	1	2	-	5	3	2
Femur	1	1	2	-	1	1	-
Scapula	1	1	-	-	3	-	-
Pelvis	2	1	-	-	-	-	-
Vert/ribs	-	-	-	-	-	-	-
Mandible	-	-	1	1	2	3	-
Maxilla	-	-	-	-	-	-	-
Tusk	-	-	-	1	-	-	1
Antler	-	-	-	-	-	-	-
TOTALS	**52**	**38**	**15**	**9**	**80**	**40**	**6**

Table 7.10: Animal bone body part representations from Romagnano III Late Castelnovian (Layers AA) and Late Castelnovian (Area 4)

also apply to this pottery. The lithic material for this level shows little change from the preceding Castelnovian layers and clearly belong to that tradition. Together with end scrapers, retouched blades, which started to increase in quantity in layers AB1-2 dominate the assemblage and these continue to be of importance in the earlier Neolithic. Broglio and Kozlowski's 1983 study does not present any information of these earlier Neolithic deposits, even though there is some continuity in the composition of the lithic assemblage. Backed blades and flakes together with truncated blades continue, although trapezes are not common. A total of 130 identifiable and 65 unidentifiable bone fragments are recorded.

Large Mammals (see Table 7.10)

Red Deer (*Cervus elephus*)

Layer AA produced 52 red deer bones. The majority consist of phalanges and metapodials. Apart from the third phalanges most had been chopped open for marrow and many were also burnt. Unlike the previous layers further bones types were present and included two acetabulum (pelvic) fragments from two different animals. One fragment was burnt and both had been heavily cut or chopped near the socket holding the femoral ball (PS7/PS9 in Binford 1981:113). These marks are the result of dismembering the rear legs from the body of the animal. A burnt fragment of a proximal femoral ball was also recorded. This had two heavy cut or chopmarks on the lower surface of the ball and is consistent with the location of the butchery marks on the pelvic bones mentioned above.

Evidence for further butchery came from a calcaneus fragment. This had been chopped through the posterior end at the position where the tendon linking the tibia holds to the calcaneus (in area of TC3 in Binford 1981:120). Two astragalus fragments were also recorded and appear to articulate with the calcanii. The articular end of a scapula belonging to a mature animal was also recorded, together with a radius fragment. This assemblage contains proportionately more young animal bones (nine out of 52).

Roe deer (*Capreolus capreolus*)

Layer AA contained 38 roe deer bones of which 26 were phalanges. These were mainly from mature animals, some were badly burnt and most had been chopped. Two metacarpals indicated that younger animals were represented in this assemblage. Other bones fragments of a pelvis (ilium), a humerus, a scapula, a femur and an ulna. Both the ilium and the scapula were unfused fragments. Cutmarks near the articular surface of the ulna indicate dismembering of the radius/ulna from the humerus (RCp-5 in Binford 1981:124).

Chamois (*Rupicapra rupicapra*)

Layers AA produced fifteen fragments of chamois. As is the case in all the material from the later levels, the chamois bones were better preserved and appeared to show a greater range of bone types. Long bones included two distal fragments of humerus from different bones, two proximal fragments of femur from different bones and a proximal and distal fragment of two different radius bones. A distal tibia fragment was also recorded. One of the humeri had a possible cutmark on the anterior surface above the distal epiphysis. A mandible fragment was also recorded. The surviving teeth indicate a mature animal.

Wild boar (*Sus scrofa*)

Layers AA contained nine wild boar bones consisting mainly of phalanges. In addition a tusk fragment and a mandibular fragment with a large M3 tooth.

Smaller Mammals and Carnivores (Table 7.9)

Brown Bear (*Ursus arctos*)

Five bear bones were recorded from the later Castelnovian period. These consisted mainly of teeth, two M3, a canine and an M1. A single third phalange was also recorded. It is suggested that two bear were represented by these teeth, as one of the M3s belonged to a young adult and the second was from a mature individual.

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

Three beaver bones were recorded consisting of two second phalanges and a radius. Eight fragments of pine marten were also recorded. These comprised two metatarsals and two metacarpals, and single fragments of mandible, humerus, tibia and a first phalange. The two metacarpals belonged to a young pine marten as the proximal ends were unfused.

Four fox teeth are recorded from these layers and consist of three molars and a pre-molar.

Late Mesolithic (Late Castelnovian Period) - Area 4

Although the Area 4 assemblage is broadly contemporary with Layers AB3 - AB1 and AA2 and AA1, it is presented as a separate unit because it was not possible to relate it directly with any of the other deposits.

Large Mammals (see Table 7.10)

Red deer (*Cervus elaphus*)

Area 4 produced well preserved faunal remains, of which 80 belonged to red deer. Although phalanges were still the most common (46), other leg bones were also present. The phalanges showed butchery patterns associated with marrow extraction. Three calcaneum had heavy cut or chopmarks associated with dismemberment of leg bones (TC3 in Binford 1981:120). One tibia fragment had marks associated with its dismemberment from the femur. Three radii show evidence of dismemberment from the humeri, as well as evidence for marrow extraction (below RCp 5 in Binford 1981:125). Four out of the five humeri also contained evidence for butchery. These included cut marks associated with dismembering the bone from the radius (above Hd2 in Binford 1981:123) and heavy chopping on the proximal end, possibly associated with dismembering it from the scapula (Hp2 in Binford 1981:123). A scapula fragment had chopmarks on the tip of the navicular cuboid and a cutmark further down on the neck of the bone (S1 in Binford 1981: S2). One mandible fragment was from a juvenile animal and another belonged to a mature animal.

A minimum of three red deer individuals were recorded within the Area 4 assemblage (based on distal humeri). Fusion evidence from Area 4 indicates a larger number of young / juvenile animals than recorded in the earlier Mesolithic levels (12 bones). This trend is broadly similar to the Late Castelnovian levels in the main area of Romagnano III. Although it is argued that this is a reflection of the subsistence pattern in which a wider age range of red deer were hunted, it is possible that material was better preserved in the later levels and thus younger bones were more visible. The study of the Pradestel fauna will add further to the proposal that this information represents changing subsistence strategies.

Roe deer (*Capreolus capreolus*)

Area 4 contained 40 roe deer bones. Phalange and metapodial fragments were the mot common bones, and most had been split open for marrow. One calcaneum was split open and one astragalus was completely burnt. Upper leg bones comprised three fragments of humeri, including a chopped proximal fragment (Hp2 in Binford 1981:123). Two other distal fragments had cut marks associated with dismembering the bone from the radius/ulna (above Hd2 in Binford 1981:123). Single fragments of a radius and an ulna were recorded. These were from the same leg as one of the humerus fragments and showed no sign of butchery. Rear upper leg bones consisted of a proximal femur and a distal tibia. Both had traces of butchery in the form of cutmarks just below the femoral ball (Fp6 in Binford 1981:131) and the tibia had a chopmark above the distal articular surface. These butchery marks were probably the result of dismembering the bones, although the mark on the tibia could have been part of the process to extract marrow from the lower end of the bone.

Wild Boar (*Sus scrofa*)

Six fragments of wild boar bone are recorded from Area 4. These include two distal fragments of humerus from different bones with traces of butchery in the form of chopmarks. One fragment had a chopmark on the anterior surface just above the distal epiphysis (Hd3 in Binford 1981:123). The second had a chopmark on the posterior side above the epiphysis (above Hd2 in Binford 1981:123). It is assumed that these are both dismemberment marks relating to removing the upper meat bearing bones from the lower quality meat bones of the radius and below. Also recorded was a distal tibia fragment with a chopmark on the posterior surface above the epiphysis.

Smaller Mammals and Carnivores (see Table 7.9)

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

Eleven beaver bones were recovered and belonged to mature animals. The majority consisted of phalange fragments. One metacarpal, two metatarsals, a calcaneus and mandible fragment are also recorded. One of the metatarsal fragments, an Mt2, had a longitudinal chopmark down the distal end.

Three pine marten bones were recovered consisting of distal ends of a femur, a humerus and a mandible fragment.

The Early Neolithic Period

The final deposits in this present study of Romagnano consist of early Neolithic layers. Layer T4 /T2 lies immediately above AA (the late Castelnovian layer that produced early pottery). Ten red deer bones were recorded from layers T4 / T2. These consisted of two ulna fragments, three metacarpals, three phalanges and a tibia and calcaneum. These belonged to mature animals and butchery traces indicate marrow extraction and possibly dismemberment chop marks on the tibia . One of the two ulnae had a possible chopmark on the distal region of the bone. Eight roe deer bones were recorded consisting of four phalanges and two radii fragments and all the bones belonged to mature animals. Butchered fragments of a humerus and a tibia are also recorded.

Summary of Faunal Material from Romagnano III

The animal bone assemblage from Romagnano is well preserved but fragmented. It is argued that much of the fragmentation was the result of butchery activity associated with marrow extraction. These attributes are shared by sites such as Pradestel and Vatte di Zambana. Although it could be argued that the effects of trampling and compression from later levels was not so extreme, the later Neolithic, Bronze Age, Iron Age and later activity at Romagnano III would have produced equivalent compression and fragmentation to the earlier periods. A fuller discussion will be given once these sites have been presented.

Lower leg bones (phalanges and metapodials) from red deer, roe deer, ibex and chamois were all extensively processed, and there is some evidence that brown bear were also processed for marrow. It is also possible that bone tools were made from metapodials and other bones. Many of the phalange and metapodials were burnt, and it is likely that heat or fire was part of the process relating to marrow extraction. Wild boar phalanges appear to have been less intensively processed. This a feature that was also noted at the Bronze Age site of Fiavé with regard to domestic pig (Clark 1985), and may indicate that the boar bones were harder to break, or that the marrow levels were too low to be worth intensive processing. Alternatively, it shows a preference away from pig marrow.

Other elements such as upper leg bones and scapula and pelvic material are present in the assemblage. These, however, are more common in the later levels. Chapter 8 will explore the proposal that this represents evidence for a change from intercept to encounter hunting as discussed in pervious chapters.

In terms of further trends in the faunal record , there is also qualitative data to indicate that the later Mesolithic deposits contain a greater range of younger animals. This is particularly the case with regard to red deer, and possibly with chamois and corresponds with the stage when ibex cease to be recorded in the assemblages. Issues relating to butchery patterns and changing hunting strategies and nutritional levels will be developed further at the end of this chapter and in Chapter 8.

Pradestel

The Pradestel rock shelter is located at Ischia Podetti six kilometres north of Trento. The site lies on the western bank of the Adige Valley, approximately 20m above the current level of the river and thus occupies a similar location to Romagnano III at a height of *c.*225m asl. The rock shelter was discovered between two large limestone outcrops during quarrying activity 1972 (see Plate 8). The accumulated deposit was approximately 5m in depth (see Figure 7.3).

Excavations were started by Bagolini in 1973 and further work undertaken by Broglio in 1975. The occupational sequence at Pradestel covers a similar time period to Romagnano III. The intervening deposits sealing settlement deposits are slightly different to those at Romagnano III. Particularly in the earlier periods Pradestel contains clearer occupational breaks consisting of silty and calcified materials, together with large limestone boulders. This may suggest more intermittent occupation during the earlier periods, or more widespread natural depositional processes. Soil pollen samples were taken from Pradestel, and are included in the following descriptions (Cattani 1977 and 1994).

Preliminary reports on the faunal remains (Boscato and Sala 1980) and the lithics (Bagolini and Broglio 1975 and Biagi 1981) outline the main characteristics of human occupation at Pradestel. Compared to Romagnano III fewer lithic tools or debitage were recorded and were studied by different people. Tables 7.11 -7.13 list the lithic artefacts according to Biagi (1981:45) and Bagolini (pers comm.). Table 7.13 is taken from Biagi 1981:45 and summarises the full number of lithics recovered from Pradestel. The numbers are higher than the listings given in Tables 7.11 and 7.12. These differences are likely to refer to unidentifiable lithic fragments that were recovered.

The level of tool types summarised in Tables 7.12 and 7.13 is more detailed compared to Romagnano III in the main classification system used by Broglio and Kozlowski (1983). It has been decided to use the Biagi (1981) typology because the detail, particularly relating to an increase in scraper types in Layer G and F, corresponds to an increase in smaller mammal types including beaver, wild cat and hare. It is suggested here that the scrapers represent tools for processing fur pelts.

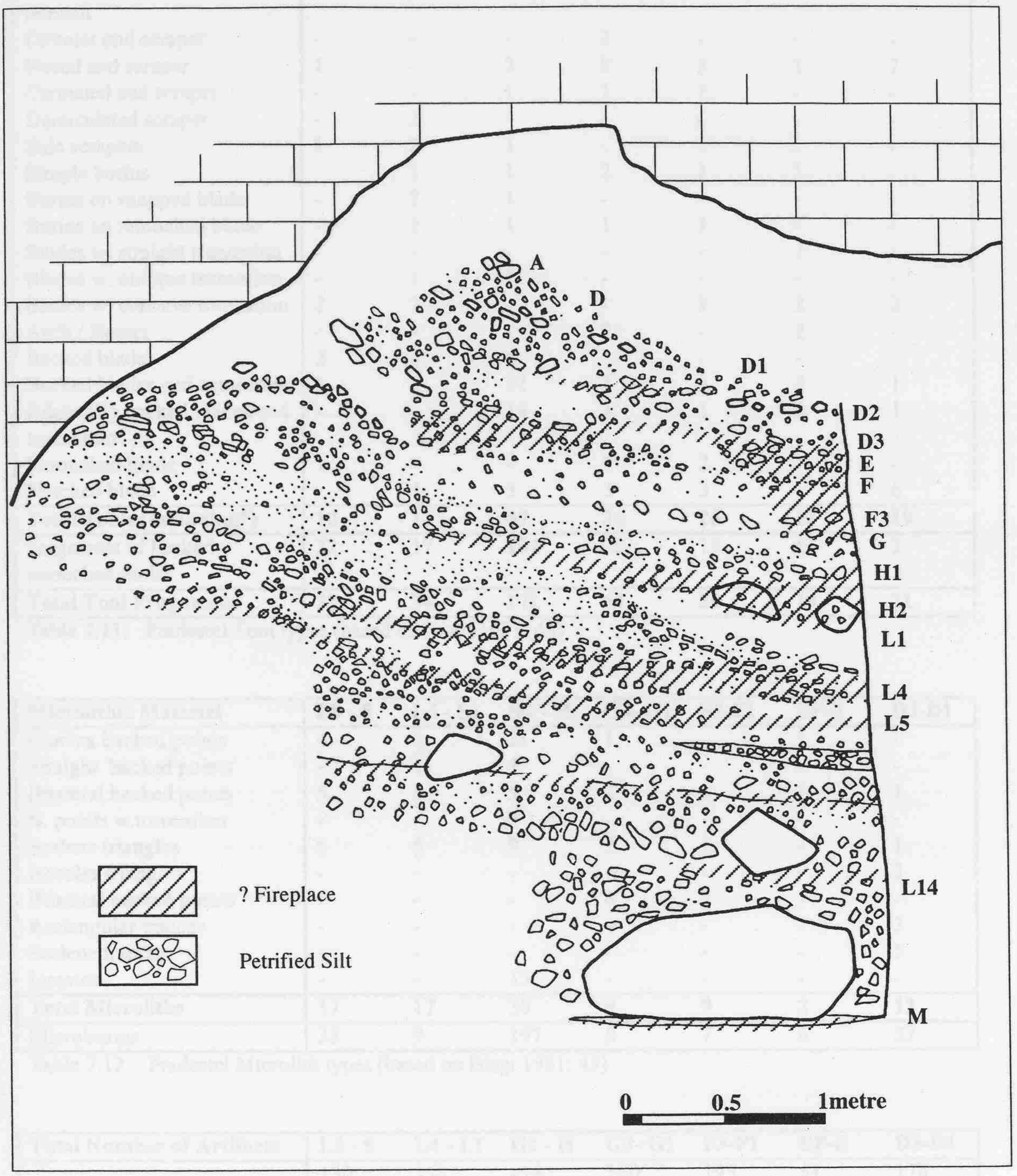

Figure 7.3 Pradestel
section through rock shelter deposits

Layers **M** - **L5**:	Early Sauveterrian
Layers **L4** - **L1** and **H2** - **H**:	Mid to Later Sauveterrian
Layers **G3** - **G1** and **F3** - **1**:	Final Sauveterrian
Layers **EF** - **E**:	Early Castelnovian
Layers **D1** -**D3**:	Middle Castelnovian
Layers **D** - **A**:	Late Castelnovian

Tools:	L8-5	L4 - L1	H2-H	G3- G1	F3-F1	EF-E	D3-D1
Short end scraper	2	-	4	5	7	2	2
Short end scraper w side retouch	-	-	3	2	1	-	-
Circular end scraper	-	-	-	1	-	-	-
Nosed end scraper	1	-	2	8	5	1	7
Carinated end scraper	-	-	1	1	1	-	-
Denticulated scraper	-	2	-	-	-	-	-
Side scrapers	1	2	1	-	-	-	-
Simple burins		1	1	2	1	1	-
Burins on snapped blade	-	2	1	-	-	-	-
Burins on retouched blade	-	2	1	1	1	-	-
Blades w. straight truncation	-	-	-	-	-	1	-
Blades w. oblique truncation	-	1	1	-	-	-	-
Blades w. concave truncation	2	2	-	-	1	2	2
Awls / Borers	-	-	-	2	-	2	-
Backed blades	2	4	4	-	-	-	-
Backed blades and truncation	1	-	31	7	3	2	1
Bilaterally backed blades and truncation	-	-	14	3	1	2	1
Retouched blade	1	-	-	1	2	-	-
Notched blade	-	1	3	3	3	-	6
Total Tools (excluding*)	**10**	**17**	**67**	**36**	**26**	**13**	**19**
Fragments of backed retouched tools*	22	17	104	28	13	6	2
Total Tool Fragments	**32**	**34**	**171**	**64**	**39**	**19**	**21**

Table 7.11: Pradestel Tool types (based on Biagi 1981: 45)

Microlithic Material	L8 - 5	L4 - L1	H2 - H	G3- G1	F3-F1	EF-E	D3-D1
Convex backed points	4	5	11	1	-	1	-
Straight backed points	-	1	3	-	-	-	-
Bilateral backed points	5	6	5	2	3	1	1
B. points w.truncation	-	-	2	-	-	-	-
Scalene triangles	8	5	9	2	1	-	1
Isoceles triangles	-	-	-	-	-	-	3
Bilateral backed points	-	-	-	4	5	-	-
Rectangular trapeze	-	-	-	-	-	-	3
Scalene trapeze	-	-	-	-	-	-	5
Lunates	-	-	15	-	-	-	-
Total Microliths	**17**	**17**	**30**	**9**	**9**	**2**	**13**
Microburins	38	9	197	8	7	6	27

Table 7.12 : Pradestel Microlith types (based on Biagi 1981: 45)

Total Number of Artifacts	L8 - 5	L4 - L1	H2 - H	G3- G1	F3-F1	EF-E	D3-D1
	130	138	414	160	193	51	178

Table 7.13: Pradestel total number of lithic artefacts (based on Biagi 1981: 45)

Key to Tables 7.11-7.13 Layers L8 - L5 =Early Sauveterrian, Layers L 4 - L1 =Early - Middle Sauveterrian, Layers H2 - H = Late Sauveterrian , Layers G3-G1 = Final Sauveterrian, Layers F3-F1= Final Sauveterrian, Layers EF - E VII =Early Castelnovian, Layers D1 - D3 = Middle Castelnovian, and Layers D - A Late Mesolithic / Early Neolithic.

The tool types indicates that the layers predating Layers D3 - D consist of an early Mesolithic Sauveterrian assemblage with no trapezoidal microliths, as are typical in the later Castelnovian period. No trapezes are recorded for Layers EF-E, although these deposits also date to the Castelnovian period. This may be due to transitional factors and that the rock shelter related more to residential activities than directly to hunting. As a result microlithic projectiles like trapezes may not have become incorporated into the archaeological record so readily. My view is that typological boundaries between projectiles like triangles from the Sauveterrian and trapezes from the Castelnovian periods are less meaningful in sites where food processing and consumption were more common than the manufacture of projectiles for hunting. However, this does not exclude the fact that production of such weapons is likely to have taken place within the rock shelters. Compared to Romagnano, the lithic assemblage contains numerous forms of blades, scrapers and backed points within this assemblage, and these appear throughout the deposit. This is particularly evident in Layers H2-H which contain a higher than usual number of backed-blades.

Animal Bone from Pradestel

The faunal assemblage consists of 4882 animal bones and 237 fragments of teeth. Out of the 4882 bones, 1578 (32.3%) were identifiable to animal species and bone type and 3304 (67.7%) were unidentifiable. The assemblage is therefore over three times as large as the one from Romagnano III.

A more detailed study of the teeth was also undertaken. The teeth belong mainly to mature animals, but there is some evidence for more younger specimens during the later periods of occupation. This trend may also be seen in the main animal bone assemblage. A full listing of teeth fragments is given in Appendix 6. The unidentifiable fragments will be examined in some detail in a later section of this chapter.

Early Mesolithic: Early Sauveterrian Period (Layers M and L 14 - L5)

The early to later Sauveterrian phases consist of a sequence of 15 layers that are sub-divided into two groupings: Layers M and L14 - L5 and Layers L4 - L1. Although the 15 layers consist of over 2m of deposit, much of this material is of natural origin and

Pradestel	L8-6	L4-L1	H2-H	G3-G1	F3-F1	EF-E	D3-D1	D-A
Bird	yes	yes	yes	no	yes	yes	yes	yes
Fish	yes	yes	yes	yes	yes	no	no	yes
Fresh water turtle	yes	yes	yes	no	no	no	no	no
Total faunal assemblage	191	892	502	517	1060	1020	770	79

Table 7.14 Presence / absence of bird, fish and marsh turtle bones at Pradestel

includes rock falls. The earliest evidence for occupation was a light brown stony loam and silty soil associated with anthropogenic material (Layer M). A small number of lithic artefacts indicate a very early Mesolithic date. Although no radiocarbon dates are available for this layer, the deposit clearly dates to the early post-glacial period. Pollen analysis shows that *Pinus silvestris montana* was the dominant tree, together with *Tilia*, *Alnus* and *Quercus* (Cattani 1977 and 1994). This indicates a relatively cold and arid post-glacial climate. No archaeological features or animal bones were recovered from this context. A large boulder sealed this layer from subsequent occupational activity.

Two further levels with traces of anthropogenic material were recorded that predate more substantial occupation. These levels (L14 and L11) also belong to the early Mesolithic period.

Layers L8 - L5 are the first major occupational period at Pradestel, although no clear archaeological features such as fireplaces, pits or post holes were recorded. These layers were composed of dark grey sandy loam soils containing pebbles. The deposits represent a transitional period associated with a tree vegetation comprising *Pinus silvestris montana* and mark the final stages of cold climatic conditions (Cattani 1983). Faunal remains occurred in small numbers and comprised of red deer, pig, beaver and pine marten fragments. These consisted of 13 identifiable and 173 unidentifiable fragments. The seven red deer bones consisted of six phalange fragments and a metatarsal. Two phalanges and a metacarpal were identified as wild boar. Beaver consisted of a scapula and phalange fragment. A phalange of a pine marten was also noted. Five teeth fragments of red deer, pig, bear and beaver were also recorded (see Appendix 6).

A single radiocarbon date of 9320±50bp for the earlier levels in this group (Layers L7-L8) confirms an early Mesolithic date.

Early Mesolithic: Middle to Later Sauveterrian Period (Layers L 4-L1 and H2-H)

Layers L4-L1 consists of a clear occupational deposit sealing a small banding of natural silts and limestone above Layer L5. This deposit contains a larger assemblage of animal bone. Layer L4 contained a fireplace with some burnt bone material associated with the ash. Layers L3-L1 appear directly associated with Layer 4. This group of layers has a single radiocarbon date of 8240±200bp, and therefore dates to the early to middle Sauveterrian period.

Layer L4 coincides with an abrupt fall in *Pinus*, together with a steady rise in *Quercus*, *QM* (*Querculum mixtum*), *Tilia*, *Corylus* and *Alnus*. This indicates an increase in temperate and humid conditions resulting in a mixed oak forest with hazel nut, and became even more marked in the Layers F-E (Cattani 1994). Layer L4 marks to transition between the Boreal and Preboreal periods.

A rock fall, or period of abandonment was followed by Layers H2-H. These layers consist of a discreet deposit dating to the late Sauveterrian period and are radiocarbon dated to 8200±50bp, and is similar in date to the previous L4-L1 layers. Layers H2-H were 15cm thick and consisted of two clear levels of sandy, stony loam soils with small amounts of light brown clay. Although there were extensive traces of fireplace deposits, no features such as pits or post holes were recorded.

As the Layers L4-L1 were discreet from the later H layers, the faunal remains are presented separately. A total of 192 identifiable and 655 unidentifiable bone fragments were recorded, together with 44 teeth.

<u>Large Mammals</u> (see Tables 7.15)

Red Deer (*Cervus elaphus*)

Forty-two bone fragments were recorded consisting largely of lower leg bones. Butchery evidence includes dismemberment and marrow extraction chopmarks. Over half of the phalanges were split longitudinally. The metapodial fragments were small with no clear evidence for butchery. One calcaneum had a chopmark on the dorsal surface (TC-3 in Binford 1981:120). Ethnographic study indicates that such marks are produced during the dismemberment of the feet bones from the lower leg.

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	16	9	5	2	5
Metapodials	11	5	2	3	2
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	2 / -	- / 1	-	-	- / 1
Tibia	2	-	1	-	-
Calcan/Astrag	3 / 3	- / 2	-	-	- / 3
Humerus	1	-	-	-	-
Femur	1	-	-	-	-
Scapula	2	-	-	-	-
Pelvis	-	-	-	-	-
Vert/ribs	-	-	-	-	-
Mandible	-	-	-	-	3
Maxilla	-	-	-	-	-
Antler	1	-	-	-	-
Totals	**42**	**17**	**8**	**5**	**14**

Table 7.15: Animal bone body part representations from Pradestel Middle to later Sauveterrian (Layers L4 - L1).

Both radii fragments were fully fused proximal ends and could have belonged to the same animal. Two fragments of tibia were part of the same bone. The distal end was fully fused and the midshaft fragment contained a possible chopmark. Two scapulae fragments contained cutmarks around the glenoid cavity (S1 Binford 1981:122). Binford argues that such cutmarks are commonly a secondary butchery process, unless the animal is large. He also claims that such marks are usually seen in locations of food consumption (Binford 1981:121).

A single antler fragment showed two clear chopmarks associated with its removal from the red deer head.

Roe deer (*Capreolus capreolus*)

Seventeen roe deer bones are recorded from Layers L4-L1. With the exception of a single ulna fragment, these consisted of lower leg bones. Longitudinal chopmarks were a common feature amongst the phalange fragments, and a proximal metapodial end was split longitudinally through the articular surface. One of the astragali was badly burnt.

Ibex (*Capra ibex*) and Chamois (*Rupicapra rupicapra*)

Eight ibex bones are recorded. These included phalange fragments most of which had been split for marrow. Two unfused distal epiphysial ends of metacarpals, together with a burnt distal end of a tibia were also recorded.

	Layers L4 - L1	Layers H2 - H
Bird (Gull?)	Scapula	-
Beaver	x 90 (see text)	-
Pine marten	x 8 (see text)	-
Brown bear	-	Phalanges x6, metatarsal
Fox	Calcaneum x2	Phalanges x2, humerus
Hare	Phalanges x3	Phalanges x4
Wolf	Phalange	Phalanges x 6, metacarpal
Otter	Radius	Metacarpal
Total	**106**	**22**

Table 7.16: Smaller mammal, carnivores and bird bone from Pradestel Middle to Later Sauveterrian Period

Five chamois bone fragments consisted of two phalanges and three metapodials.

Wild boar (*Sus scrofa*)

Fourteen wild boar bones were recorded consisting of lower leg bones such as phalanges, metapodials and astragali. Three mandible fragments (probably all from the same jaw bone) were also identified.

<u>Smaller Mammals and Carnivores</u> (see Table 7.16)

Beaver (*Castor fiber*)

A total of 90 beaver bones were recorded. In comparison with the large mammal assemblages, the quantity and range of beaver bones does allow for some quantification. According to standard Minimum Numbers of Individual (MNI) calculations (Grayson 1984), Layers L4-L1 contained a minimum of five individuals (based on proximal right sided ulnae). Most anatomical elements of the skeleton were present. Although the bones were carefully scanned for cutmarks associated with skinning or dismemberment, none were recorded. It is difficult to conclude whether the beaver deposits were natural accumulations in the rock shelter deposits (the river Adige is close by), or if they had been hunted or trapped. Fourteen bone fragments, including ulnae, humeri, tibia and phalanges were burnt. This could have been the result of later fire-side activity in the shelter, with the beaver bones becoming incorporated into the hearth deposits. Twelve beaver teeth were also recorded.

	Layer L4 - L1	Layers H2 - H/G
Bear	1	
Beaver	12	1
Caprid?	-	1
Ibex	7	2
Wild boar	10	2
Red deer	10	8
Roe deer	4	10
Unidentifiable	-	9
Total	**44**	**33**

Table 7.17 Teeth from Pradestel - Middle to Late Sauveterrian Period

Pine marten (*Martes martes*)

Eight pine marten bones comprising of five phalanges, two scapula and an ulna. These belonged to a mature animal(s) and contained no evidence for skinning.

Other animal (and bird) bone fragments recorded include fragments of a bird scapula, as well as fox, hare, wolf and otter. All belong to mature animals.

Teeth

Table 7.17 lists teeth fragments (information such as tooth type, wear stage or age/maturity is provided in Appendix 6). The red deer teeth were from both young and mature animals. Both the roe deer and wild boar teeth belong to mature animals.

Early Mesolithic: Later Sauveterrian Period (Layers H2 - H)

The Sauveterrian Layers H2-H consist of a later group of deposits representing the reoccupation of the rock shelter after a period of abandonment associated with rock collapses. A total of 218 identifiable and 262 unidentifiable bone fragments were recorded, together with 27 teeth.

Large Mammals (see Table 7.18)

Red Deer (*Cervus elaphus*)

A total of 82 red deer bones are recorded from Layers H2-H consisting primarily of phalange fragments. Practically all belonged to mature animals, and at least half of the phalange and metapodial bones had been longitudinally split open for marrow. Excavation records indicate that these bones were deposited near the wall of the shelter.

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	62	10	11	33	22
Metapodials	9	2	4	6	9
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	1 / 1	1 / -	-	-	1 / -
Tibia	-	-		-	-
Calcan/Astrag	3 / 3	-	2 / -	- / 2	3 / 1
Humerus	-	1	-	-	-
Femur	-	-	-	-	-
Scapula	2	-	1	-	1
Pelvis	-	1	-	-	1
Vert/ribs	-	-	-	-	-
Mandible	-	2	-	-	-
Maxilla	1	-	-	-	-
Antler	-	-	-	-	-
Totals	**82**	**17**	**18**	**41**	**38**

Table 7.18 : Animal bone body part representations from Pradestel Later Sauveterrian (Layers H2 - H)

A proximal end of an ulna contained a cut/chopmark on the lateral side close to the articular surface (RCp-2 in Binford 1981:125). These marks are usually the result of dismemberment of the radius/ulna from the distal humerus.

Roe deer (*Capreolus capreolus*)

A total of 17 roe deer bones are recorded consisting mainly of phalanges and metapodials. An unfused distal end of a humerus contained a chopmark on the anterior surface of the bone . This is slightly above the cutmark area Hd-2 in Binford (1981:123) and may be the result of the removal of meat from the bone, or possibly dismemberment from the radius and ulna. Two mandible fragments indicate that a relatively young animal was also butchered.

Chamois (*Rupicapra rupicapra*) and Ibex (*Capra ibex*)

Eighteen ibex bones were recorded. Eleven of these consisted of phalanges, most of which had been split open for marrow. Two metapodials were also split through the proximal ends. All the bones belonged to mature animals.

Forty-one chamois bones were recorded from these layers. Thirty-three comprised of phalange fragments, most of were broken open. The remaining eight bones were also lower leg bones.

Wild boar (*Sus scrofa*)

A total of 38 wild boar bones were recorded, most comprised of phalange and metapodial fragments, which were split open for marrow. Scapula and radius fragments were unfused and belonged to a young animal(s).

Smaller Mammals and Carnivores and Teeth (see Table 7.16)

Bear, fox, hare, wolf and otter are recorded in Layers H2-H. All fragments belonged to mature animals. Table 7.18 lists the teeth by species. Teeth from Layer G are included in this grouping because Layers H and G fragments were mixed together.

Early Mesolithic: The Final Sauveterrian Period (Layers G3-G1 and F3 -F1)

The Final Sauveterrian phases consist of two groupings of deposits (Layers G3-G1 and Layers F3-F1). These layers contained evidence for hearths or fireplaces. Pollen analysis indicates a continuation of the establishment of mixed oak woodland during this period, with increases in *Quercus* and QM (*Querculum mixtum*), *Betula* and *Alnus* and is likely to represent the end of the Boreal (Cattani 1977 and 1994). This phase correlates with Layer 8 at Vatte di Zambana (Cattani 1994 and Chapter 8).

Although there is no radiocarbon date for these final Sauveterrian phases of occupation, broadly contemporary deposits at Romagnano III suggests a date of *c.*8000bp.

The occupational material consists of a discrete grouping of layers (G3-G1) and slightly more disturbed material immediately above it (F3-F1). The G layers were approximately 17cm thick and comprised of dark brown stony loam soils. A total of 154 identifiable and 357 unidentifiable bone fragments were recorded, together with 6 teeth.

Large Mammals (see Tables 7.19)

Red deer (*Cervus elaphus*)

The G layers contained 57 red deer bones. Most of the phalange and metapodial fragments had been chopped open for marrow. One of the calcaneum fragments had a deep cutmark near the distal end (TC-3 in Binford 1981:119-120). This mark is often interpreted as the result of cutting the tendon attachment of the gastrocnemius muscle at the tuber calcis or the posterior end of the calcaneus. Binford's ethnographic work

(Binford and Bertram 1977 and Binford 1981) revealed a further butchery process that results in a similar cut/chopmark. In studies of the Navaho and the, Nunamiut where carcasses or entire leg bones are hung on drying racks, "... the tissue between the shaft of the tibia and the attachment of the tendon at the tuber calcis is cut with a knife to facilitate inserting a rope or a gambrel for hanging the rear leg or the carcass for further butchering" (Binford 1981:119). Similar marks have also been recorded from other North American and African sites (*ibid*). This mark could indicate that whole leg bones were being processed at Pradestel, and that some form of knife or blade technology was being used for butchery purposes during this period.

Two radii fragments consisted of right and left side distal ends. Both were unfused and probably belonged to the same animal (approximately 18-24 months in age). Tibiae include two mature distal fragments with cutmarks (Td-4 in Binford 1981:132) and are the result of filleting or stripping meat from the bone.

A scapula fragment was burnt and had a chopmark that removed part of the glenoid cavity. This is likely to be the result of the dismemberment of the bone from the humerus. Scapulae from Klasies River Mouth contained cutmarks or chopmarks in precisely the same area (Binford 1984:128 Fig 4.14-Marks Type "C").

A proximal femur fragment had a chopmark on the greater trochanter area (Fp-5 in Binford 1981:117), but on the anterior side of the bone. This was the result of dismembering the femur from the acetabulum area of the pelvis. One acetabulum fragment was burnt with chopmarks around the socket (PS7/PS9 in Binford 1981:113). Ethnographic evidence indicates that these marks are made after the femur has been dislocated from the pelvis by physical force. A 'knife' or blade is then inserted between the head of the femur and the ball socket of the acetabulum (Binford 1981).

Roe deer (*Capreolus capreolus*)

Fifteen roe deer bones were recorded from layers G3-G1 and bones belonged to mature animals. Two distal fragments of metapodials were unfused and from a young animal. Two of the phalange fragments were chopped open for marrow and a humerus fragment

Bone type	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	28	4	23	1	1
Metapodials	11	2	2	1	2
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	2	-	4 / 1	- / 1	2 / -
Tibia	3	-	1	-	-
Calcan/Astrag	2	1	1 / 1	-	- / 1
Humerus	1	1	-	-	-
Femur	2	-	-	1	-
Scapula	1	1	1	-	-
Pelvis	2	4	2	-	1
Vert/ribs	-	-	-	-	-
Mandible	-	-	1	-	-
Maxilla	-	-	-	-	-
Antler	5	2	1	-	-
Totals	**57**	**15**	**38**	**4**	**7**

Table 7.19: Animal bone body part representations from Pradestel Final Sauveterrian (Layers G3-G1).

contained a chopmark on the distal anterior end (Hd-6 in Binford 1981:133). This is thought to be associated with filleting. An acetabulum fragment revealed a chopped area associated with the dismemberment of the femur/rear leg bone, similar to that previously described for red deer.

Ibex (*Capra ibex*) and Chamois (*Rupicapra rupicapra*)

A total of 38 ibex and four chamois bones were recorded, most were from the lower leg region and comprised of split phalange fragments. Radii and metacarpal fragments were also split indicating that they had been chopped for marrow. Two metatarsal fragments from an ibex and chamois were badly burnt, and an ibex metacarpal had been gnawed, possibly by a wolf or dog.

Wild boar (*Sus scrofa*)

Seven wild boar bones were recorded consisting of mature bones belonging to very large individual(s). The bone fragments indicate that metapodials, radii and phalanges were processed for marrow.

<u>Smaller Mammals and Carnivores</u> (see Table 7.20)

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

Nine beaver bones consisting mainly of lower leg fragments were recorded. An ulna displayed a chopmark through the proximal olecranon area. This may have been the

	Layers G3-G1	Layers F3-F1
Beaver	x 9 (see text)	x53 (see text)
Pine marten	Mandible, humerus	x 23 (see text)
Brown bear	Metatarsal, phalange, skull	-
Fox	Mandible and phalanges x6	Calcaneum x2, phalanges x2
Hare	Phalange, metatarsal	Phalanges x2
Lynx	Phalanges x 2	Phalange
Badger	-	Phalanges x2, ulna
Wolf	Phalanges x3, astragali x2	Phalanges x2
Wild cat	Phalange	Phalange
Bird	Femur, metatarsal	-
Total	**33**	**89**

Table 7.20: Smaller mammals, carnivores and bird bone from Pradestel Final Sauveterrian (Layers G3-G1 and Layers F3-F1)

result of dismemberment and is the only direct evidence that beaver was exploited by the Mesolithic hunter gatherers. Pine marten bones were also recorded, these consist of a mandible and humerus fragment.

Animal bone fragments recorded in Layers G3-G1 include bear, fox, hare, lynx, wolf and wild cat. The bones all belonged to mature animals. Teeth from four red deer, an ibex and a caprid(?)were recorded from Layer G (see Table 7.17).

The End of the Early Mesolithic: The Final Sauveterrian Period (Layers F3 - F1)

Layers F3-F1 contained large quantities of limestone rubble within the deposits which were light brown in colour compared to the earlier G levels. The F layers were extensive deposits with evidence for hearths and fireplaces within the outer part of the shelter. The soil pollen shows further rises in *Quercus* and suggests increasing temperate and humid conditions (Cattani 1994). The faunal material from Layers F3-F were very similar in animal species and bone type to the G3-G1 layers and contained good butchery evidence. A total of 348 identifiable and 690 unidentifiable bone fragments were recorded, together with 49 teeth. This represents the largest grouping of animal bones studied.

<u>Large Mammals</u> (see Table 7.21)

Red deer (*Cervus elaphus*)

Layers F3-F1 contained 176 red deer bones mostly comprising phalange fragments. A large proportion were split longitudinally. Some were burnt and others showed traces of gnawing by rodents. Contextual information suggests that quantities of phalange material had been dumped in a single episode, as most of the material was found against the wall of the shelter. All the phalange material belonged to fully mature animals.

Butchery traces on the metapodials consisted of longitudinal splits and were often chopped through the proximal ends. This is likely to have been the result of marrow extraction or the manufacture of bone tools. Cutmarks along the proximal anterior surface are associated with dismemberment or skinning. These bones were fully mature specimens and consisted of midshaft fragments as well as articular ends.

An astragalus had cutmarks on the anterior surface (TA-1 in Binford 1981:120) and are likely to have been the result of dismembering the upper leg bones from the lower feet. The radii and ulna fragments belonged to mature animals and contained further butchery evidence. One radius had been longitudinally chopped through the proximal end, possibly for marrow extraction. Two radii fragments were chopped through on the upper part of the midshaft, in the area where the ulna fuses to the radius. A burnt proximal ulna fragment had cut or chopmarks close to the semilunar notch (RCp 3 and 4 in Binford 1981:125). These were probably the result of dismembering the radius/ulna from the humerus.

The two distal tibia fragments contained butchery traces. One had been longitudinally split open and a cutmark was evident on the lateral side of the second fragment. This cutmark is well documented, and is the result of dismembering the rear leg bones from the calcaneum and lower feet bones (Binford 1981:118-119). A single chopmark was noted above the glenoid cavity of a scapula (S1 in Binford 1981:122).

Three mandible fragments appear to belong to young animal(s). One appeared to have the bottom of the jaw split open to extract marrow. It is possible, however, that this was the result of natural attrition.

Five vertebrae, including cervical and thoracic fragments were identified. Three of the fragments had hack marks consistent with the removal of slabs of rib meat.

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	110	23	5	3	2
Metapodials	23	9	2	1	2
Carpal/Tarsals	-	-	1	-	-
Radius/Ulna	6 / 2	7 / 4	-	-	-
Tibia	5	1	-	1	-
Calcan/Astrag	3 / 6	3 / 3	-	2 / 1	-
Humerus	1	4	-	1	1
Femur	1 (+4?)	-	-	-	-
Scapula	1	-	-	-	-
Pelvis frags	5	2	-	1	-
Vert/ribs	5	-	-	-	-
Mandible	3	1	-	-	1
Maxilla	-	-	1	-	-
Antler	1	1	-	-	-
TOTALS	**176**	**58**	**9**	**10**	**6**

Table 7.21: Animal bone body part representations from Pradestel Final Sauveterrian (Layers F3-F1).

Roe deer (*Capreolus capreolus*)

Layers F3-F1 contained 58 roe deer bones consisting mainly of lower leg fragments. Although some of the phalanges were split open, most were small fragments, and it is impossible to determine if they had been butchered. It is considered likely that some were originally butchered for marrow and subsequently crushed into smaller fragments by post-depositional processes such as trampling and gnawing. One second phalange fragment had a tooth puncture hole in the proximal end of the bone. A distal humerus had tooth marks attributed to wolf or dog, rather than humans. There is some evidence that metapodials were split open for marrow.

Four radii fragments produced butchery evidence. One had marks associated with the removal of the radius/ulna from the distal humerus, comprising of cutmarks on the interior surface (RCp-5 in Binford 1981:124-125). A second radius had been split longitudinally through the proximal end. An ulna fragment had a chopmark/cutmark around the semilunar notch, providing further evidence for dismemberment (RCp2 in Binford 1981:125). Cut or chopmarks on a distal tibia (Td1 in Binford 1981:118) and a distal humerus (above Hd2 in Binford 1981:123) represent evidence for the processing of bones for either meat removal or marrow extraction. Although most of the bones belonged to mature roe deer, a mandible with an M1 and M2 beginning to erupt, and an unfused distal metapodial indicate that younger animals were also hunted.

Ibex (*Capra ibex*) and Chamois (*Rupicapra rupicapra*)

Layers F3-F contained nine ibex and ten chamois bones, and in common with other deposits, these consisted mainly of phalange and lower leg bone fragments. A skull fragment is likely to have belonged to a young animal.

Chamois bones include a distal humerus with evidence of impact marks associated with hammering or bludgeoning activity. This is likely to have been associated with marrow extraction. Impact cracks were clearly seen on the anterior face of the bone, and are similar to Figure 4.53 in Binford (1981:160). Such processing does not normally take place at butchery sites and is an activity associated with residential sites (ibid).

A chamois acetabulum fragment had a cut or chopmark around the socket area (PS7/PS9 in Binford 1981:113), indicating evidence for dismemberment. A calcaneum fragment was split longitudinally. It is unlikely that this was the result of dismemberment as cutmarks usually go across the bone and not longitudinally. It also unlikely that the bone was processed for marrow, as the amount of marrow would have been insignificant.

Wild boar (*Sus scrofa*)

A total of six bones belonged to wild boar. Two metapodial fragments were split and a humerus had an impact notch on the distal end indicating possible further evidence for marrow extraction.

<u>Smaller Mammals and Carnivores</u> (see Table 7.20)

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

A total of 53 beaver bones were recorded from Layers F3 - F1. A Minimum Numbers of Individual (MNI) estimate is based on left sides of ulnas and indicates a minimum of three animals. The majority of bones consisted of phalange and metapodial fragments. All the bones belonged to mature animals and none show evidence of butchery or skinning. Twenty-three pine marten bones were recorded. Minimum number (MNI) calculations based on humeri, scapulae and ulna indicate a minimum of two individuals from these layers.

Further animal bone recorded in Layers F3-F1 includes wolf, wild cat, lynx and badger, and all bones relate to mature animals. Together with Layers G3-G1, these Late Sauveterrian deposits contain the greatest species diversity (Layers G3-G1=14 and Layers F3-F1=13 (including large mammals)). These deposits also contain the widest range of tool types, especially scrapers. This evidence may reflect a wider range of animal processing activities taking place, including the processing of fur pelts. Unfortunately, there are no radiocarbon dates for these layers, but this period broadly relates to the beginning of the Atlantic pollen stage and also corresponds with a significant reduction in the use of the high altitude sites. Chapter 3 predicted a change to more valley based subsistence during the later Mesolithic, and that increased valley resource diversity, may be reflected in archaeological deposits containing greater ranges on animal species. Layers G3-G1 and F3-F1 appear to provide the supporting evidence.

Teeth

Table 7.22 provides a full listing of teeth fragments. Four of the red deer tooth fragments belonged to young animal(s). The following lists the teeth by species:

Red deer	15
Roe deer / ibex	13
Wild Boar	2
Unidentifiable	19
Total	**49**

Table 7.22: Teeth from Pradestel Final Sauveterrian (Layers F3-F)

The Later Mesolithic: The Early Castelnovian Period (Layers EF - E)

At Pradestel the later Mesolithic is divided into the Early, Middle and Later Castelnovian periods. There is no radiocarbon date for the earlier period, but the middle phase has a single date of 6870±50bp. Steep rises in *Betula*, *Quercus* and *Corylus* and an increase in the ratio of arboreal to non-arboreal pollen marks the beginning of more humid climatic conditions attributable to the Atlantic pollen zone (Cattani 1994).

Layers EF-E (Layers EF, E4, E3, E2, E1 and E) date to the early Castelnovian phase and contain a relatively high quantity of animal bone. A total of 361 identifiable and 631 unidentifiable bone fragments were recorded, together with 51 teeth fragments.

Large Mammals (see Table 7.23)

Red deer (*Cervus elaphus*)

A total of 152 red deer bones were recorded. Phalange and metapodial fragments dominate the assemblage. A high proportion were chopped either longitudinally or across the midshaft. It is possible that fragments that are split vertically and horizontally (forming 'quarter section' fragments) are the result of further processes such as trampling. Longitudinal chopmarks through proximal ends of metapodials was a common feature. Distal fragments together with midshaft splinters indicate that distal ends were also split open. The astragali and calcaneum fragments belong to mature animals. Two ulna fragments had a chop or cutmark around the semilunar notch, indicating dismemberment from the humerus (RCp-2 in Binford 1981:125). Two tibia fragments consisted of distal ends that were unfused, while a third fragment had a chopmark on the midshaft above the articular end. This is likely to have been the result of either dismembering the rear lower leg bones from the upper meat bearing bones, or an attempt to extract marrow.

Two distal humerus fragments had cut/chopmarks immediately below the midshaft breakage points on the bone. These could have been the result of bludgeoning the bones open for marrow, rather that dismemberment from the radius/ulna bones. A proximal end of a femur appears to have been 'snapped', perhaps to facilitate marrow extraction.

The remaining red deer bones consisted of mandible and antler fragments. Most of the mandible fragments belonged to mature animals, but none had teeth within the jaw bones. Two fragments of mandibles belonging to immature animals included one with M1 and M2 teeth.

Roe deer (*Capreolus capreolus*)

Layers EF- E contained a total of 117 roe deer bones consisting mainly of phalange fragments. A higher percentage than usual were complete, and few had clear evidence for marrow extraction (19%). This is probably because the bones are relatively small compared to red deer.

A large proportion of articular fragments of metapodials belonged to young animals. Most were highly fragmented with little evidence for butchery. Four metapodial fragments were split longitudinally through the articular ends. Three radii fragments have clear evidence for chopping below the proximal epiphysial end. One radius had a chopmark immediately above the chopped surface itself and was probably butchered for marrow. Five distal ends of tibia may also have been chopped in a similar way. Four distal humerus fragments, including an unfused neo-natal fragment were recorded. The humeri fragments, together with the radii and tibiae bones indicate that a minimum number (MNI) of two roe deer are recorded from these levels.

Chamois (*Rupicapra rupicapra*) and Ibex (*Capra ibex*)

Twelve fragments of chamois bones consisted mainly of phalange and metacarpal fragments. There was no direct butchery evidence from the phalange fragments, as they were either complete bones or small proximal ends. It is probable that the proximal ends were the result of marrow processing. A metacarpal fragment was longitudinally split open. A radius fragment had a single cut or chopmark on the anterior surface, similar in position to RCp 6 in Binford (1981). Binford interprets such marks as the result of filleting (*ibid*). As the cut/chopmark is so close to the chopped end, it could equally have been the result of marrow extraction.

Two ibex bones were recorded from Layer E1 consisting of a femur and metacarpal fragment. These are the final ibex bones recorded from Pradestel.

Wild boar (*Sus scrofa*)

Eight wild boar bones were recorded, including a mandible fragments with a very large M3 tooth (Grant wear stage F).

Smaller Mammals and Carnivores (see Table 7.24)

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

Forty two beaver bones were recorded from Layers E1-3-E. These consisted of metapodials and phalanges, together with humeri, scapulae, ulnae and a mandible fragments. An ulna contained a chopmark on the olecranon area of the bone. This chopmark was also recorded on a beaver ulna in the G3 Layer and may relate to

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	93	68	-	7	4
Metapodials	24	22	1	2	3
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	3 / 4	4 / 2	-	1 / -	-
Tibia	4	5	-	1	-
Calcan/Astrag	2 / 4	1 / 5	-	- / 1	-
Humerus	2	4	-	-	-
Femur	4	1	1	-	-
Scapula	-	-	-	-	-
Pelvis frags	-	-	-	-	-
Vert/ribs	-	-	-	-	-
Mandible	10	4	-	-	1
Maxilla	-	1	-	-	-
Antler	2	-	-	-	-
Totals	**152**	**117**	**2**	**12**	**8**

Table 7.23 : Animal bone body part representations from Pradestel
Early Castelnovian (Layers EF - E)

	Layers EF - E	Layers D1 - D3
Beaver	x 42 (see text)	x 26 (see text)
Pine marten	x 17 (see text)	x 6 (text)
Badger	Phalanges x3, metatarsal, ulna, femur	Phalange, metatarsal, femur
Brown bear	Metapodials x3	Femur
Lynx	-	Phalanges x2
Wolf	-	Phalanges x2, mandible x2, metacarpal
Bird	Metatarsal, femur	-
Total	**70**	**43**

Table 7.24: Smaller mammals, carnivores and bird bone from Pradestel
Early Castelnovian (Layers EF - E) and Middle Castelnovian period (Layers D1 - D3)

dismemberment relating to skinning or meat consumption. Seventeen pine marten bones were also recorded. These included nine skull and mandible fragments from at least two animals. Other small mammal bones include badger, bear as well as bird.

Teeth

The following table lists the recorded teeth. Three red deer and two roe deer teeth belonged to young animals. The following lists the teeth by species:

Teeth	Layers EF - E	Layers D1 -D3	Layers D - A
Dog / wolf	-	2	-
Red deer	7	9	2
Roe deer/ibex sized	18	5	1
Bear	1	-	-
Beaver	2	-	-
Rodent	-	1	-
Unidentifiable	23	32	3
Total	**51**	**49**	**6**

Table 7.25: Teeth from Pradestel - Early Castelnovian (Layers EF -E),
Middle Castelnovian period (Layers D1 - D3) and Late Castelnovian (Layers D-A)

Late Mesolithic: Middle Castelnovian Period (Layers D1 - D3)

Layers D1 to D3 consist of three occupational deposits dating to the middle of the Castelnovian sequence and saw the disappearance of ibex and chamois. Charcoal from these layers produced a radiocarbon date of 6870±50bp. Large mammal exploitation focused on red deer and roe deer. A total of 228 identifiable and 524 unidentifiable bone fragments were recorded, together with 51 teeth.

Large Mammals (see Table 7.26)

Red deer (*Cervus elaphus*)

A total of 108 red deer bones was recorded from the D3-D1 layers. Most consisted of phalange and lower leg bones. The majority of the phalange fragments were split open for marrow. Some of the metapodials had also been processed. Although the metapodial fragments comprised a high percentage of immature bones (40%), this figure is skewed by unfused distal epiphysial ends that are detached from the main bone. This does, however, indicate a rise in the proportion of younger animals exploited in both this and the preceding early Castelnovian phase, and may be evidence for changes in later Mesolithic hunting strategies (see Chapter 3).

Small fragments of humerus and femur were also recorded and were too small to recognise butchery traces. One distal humerus appears to have been chopped and may have been the result of bludgeoning the bone open for marrow rather that dismemberment from the radius/ulna bones.

An acetabulum fragment contained cut/chopmarks around the rim of the socket (PS9/10 in Binford 1981:113) and on the arm of the ischium (PS8 in Binford 1981). The marks around the socket relate to the dismemberment of the femur, while the cutmarks on the ischium arm may result from filleting meat off the bone. A second acetabulum may be a chopped fragment. A third piece was badly burnt.

Three ulna fragments contain diagonal cut/chopmarks across the lateral surface of the olecranon, associated with the dismemberment from the humerus. This cut/chopmark is recorded as RCp-2 in Binford 1981. A radius fragment was chopped longitudinally through the proximal end, probably to extract marrow.

Bone type:	Red Deer	Roe Deer	Wild Boar
Phalanges	69	35	1
Metapodials	10	17	4
Carpal/Tarsals	-	-	-
Radius/Ulna	3 / 4	3 / 1	-
Tibia	2	-	-
Calcan/Astrag	3 / -	1 / 2	-
Humerus	3	3	-
Femur	4	5	-
Patella	2	-	-
Scapula	-	2	-
Pelvis frags	4	1	-
Vert/ribs	-	-	-
Mandible	4	1	-
Maxilla/tooth	-	-	1
Antler	-	-	-
Totals	**108**	**71**	**6**

Table 7.26: Animal bone body part representations from Pradestel Middle Castelnovian period (Layers D1 - D3)

The distal femur is poorly represented at Pradestel and most of the other sites. A fragment from the Layer D3 contained a mark consisting of a longitudinal cut or chop along the lateral face of the medial condyle (Fd-3 in Binford 1981:117). According to Binford (1981) this relates to the dismemberment of the femur from the tibia. A proximal femur fragment contained gnaw marks on the femoral ball. These are likely to have been caused by wolf or dog, and not humans.

Roe deer (*Capreolus capreolus*)

A total of 71 roe deer bones are recorded from layers D3-D1. Practically all belonged to mature animals. The majority comprised of phalange and metapodial bones with extensive evidence for marrow processing: bones were split open longitudinally. Two astragali fragments were split open longitudinally as if they were also processed for marrow. This seems improbable as there is little marrow within such bones.

Two proximal radii contained evidence for dismemberment and bone splitting. One revealed two cut or chopmarks on the edge of the articular surface of the bone (RCp-5 in Binford 1981:125), and are the result of a blade cutting into the joint between the distal humerus and proximal radius. A proximal radius fragment was also longitudinally split open for marrow. Upper long bones, including a femur, humerus and scapula contained butchery evidence. Both the humerus and femur fragments had transverse chopmarks through the bones indicating marrow extraction. The scapula contained a cut or chopmark around the lateral surface of the glenoid cavity and represents a dismemberment mark. Binford suggests that these marks are most commonly a secondary butchery operation, unless the animal is quite large and are likely to be found in "... locations of consumption, unless there is processing for drying, or in situations where relatively large animals are being butchered and the parts are destined for transport rather than processing " (Binford 1981:121).

Wild boar (*Sus scrofa*)

Six wild boar bones are recorded consisting of four metapodials, a phalange and a canine tooth. This is the final phase containing wild boar bones.

Ibex (*Capra ibex*) and Chamois (*Rupicapra rupicapra*)

No ibex or chamois bones were recorded from these layers.

Smaller Mammals and Carnivores (see Table 7.24)

Beaver (*Castor fiber*) and Pine Marten (*Martes martes*)

Twenty-six beaver bones were recorded. These consisted of ten metapodials and ten phalanges, plus scapula, humerus, tibia and mandible fragments. Most were unfused and belonged to a young animal. Six pine marten bones were also recorded. Further small mammal bone fragments recorded include badger, bear, wolf and lynx.

Teeth

Appendix 7.1 provides a full listing of teeth fragments, together with information such as tooth type, wear stage or age /maturity. Four of the red deer teeth belonged to young or young adult animals. Table 7.25 lists the teeth by species.

Late Mesolithic: Late Castelnovian and Early Neolithic Period (Layers D-A)

The final Mesolithic layers consist of Layer D, together with material belonging to Layers B-C and A-A3 (attributed to the final Mesolithic or early Neolithic periods).

There are, however, no radiocarbon dates to confirm this. This group consists of a much smaller bone assemblage of 64 identifiable and 12 unidentifiable fragments, together with 6 teeth.

Bone type:	Red Deer	Roe Deer	Chamois	Wild Boar
Phalanges	16	8	-	-
Metapodials	5	2	2 (?)	1
Carpal/Tarsals	-	-	-	-
Radius/Ulna	-	-	-	-
Tibia	2	1	-	-
Calcan/Astrag	1/3	1/1	-	-
Humerus	2	-	-	-
Femur	3	1	-	-
Patella	-	-	-	-
Scapula	3	-	-	-
Pelvis frags	7	1	-	-
Vert/ribs	-	1	-	-
Mandible	1	2	-	-
Maxilla	-	-	-	-
Antler	-	-	-	-
Totals	**43**	**18**	**2**	**1**

Table 7.27: Animal bone types from Pradestel - Late Castelnovian period (Layers D-A)

Forty-three red deer bones are recorded from Layers D- A. Most of the phalange and metapodial fragments were split open for marrow. Scapulae and pelvic fragments contained good evidence for dismemberment from long bones. A femur fragment had cut or chopmarks below the femoral ball, providing further evidence for dismemberment.

Eighteen roe deer fragments were also recorded. Phalange fragments were split open and a distal tibia had a chopmark above the articular end. Two caprid metacarpal and a wild boar metatarsal were also recorded.

Identifying the Unidentifiable

Pradestel contains a larger assemblage, with a greater range of species, than Romagnano III. Out of 4882 bones, over two thirds were unidentifiable to bone type and species (3304 or 67.7%). This is a large element of faunal material that needs to be examined for further insights into Mesolithic subsistence. Because of the imprecise nature of fragmented bone, it is only possible to give broad interpretations that can then be used to compare with the identifiable material.

The main reason for the high level of unidentifiable bone is fragmentation. Although this is largely the result of hunters processing the bones, it is also likely that subsequent human trampling of earlier deposits, as well as carnivore gnawing and natural processes such as freeze-thaw all contributed to the fragmentation process (Brain 1981 and Schiffer 1987).

The layer with the highest percentage of unidentifiable bones was the early Mesolithic (Sauveterrian) Layers L8-L5, where less than 7% of the bones were identifiable to bone type and animal species. The faunal sample from these layers is small (186 bones). This is one of the earliest occupational levels at Pradestel, and indicates that fragmentation resulted from compaction by the above, mainly naturally, accumulated deposits in early post glacial conditions. If unidentifiable bones are used as an index for fragmentation throughout the early and late Mesolithic deposits (excluding the small sample of Layers L8-L5 and D-A), Table 7.28 illustrates that unidentifiable bones comprise between 77.3% and 54.6% of each group of layers. Therefore there appears little justification to argue that the lower levels are more highly fragmented than the later Mesolithic bone.

Small mammal bones were, in general, less fragmented compared to the larger material. If fragmentation was caused by excessive trampling, it is highly likely that small mammal material, being quite fragile would also be fragmented. This adds further support to the conclusion that most fragmentation was caused by butchery: the small mammal bones were not butchered to the same extent.

In order to examine trends in the unidentifiable fragments, the material was broadly divided into bone types based on the known range of animals recorded at Pradestel. Table 7.29 outlines these ranges. The bone fragments were divided into three size ranges, smaller mammals (beaver sized), medium sized (roe deer, chamois, small pig and ibex) and larger mammals (red deer). Table 7.30 provides the same information for Romagnano III.

The patterns within the unidentifiable material relate quite closely to trends seen in the identifiable bones. The deposits that contain a greater range of identifiable small mammals, such as Layers G3- G1 contain higher levels of unidentifiable material attributed to smaller mammals. The identifiable bones indicates that these fragments are likely to represent beaver, pine marten, fox badger, wild cat and hare. The highest level of small mammal unidentifiable material belongs to the early Layers 8-5 and probably

Layers	Identifiable	Unidentifiable	Total	Teeth
L8-L5	13 (7%)	173 (93%)	186	5
L4-L1	192 (22.7%)	655 (77.3%)	847	44
H2-H	218 (45.4%)	262 (54.6%)	480	27
G3-G1	154 (30%)	357 (70%)	511	6
F3-F	348 (33.5%)	690 (66.5%)	1038	49
EF-E	361 (36.4%)	631 (63.6%)	992	51
D1-D3	228 (30.3%)	524 (69.7%)	752	49
D - A	64 (84.2 %)	12 (15.8%)	76	6
Totals	1578 (32.3%)	3304 (67.7%)	4882	237

Table 7.28: Numbers and percentages of identifiable and unidentifiable animal bones

Pradestel		**Occupation Layers**							
Animal Size	**Bone Fragment Types**	L8-L5	L4-L1	H2-H	G3-G1	F3-F1	EF - E	D1-D3	D-A
Smaller mammals	Small long bones :	34	96	35	67	87	82	53	0
	Small skull :	13	27	6	3	15	23	6	0
(Beaver sized)	Small vertebrae :	3	22	14	11	12	17	22	0
	Total	50	145	55	81	114	122	81	0
	% of total in Layers*	**28.9**	**22.1**	**20.9**	**22.6**	**16.5**	**19.3**	**15.5**	**0**
Medium	Medium long bones:	32	90	52	84	62	72	53	0
	Medium ribs :	12	68	33	33	63	42	7	0
Roe deer, chamois, ibex (pig ?)	Medium vertebrae :	4	31	5	3	26	31	45	0
	Medium carpal / tarsal:	5	55	12	5	33	14	2	0
	Total	53	244	102	125	184	159	107	0
	% of total in Layers*	**30.6**	**37.3**	**38.9**	**35.0**	**26.7**	**25.2**	**20.4**	**0**
Larger mammals	Large long bones :	12	27	22	20	52	29	55	0
	Large ribs :	1	21	7	12	33	16	27	0
Red deer, (pig?)	Large skull :	10	44	6	13	61	87	50	2
	Large vertebrae :	0	4	3	6	12	18	38	3
	Large carpal / tarsal:	6	24	15	16	32	32	34	0
	Very large carpal /tarsal:	0	5	0	0	13	15	12	2
	Total	29	125	53	67	203	197	216	7
	% of total in Layers*	**16.8**	**19.1**	**20.2**	**18.8**	**29.4**	**31.2**	**41.2**	**58**
Indeterminate	Other :	41	141	52	84	189	153	120	5
	% of total in Layers*	**23.7**	**21.5**	**19.8**	**23.5**	**27.4**	**24.2**	**22.9**	**41**
Total Number of Unidentifiable Fragments		**173**	**655**	**262**	**357**	**690**	**631**	**524**	**12**

Table 7.29 : Total number of unidentifiable bone fragments - 3304

Key - Layers L8 - L5 =Early Sauveterrian, Layers L 4 - L1 =Early - Middle Sauveterrian, Layers H2 - H = Late Sauveterrian , Layers G3-G1 = Final Sauveterrian, Layers F3-F1= Final Sauveterrian, Layers EF - E VII =Early Castelnovian, Layers D1 - D3 = Middle Castelnovian, and Layers D - A Late Mesolithic / Early Neolithic. (Note: *** Refers to the number of unidentifiable bones within each group of Layers)**

Romagnano III		Occupational Layers				
Animal Size	**Bone Fragment Types**	AC8-AC4	AC3-AC1	AB3	AB2-AB1	AA2-AA3
Smaller mammals	Small long bones :	4	1	1	4	4
	Small skull :	1	-	-	-	-
(Beaver sized)	Small vertebrae :	1	-	-	-	2
	Total	6	1	1	4	6
Medium	Medium long bones:	2	2	-	-	-
	Medium ribs :	6	2	-	-	-
Roe deer, chamois,	Medium vertebrae :	-	3	1	-	2
Ibex (pig ?)	Medium carpal /tarsal :	20	4	3	-	-
	Total	28	11	4	-	2
Larger mammals	Large long bones :	8	4	3	2	4
	Large ribs :	1	15	2	3	5
Red deer, (pig?)	Large skull :	1		2	3	-
	Large vertebrae :	12	5	2	-	6
	Large carpal / tarsal :	37	16	9	4	3
	Very large carpal / tarsal:	27	8	2	9	4
	Total	86	48	20	21	22
Indeterminate	Other :	13	6	15	19	-
Total Number of Unidentifiable Fragments		**133**	**66**	**40**	**44**	**30**

Table 7.30: Total number of unidentifiable bone fragments - 313 Key - Layers AC8 - AC4 = Main Sauveterrian, Layers AC3-AC1= Later Sauveterrian, Layers AB3 = Late Sauveterrian, Layers AB2-AB= Castelnovian, Layers AA= Late Castelnovian
(Area 4 / early Neolithic not included)

relate in part to fragmentation caused by compaction through natural processes (see above). It is not possible to evaluate this further because these early layers do not contain any identifiable small mammal material.

A trend that is also recorded in the unidentifiable assemblage is the gradual decline of medium sized bones. This is taken to include ibex and chamois, as well as roe deer. Ibex and chamois disappear from the record during the later Castelnovian period (Layers D1-D3) and this may be seen in the drop to 20.4% of the unidentifiable fragments. Roe deer continue as part of the medium sized fragments. A gradual rise in larger mammal unidentifiable material, relative to the drop in medium sized bones, is seen in the identifiable bones as the continued presence of red deer.

The unidentifiable bone fragments confirm the main patterns seen in the identifiable fragments. Ibex and chamois begin to disappear at the same time that the overall percentage of medium to large mammals drops.

Change in the Animal Bone Assemblages from Pradestel and Romagnano III

Pradestel and Romagnano III are two of the larger rock shelters containing lithic and faunal assemblages. Both sites occupy similar locations on the western side of the River Adige. Although there is evidence that fish, birds and fresh water turtle were exploited during all phases of occupation at both these sites, this material was unavailable for study. It would, however, be unwise to under-estimate the importance of these and plant sources to the Mesolithic hunter-gatherers.

Species Type and Age Range

Pradestel and Romagnano III contain very similar faunal assemblages, with red deer, roe deer, ibex , chamois and wild boar being the main animals exploited. By the beginning of the Castelnovian period ibex and chamois bones are no longer recorded. Layers EF-E at Pradestel and Layers AB2-AB represent the end of ibex (radiocarbon dated to between 7850± 60 and 7500±160bp at Romagnano III). This corresponds with the transition into the Atlantic pollen zone, with denser forest pushing the timberline higher in altitude. This coincides with a significant reduction in the use of mountain sites. Practically all high altitude sites, (see Chapter 5), were no longer occupied in the later Mesolithic Castelnovian period. From this period later Mesolithic subsistence was focused in the lower altitudes. Layers G3-G1 and F3-F1 at Pradestel contain greater species diversity compared to the earlier levels, and <u>may</u> be the evidence for hunting a wider range of animals within the valley area. Chapter 3 predicted that increased resource diversity in the Atlantic/later Mesolithic period, could result in hunting a greater range of animals.

Chapter 3 suggested that if <u>encounter</u> hunting replaced the high altitude <u>intercept</u> hunting at this time, hunters may also have been less selective in terms of hunting red deer and a greater age range of animals may have been killed. A second trend in the data appears more visible at this time. Unfortunately, confidence in the data is limited, due to small sample sizes and possible taphonomic processes. Broadly, from Layers AB2-AB and Area 4 - the Castelnovian levels at Romagnano III and Layers D1-D3 at Pradestel, there appears to be an increase in young and juvenile red and roe deer, compared to the earlier periods. This coincides with the disappearance of ibex and chamois. This is, however, a broad trend in qualitative data, rather than something that is quantifiable. Further data will be explored in Chapter 8 as evidence for a change in large mammal hunting as predicted in Chapter 3.

Butchery and Bone Types

Caution was applied when identifying butchery traces in the assemblages, due to the perceived effects of trampling, as well as other activity such as by carnivore gnawing or freeze-thaw processes. Although it is accepted that some of the butchery could be the result of natural processes, confidence in the analysis was supported by the fact that most marks were within areas of bone predicted to contain processing evidence from ethnographic research (e.g. specific points on or near articular surfaces) by Binford (1981), as well as by my own previous studies (Clark 1985 and Gamble and Clark 1987). The regularity and positioning of cut and chopmarks on bone types is held as conclusive evidence that it is butchery evidence, rather than other taphonomic processes that is recorded. The fact that in the upper layers, which are less fragmented, there is more evidence of butchery marks is further support that bone processing evidence is preserved within the assemblage. Recent faunal studies of Epigravettian and early Mesolithic deposits at Riparo Villabruna also demonstrate very similar butchery patterns (Aimar *et al* 1994).

The most common form of butchery at both Romagnano III and Pradestel was the high level of split phalanges and metapodials, especially with regard to large mammal bones (but less so for wild boar). It suggests that marrow and bone grease were essential forms of carbohydrates and nutrition, and that animal products provided more than meat protein (e.g. Speth 1991 and Chapter 2). Bone marrow is a particularly important form of carbohydrate containing fat soluble vitamins including Vitamin C. In environments with extreme seasonal fluctuations, such as the study area, marrow could have been nutritionally very important when plant foods are in short supply. Although there is no seasonality information for the site, such nutritional sources would have been particularly important in the winter months (Chapter 2). It is likely that Romagnano III and Pradestel were occupied during the winter months, as these sites would have provided good shelter.

The evidence for butchery, other than marrow processing appears more in the later deposits. This is due in part to less fragmented material, but also to a greater range of anatomical elements (e.g. upper leg bones) in the later levels. The earlier levels also contained butchery traces and are common throughout the Mesolithic period. Most evidence relates to the dismemberment of leg bones and includes cut or chopmarks around the acetabulum socket/proximal femur, the navicular cuboid area of the scapula and proximal humerus, cut and chopmarks on or near the articular surface of the radius/ulna and on distal tibiae and astragali/calcaneum. Cutmarks on scapulae, radii and tibiae could also be the result of meat stripping. Some bones including humerus appear to have been bludgeoned open, possibly with a heavy instrument, perhaps for marrow.

CHAPTER 8

VATTE DI ZAMBANA, RIPARO GABAN, PRE ALTA AND SMALLER ROCK SHELTERS

Introduction

Within the Adige Valley, and adjacent tributary valleys, there are further rock shelter deposits that have been excavated. The deposits within these sites vary in terms of quantities of faunal and lithic data. Vatte di Zambana contains a smaller faunal assemblage compared to Pradestel or Romagnano III, whereas Riparo Gaban contained a much larger deposit. The smaller sites of Paludei di Volano and Dos de la Forca, together with my excavations at Pre Alta will also be presented. In order to gain background knowledge to rock shelter excavations, it was considered appropriate to undertake a fieldwork project as part of this study (Clark *et al* 1992). The excavation experience helps create a bridge between the 'static data-facts' of the assemblages used in this study and the 'dynamic' problems associated with the excavation of the material and interpreting its context (e.g. "middle range theory" - Binford 1981). It was also hoped to investigate a site where talus deposits (or equivalent material away from the shelter wall) could be expected to survive, thereby providing a spatial dimension to the study.

These shelters, including Pre Alta, contain much smaller bone assemblages. Sample size is therefore an issue within this chapter, and the discussions in the final section of the chapter will further consider Romagnano III and Pradestel from this perspective, as well as issues relating to the overall understanding of these faunal deposits.

Vatte di Zambana

Vatte di Zambana is located 12 km north of Trento, near the confluence of the Rivers Noce and Adige at an altitude of 220m asl, and approximately 20m above the present valley bottom. The site was originally discovered in 1967 by local archaeologists, who began excavating when it was exposed in a quarry. The site was then excavated in detail by Bartolomei and Broglio in 1968 (see Figure 8.1).

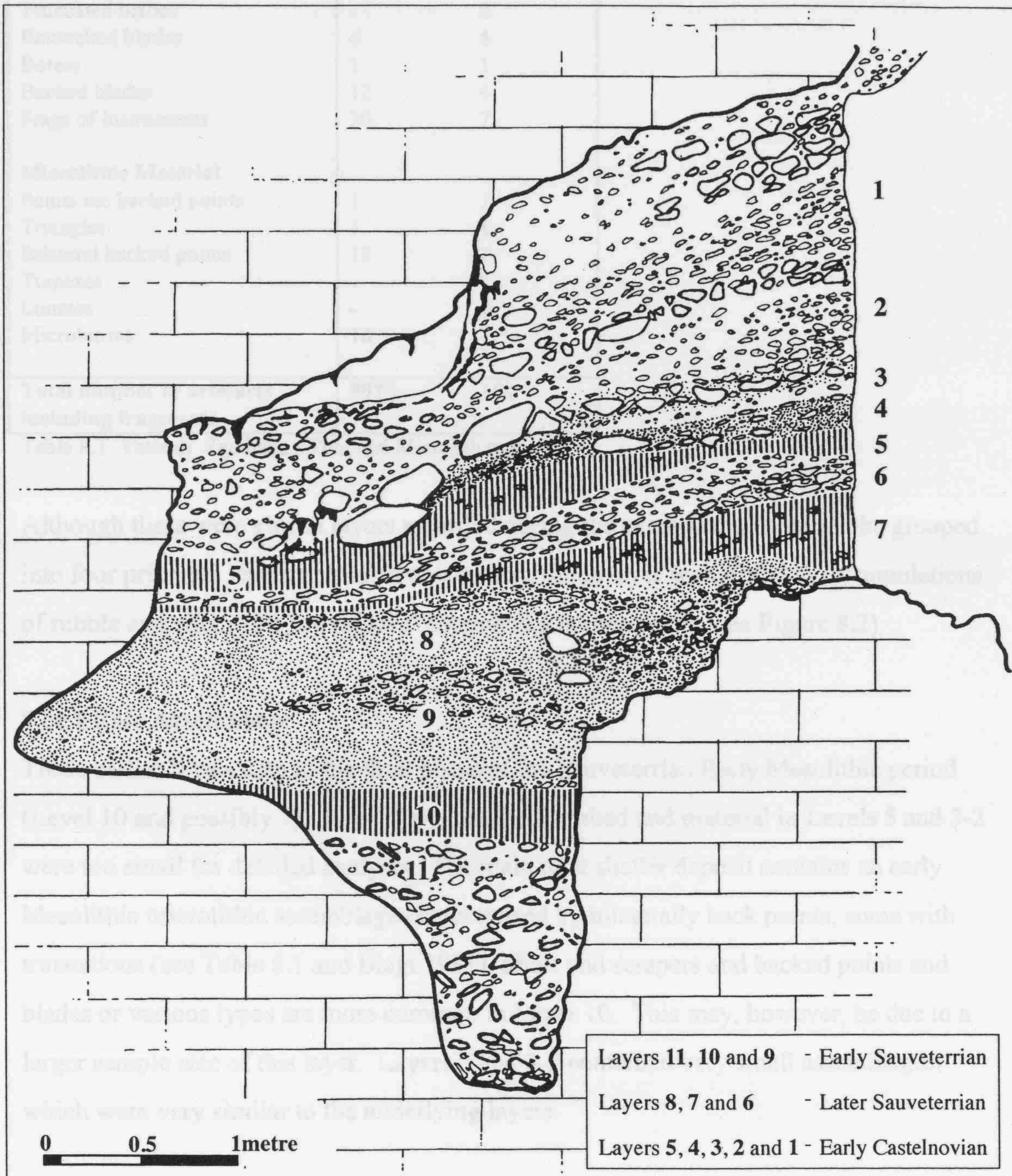

Figure 8.1 Vatte di Zambana
section through rock shelter deposits

Vatte Di Zambana: Lithics	Layers	
Instruments	10	7
Endscraper	-	-
Scrapers, denticulated flakes etc	22	11
Burins	1	2
Truncated blades	-	2
Retouched blades	4	4
Borers	1	1
Backed blades	12	4
Frags of instruments	30	7
Microlithic Material		
Points inc backed points	1	1
Triangles	1	1
Bilateral backed points	13	7
Trapezes	-	-
Lunates	-	1
Microburins	16	-
Total number of artefacts including fragments	**907**	**352**

Table 8.1 Vatte di Zambana - Tool and Microlith types

Although there were eleven layers recorded during the excavation, these can be grouped into four principal levels of human occupation. Each layer was sealed by accumulations of rubble and silts. The lowest level contained a human burial (see Figure 8.2).

The Lithic Assemblage

These earlier levels date to the final phase of the Sauveterrian Early Mesolithic period (Level 10 and possibly 7). Level 7 was badly disturbed and material in Levels 5 and 3-2 were too small for detailed analysis. The main rock shelter deposit contains an early Mesolithic microlithic assemblage characterised by bilaterally back points, some with truncations (see Table 8.1 and Biagi 1981). Short end scrapers and backed points and blades or various types are more common in Layer 10. This may, however, be due to a larger sample size of this layer. Layers 5 and 3-2 contained very small assemblages, which were very similar to the underlying layers.

The spoil from the earlier excavations contained fragments of tools suggesting a trapeze type industry for the Castelnovian period and it is therefore possible that the occupation at the site extended well into the later Mesolithic periods. It is unlikely that the earlier excavation strategy had identified lithic material in the same detail as Broglio's work.

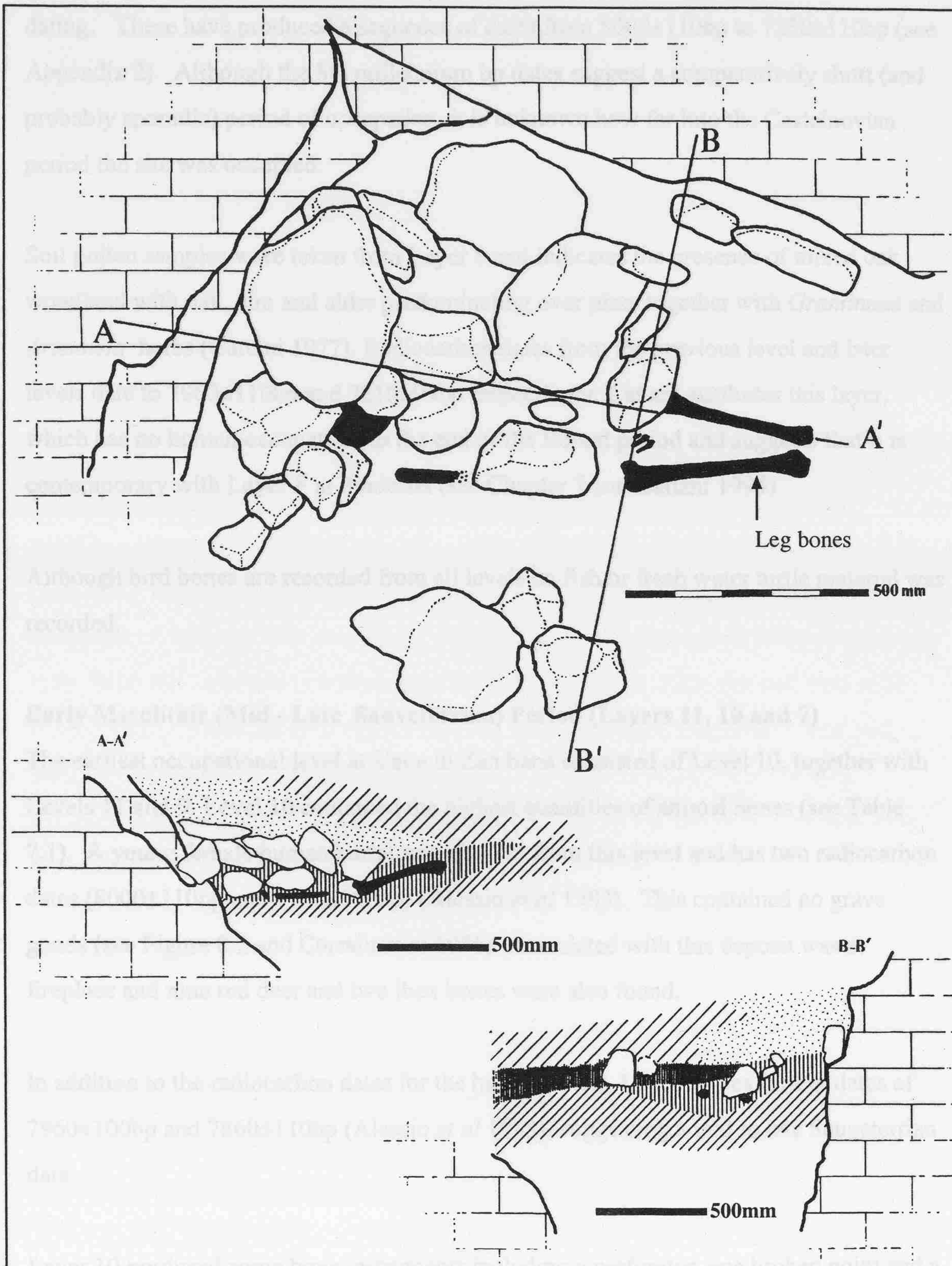

Figure 8.2 Vatte di Zambana
plan and section of female inhumation

Radiocarbon and Environmental Samples

The earlier excavations had left enough of each level to allow sampling for radiocarbon dating. These have produced a sequence of dates from 8000±110bp to 7250±110bp (see Appendix 2). Although the 8th millennium bp dates suggest a comparatively short (and probably sporadic) period of occupation, it is unknown how far into the Castelnovian period the site was occupied.

Soil pollen samples were taken from Layer 8 and indicates the presence of mixed oak woodland with oak, elm and alder predominating over pine, together with *Gramineae* and *Artemisia* herbs (Cattani 1977). Radiocarbon dates from the previous level and later levels date to 7960±110bp and 7810±95bp respectively. Cattani attributes this layer, which has no human occupation, to the end of the Boreal period and suggests that it is contemporary with Layer F at Pradestel (see Chapter 7 and Cattani 1994).

Although bird bones are recorded from all levels no fish or fresh water turtle material was recorded.

Early Mesolithic (Mid - Late Sauveterrian) Period (Layers 11, 10 and 9)

The earliest occupational level at Vatte di Zambana consisted of Level 10, together with Levels 11 and 9. Level 10 contained the highest quantities of animal bones (see Table 7.1). A young female human burial was also cut from this level and has two radiocarbon dates (8000±110bp and 7740±150bp) (Alessio *et al* 1983). This contained no grave goods (see Figure 8.2 and Corrain *et al* 1976). Associated with this deposit was a fireplace and nine red deer and two ibex bones were also found.

In addition to the radiocarbon dates for the human burial, Layer 10 has further dates of 7960±100bp and 7860±110bp (Alessio *et al* 1983), suggesting a mid to late Sauveterrian date.

Layer 10 produced some bone instruments including a perforator, one broken point and a bone decorated with hatched lines (Biagi 1981). Two perforated red deer teeth and on pierced Columbella sea shell were also found.

Bone type:	Layers 11-9 Red Deer	Ibex	Chamois	Layers 7, 8 and 6 Red Deer	Ibex	Chamois
Phalanges	26	2	-	22	1	4
Metapodials	10	-	1	8	1	3
Carpal/Tarsals	-	-	-	-	1 / -	-
Radius/Ulna	1 / -	-	1 / -	-	1 / -	1 / -
Tibia	1	-	-	-	-	-
Calcan/Astrag	- / 3	-	-	-	- / 1	1 / -
Humerus	-	-	-	-	-	-
Femur	3	-	-	2	1	1
Scapula	2	-	-	-	-	-
Pelvis	1	-	-	-	-	-
Vert/ribs	-	-	-	1 / 1	-	-
Mandible	2	1	2	6	1	-
Maxilla	-	-	-	1	-	-
Antler	1	-	-	-	-	-
TOTALS	50	3	4	41	7	10

Table 8.2: Animal bone body part representations from Vatte di Zambana
Early Sauveterrian Period (Layers 11-9) and Later Sauveterrian (Layers 7, 8 and 6)

Large Mammals (see Table 8.2)

Red Deer (*Cervus elaphus*)

Levels 11- 9 contain 50 red deer bones. These comprised mainly of phalange and metapodial fragments with chopmarks, suggesting marrow extraction. Most material was fully fused and belonged to mature animals. Six metapodial fragments had been split longitudinally, presumably to extract marrow. Two metacarpal fragments comprised unfused distal articular fragments belonging to a young individual. One chopped metapodial fragment had a pathological growth indicating that the bone may have been damaged by a fracture that had subsequently healed (Nygaard pers comm.). A chopped longitudinal fragment of a radius showed clear signs that it had been gnawed, probably by a wolf or dog.

Upper leg bones were present and included three small femur fragments, one may have been chopped. Two scapulae are of exactly the same size and probably belonged to the same adult animal. A possible tibia fragment is also recorded. Two mandibular hinges (possibly from the same animal) are recorded, together with ilium and antler fragments.

Chamois *(Rupicapra rupicapra)* and Ibex (*Capra ibex*)

Four chamois bones are recorded including a radius that appears to have been longitudinally chopped. This was the result of dismembering the bone from the upper humerus, or as part of marrow extraction. Two small mandible fragments and a chopped proximal metatarsal are also recorded.

Two ibex proximal metatarsals were recorded and had been longitudinally chopped, probably for marrow extraction.

Early Mesolithic (Later Sauveterrian) Period (Layers 7, 8 and 6)

The second main occupational period at Vatte di Zambana consisted of Layer 7, together with residual material in Layers 8 and 6. Layer 6 contained ashy soil material with quantities of faunal and lithic material. Layers 7 and 8 consisted of silty deposits with small limestone fragments and small quantities of animal bones.

Layer 7 has two radiocarbon dates: 7860±75bp and 7810±95bp and date to the late Sauveterrian (early Mesolithic) period (Alessio *et al* 1983). In addition to the lithic assemblage, Layer 7 produced a worked bone point (Biagi 1981).

<u>Large Mammals</u> (see Table 8.2)

Red deer (*Cervus elaphus*)

Red deer was the most common animal represented in these Layers by 41 bone fragments. The majority consisted of phalange fragments (22). One unusual aspect was that three of the third phalanges had been split open for marrow. Experience indicates that although marrow extraction of first and second phalanges is very common, third phalanges were rarely chopped open. All the phalange material belonged to mature animals.

Eight metapodial fragments show further evidence for processing. Some were longitudinally chopped, possible for the manufacture of bone tools such as points. A large fragment of metacarpal had evidence of wolf or dog gnawing around the proximal end.

Six mandible fragments (probably all belonging to the same set of jaw bones) were recovered. These had longitudinal cut and chopmarks below the teeth of the lower jaw

Bone type:	Layers 5 and 4 Red Deer	Chamois	Layers 3, 2 and 1 Red Deer	Chamois
Phalanges	2	2	12	4
Metapodials	1	-	-	1
Carpal/Tarsals	-	-	-	-
Radius/Ulna	1 / 1	1 / -	1 / 2	1 / 1
Tibia	-	2	1	-
Calcan/Astrag	-	-	1 / 1	- / 1
Humerus	-	-	-	-
Femur	-	-	2	1
Scapula	-	-	-	-
Pelvis	-	-	-	-
Vert/ribs	-	-	-	-
Mandible	-	-	-	-
Maxilla	-	-	1	-
Antler	-	-	-	-
TOTALS	5	5	21	9

Table 8.3: Animal bone body part representations from Vatte di Zambana Castelnovian period (Layers 5-4 and Layers 3-1)

and may have been the result of marrow extraction. A maxilla fragment was also recorded. Two midshaft femur fragments are likely to have belonged to mature animals.

Chamois (*Rupicapra rupicapra*) and Ibex (*Capra ibex*)

Ten chamois bone fragments are recorded consisting of lower leg bones and a radius and femur fragment. The proximal end of the radius had a chop mark indicating that the bone had been removed from the humerus. The phalange and metapodial fragments were chopped for marrow.

Seven ibex bones are recorded including a distal fragment of a femur belonging to a young individual. The remaining consisted mainly of phalange and metapodial fragments. A proximal radius was heavily chopped, possibly as a result of disarticulating the bone from the humerus (RCp in Binford 1981:125).

Wild Cat (*Felis silvestris*)

The remains of wild cat included seven phalange and metapodial fragments. No upper leg bone or body bones were recovered. It is very likely that the bones belonged to the same individual. There was no evidence for skinning marks on the metapodials and it is possible that the cat died of natural causes.

A single bird bone, probably belonging to a duck was also recorded.

Early - Late Mesolithic (Final Sauveterrian / Early Castelnovian) Period (Layers 5-4)

Layers 5 -4 date to the beginning of the later Mesolithic (Castelnovian) period, and only limited quantities of lithic and animal bones were recovered. Two radiocarbon dates consist of 7585±75bp and 7540±75bp (Alessio *et al* 1983). No ibex are recorded from these or the later layers.

Large Mammals (see Table 8.3)

Red Deer (*Cervus elaphus*)

Five red deer bones were recorded. These include a distal radius fragment and a proximal ulna. The ulna fragment had chopmarks on the right lateral side indicating disarticulation from the humerus (RCp-2 in Binford 1981). Two first phalanges and a metacarpal showed further evidence for marrow extraction.

Chamois (*Rupicapra rupicapra*)

Five chamois bones were recovered consisting of two distal fragments of tibia and metacarpals and a radius. The two tibia were left and right sided fragments that possibly belonged to the same animal. Both pieces were chopped above the epiphysial end and suggest that the upper meat bearing bones were removed from the lower distal bones (metatarsals, tarsals and phalanges).

Brown Bear (*Ursus arctos*)

Two mandibular teeth from a mature animal were recorded.

Later Mesolithic (Early Castelnovian) Period (Layers 1, 2 and 3)

The final occupation deposit consisted of layers 1, 2 and 3. Layer 3 contained a denser layer of anthropogenic material. In common with Layer 5, Layers 1-3 contained relatively few animal bones, and the bulk of the material was red deer and chamois.

A single radiocarbon date of 7250±110bp is given for Layers 2-3 (Alessio *et al* 1983). In addition to the limited range of lithic material from this group of layers, a red deer antler spatula was also recorded (Biagi 1981).

Large Mammals (see Table 8.3)

Red Deer (*Cervus elaphus*)

Twenty-one red deer fragments were recovered consisting mainly of phalange fragments, most of which were split open. A radius (RCp 5 in Binford 1981:124-125) and an ulna fragment (RCp-2 in Binford 1981) indicate dismemberment associated with the removal of the upper meat bearing bones from the lower leg/feet bones. A second ulna fragment may have belonged to the same bone. A calcaneus and astragalus belonged to the same leg of a red deer.

A single fragment of a red deer mandible may have been split to extract marrow from the lower jaw below the teeth.

Chamois (Rupicapra rupicapra)

Nine fragments of chamois were recovered. Four fragments comprised butchered first or second phalanges. A proximal radius/ulna fragment contained a chopmark associated with the removal of the upper meat bearing limbs from the lower leg bones (RCp in Binford 1981:125). Single fragments of metatarsal, femur and astragalus were also recorded.

A single bird bone was also recorded.

VATTE DI ZAMBANA		**OCCUPATIONAL LAYERS**			
Animal Size	**Bone Fragment Types**	Layers11 , 10 and 9	Layers 7, 8 and 6	Layers 5 and 4	Layers 1, 2 and 3
Medium	Medium long bones:	34	26	12	8
	Medium ribs :	3	5	5	1
Chamois, Ibex	Medium vertebrae :	2	-	-	-
	Medium carpal /tarsal :	4	-	-	-
	Total	43	31	17	9
Larger mammals	Large long bones :	47	17	7	6
	Large ribs :	12	-	1	1
Red deer	Large skull :	-	-	-	-
	Large vertebrae :	-	-	-	-
	Large carpal / tarsal :	7	1	3	-
	Very large carpal / tarsal:	3	5	3	-
	Total	69	24	14	7
Indeterminate	Other :	21	31	17	28
Total Number of Unidentifiable Fragments		133	55	48	44

Table 8.4: Vatte di Zambana: total number of unidentifiable bone fragments - 280

Key - Layers 11, 10 and 9 = Mid - Late Sauveterrian, Layers 7, 8 and 6 = Later Sauveterrian, Layers 5-4 = Final Sauveterrian / Early Castelnovian, Layers 1,2 and 3= Early Castelnovian

Summary

A total of 166 identifiable and stratified bones and 280 unidentifiable fragments were recorded from Vatte di Zambana. A further 14 red deer, seven chamois and four ibex bones were recorded as unstratified. The assemblage is therefore relatively small compared to Romagnano III and Pradestel.

The animals recorded consist of red deer, chamois, ibex, wild cat and bear. Most bones appear to belong to mature animals. Fragments of bird (possibly duck) and dog or wolf were also present. It is considered significant that both roe deer and wild boar are not included in the assemblage. This was also noted by Boscato and Sala (1980).

Butchery consists mainly of evidence for marrow extraction. Limited evidence for bone dismemberment is also recorded, particularly in the later levels (after Level 7).

The evidence indicates that only small numbers of animals, and sometimes only single individuals, were recorded within each of the main occupational layers. It appears likely that occupation at Vatte di Zambana was less intensive compared to Romagnano III or Pradestel, and more limited in terms of the date range for occupation. The site was not occupied during the earlier Mesolithic periods and there very little indication that occupation extended into the later Castelnovian, although this could be due to the earlier excavations destroying these deposits.

The human burial is a feature not recorded in other valley bottom sites, and it is possible that the site did not function as an intensively used residential site.

Riparo Gaban

Riparo Gaban is a rock shelter *c.*3km to the north of Trento at an altitude of 270m asl and is situated in a valley overlooking the eastern side of the Adige valley. The site is at a slightly higher location than the Adige valley rock shelters previously discussed. Unlike these sites, which were discovered during quarrying and were damaged prior to the intervention of archaeologists, Riparo Gaban was never subjected to such workings. An auger survey indicated that during the prehistoric periods a stream was located close to the shelter (Lanzinger pers comm.).

In other respects Riparo Gaban differs from the nearby shelters of Pradestel, Romagnano and Vatte di Zambana. The Gaban valley is situated in a narrow and sheltered tributary of the Adige valley and would have been ideally situated as a residential site (see Plates 9 and 10). In the winter months, it is likely to have provided good shelter against the prevailing winds with access to the hunting territories on the higher ground of the Mount Calisio area to the north-east.

Riparo Gaban is well known for its later levels which have been more extensively published, including its early Neolithic art-work (e.g. Bagolini 1980 and Clark 1989). The Gaban Group constitutes the early Neolithic pottery type for the Trento area. The lithic evidence indicates that the early Neolithic tradition grew directly out of the previous Mesolithic periods, and the faunal remains support this conclusion. The lithic industry contains burins on a side notch, trapezes with or without piquant-trièdre points, rhomboids, microburins, denticulate blades and many small microliths. There are no polished stone tools from these early Neolithic levels. If it were not for the presence of pottery, this material would clearly be considered to be of late Mesolithic date.

The 1982-1984 Excavations: Mesolithic Faunal Remains

Between 1982 and 1984 excavations at Riparo Gaban were extended to include the Mesolithic levels. The area examined totalled about 12m in length and approximately 1.5m in depth. The width of the deposits excavated varied between 1m and 4m due to the position of the rock shelter wall and disturbances to the site. These disturbances included Neolithic and later occupation and its subsequent archaeological excavation, as well as more recent pitting.

The deposit consists broadly of two Sauveterrian and two Castelnovian Mesolithic groups of layers. Small quantities early Neolithic material were also recorded. The analysis of the lithic material (undertaken jointly with S Kozlowski and the Museo Tridentino di Scienze Naturali in Trento), has yet to be completed and there are at present no radiocarbon dates available (Lanzinger pers comm).

Excavation Areas:	Zone IV						Zone III		Zone V		
Early Neolithic	E1-E2			D8-D9			Pit N TBN	TC 1	26		
				D10-E9		TBN E		TC-1A	27		
Later Castelnovian	E3-E5	E3-E4		E2	E2-E5			TC-1B	TCE-F	TCE-F	
Earlier Castelnovian	F1-F5	F1-F8/9	F1-F5	E3-E5	E6-E7	TBNE 1-5		TC 1C	TCG-L	TC G-K	27B
						TBNE 6		TC2 A-B	TCG-L	TC G-K	
Later Sauveterrian	F6-F9	F9/10-F10/3	F6-E11/13	E6-E7	E8	E09		TC 2C	TCM-R	TC-L	
Earlier Sauveterrian	F10 etc	F11/14	F12/14	F8	BEDROCK				TC S-Y		
Bedrock											

Figure 8.3a Riparo Gaban: Schematic section showing spit numbers in relation to the interpreted Mesolithic and Neolithic phasing

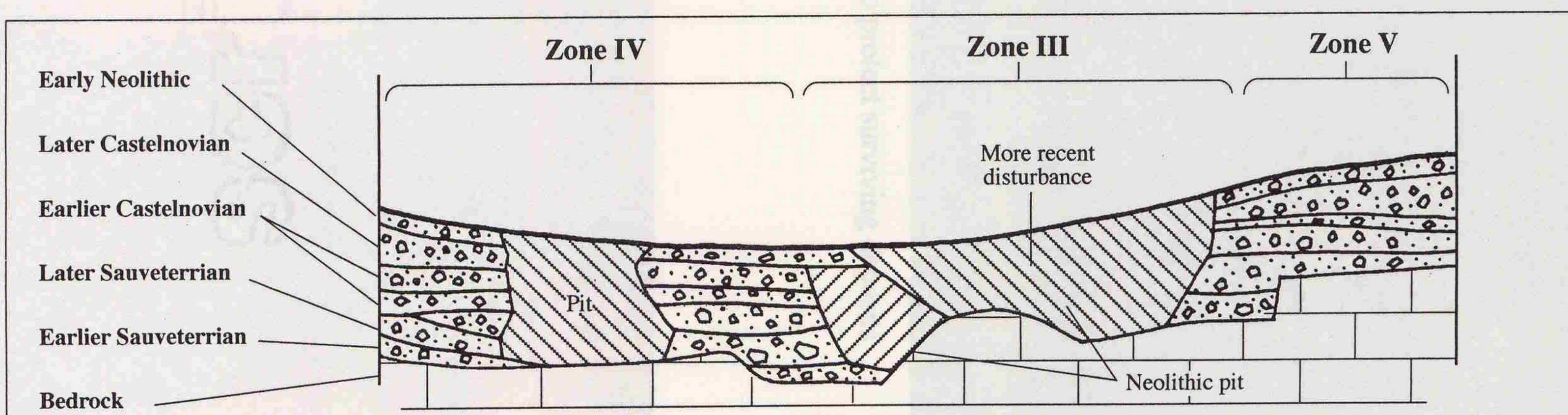

Figure 8.3b Riparo Gaban
section based on site drawing from archive

Plate 9: Riparo Gaban rock shelter showing hut to protect surviving deposits

Plate 10: Riparo Gaban surviving deposits within rock shelter

The site was excavated by two separate teams of archaeologists led by Bagolini and S Kozlowski. The site was divided into two areas (Zone IV = Italian and Zone V = Polish). The stratigraphy in the central area between the two zones (Zone III) was extensively disturbed by later activity (Neolithic pits). Excavation was by spit method and a schematic section drawing in tabular form represents the basis for ascribing the faunal remains (and other artefactual data) to particular Mesolithic and Neolithic phases. This information was supplied by Bagolini. The tabular section drawing can be compared to the main section drawing which shows the extent of pits and other disturbances (see Figure 8.3a and 8.3b).

In addition to the section drawings, two unpublished site plans (from the archive) form the main excavation records (see Figures 8.4 and 8.5). Figure 8.5 is a plan of the early Neolithic surface showing the full extent of the later disturbances, together with details of the position of Neolithic pits. Figure 8.4 shows similar details for the Castelnovian Mesolithic layers. The shaded areas on both plans represent the main zones of excavation. These excavation records are not as detailed as warrants a site of such importance.

The Animal Bones

The faunal remains were examined in Trento. The micro-fauna, assumed to have been sampled from the site, was not present in the museum stores and only limited small mammal material was found. It is possible that these small quantities were the result of a limited sieving programme.

Compared to the other Adige valley sites, the fauna was a large assemblage, particularly with regard to the late Mesolithic (Castelnovian) levels comprising of 1474 identifiable bones. The fauna was, however, fragmented and the range of species identified was relatively small. A total of 17922 bones were unidentifiable either by species or bone type. These are summarised in Table 8.16.

At present there no radiocarbon dates for the Riparo Gaban Mesolithic levels, and this analysis is based on the stratigraphical groupings advised by Bagolini. As a result only broad trends in the data are discernible. Unlike the other sites in this study, pit deposits

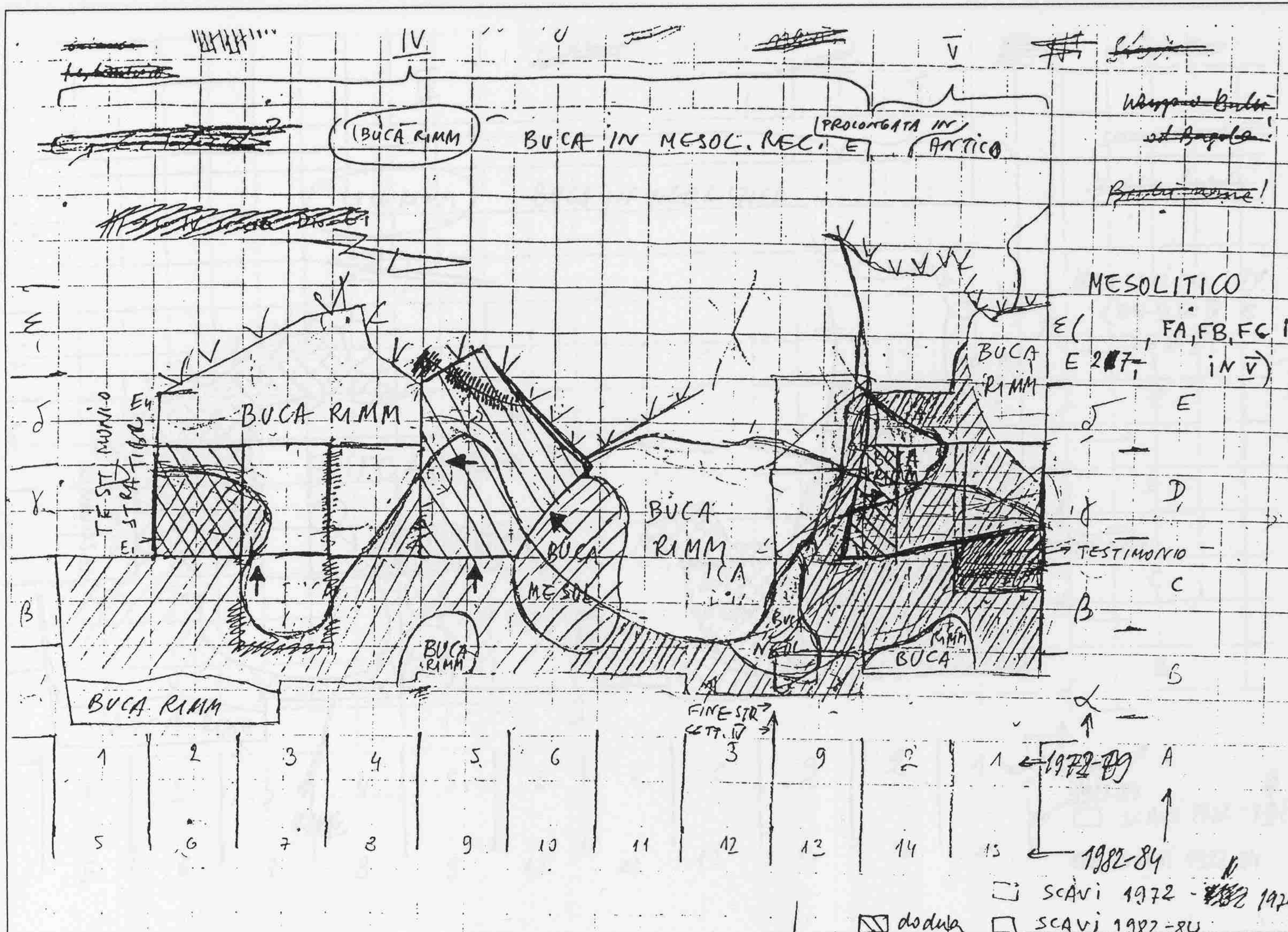

Figure 8.4 Riparo Gaban - site plan from archive showing Mesolithic deposits

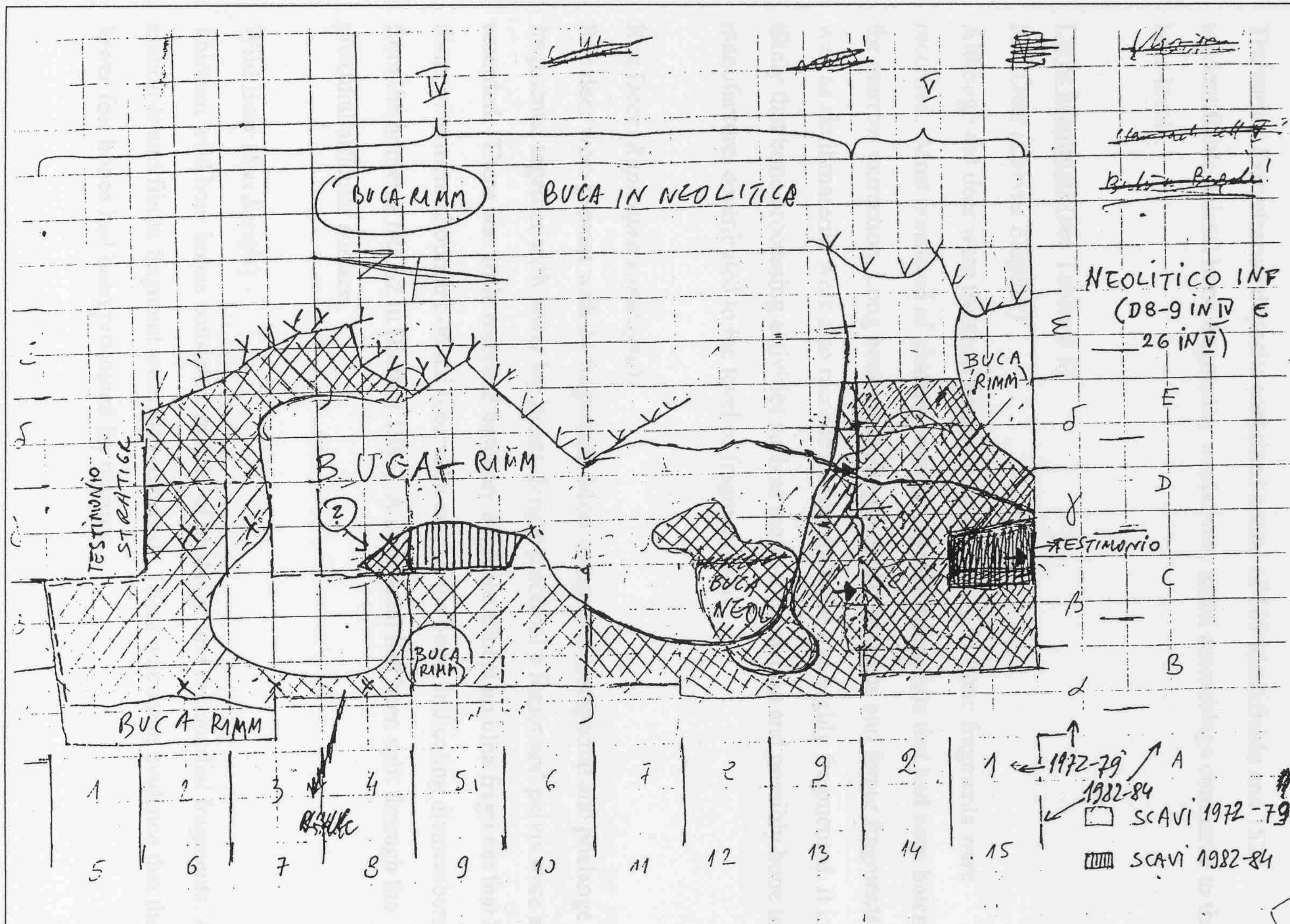

Figure 8.5 Riparo Gaban - site plan from archive showing Neolithic deposits

were recorded separately from the occupational layers. Unfortunately, the excavation records do not provide full details concerning the dimensions of the layers or pits.

Early Mesolithic (Earlier Sauveterrian) Levels

The earlier Sauveterrian deposits contained a total of 109 identifiable and 1528 unidentifiable animal bone fragments, a relatively small assemblage compared to the later levels.

Large Mammals (see Tables 8.5)

Red Deer (*Cervus Elaphus*)

Although red deer were the most common species, only 31 bone fragments were recorded. Most consisted of phalange and metapodial fragments that had been butchered for marrow extraction. Long bones including scapula, humerus and femur fragments, as well as skull material were also recorded. Most material was highly fragmented. It is likely that bone processing activities such as marrow extraction and possibly bone tool manufacture, contributed to the level of fragmentation.

Roe Deer (*Rupicapra rupicapra*)

Roe deer were present with 24 fragments. Most comprised metapodial and phalange fragments, together with lower leg bones. Single pieces of a femur and pelvis were also recorded. There was little recorded butchery evidence except an ulna fragment that had a dismemberment chopmark on the olecranon area of the bone, indicating dismemberment from the humerus (RCp2 in Binford 1981). A metatarsal had been split through the proximal articular surface.

Wild Boar (*Sus Scrofa*)

Thirteen wild boar bones consisted mainly of phalange and metapodial fragments. A mandible and fibula fragment were also recorded. There was some evidence that the lower feet bones had been processed for marrow.

Bone type:	Red Deer	Roe Deer	Ibex	Chamois	Wild Boar
Phalanges	10	4	3	1	6
Metapodials	7	13	1	2	5
Radius/Ulna	-	- / 1	-	-	-
Tibia/Fibula	1	2	1	-	- / 1
Calcan/Astrag	-	1 / 1	-	-	-
Humerus	1	-	1	2	-
Femur	5	1	-	-	-
Scapula	2	-	1	-	-
Pelvis material	-	1	-	-	-
Vert/ribs	1 / -	-	-	-	-
Mandible	1	-	1	-	1
Maxilla	2	-	-	-	-
Antler	1	-	-	-	-
Totals	**31**	**24**	**8**	**5**	**13**

Table 8.5: Animal bone body part representations from Riparo Gaban
The earlier Sauveterrian Period

Ibex (*Capra ibex*) and Chamois (*Capreolus capreolus*)

Small quantities of ibex (8) and chamois (5) bones were recorded. These included lower leg bones and humerus fragments. A burnt mandibular fragment was also recorded.

<u>Smaller Mammals and Carnivores</u> (see Table 8.6)

Limited quantities of small mammal and carnivore material are recorded from the Early Sauveterrian levels. The pine marten material is likely to have consisted of a minimum of two individuals and the bone was in good condition. There were no cut marks visible that may have been attributed to skinning for fur.

Wolf or large dog bones included a mandible and two phalange fragments which were badly burnt. This was probably due to the proximity of a fireplace.

Human bone was also found and consisted of a long bone fragment and a tibia.

Compared to the large mammal bones, the bones from the smaller animals such as pine marten were in good condition, and in particular, less fragmented. This observation is significant because the smaller animal bones are likely to be more fragile and thus more liable to fragmentation than the larger mammal bones. It is possible to argue that this suggests that most bone fragmentation was the result of human processing (as well as

Animal Species	Earlier Sauveterrian	Later Sauveterrian
Pine Marten	16	8
Wolf or large dog	6	2
Beaver	2	2
Brown Bear	2	1
Hare	-	1
Human	2	-
Totals	**28**	**14**

Table 8.6: Smaller Mammal and Carnivore bone fragments from Riparo Gaban
The Sauveterrian Period

secondary gnawing by scavengers). This is because fragmentation caused by trampling would have damaged the small mammal bones as well as the larger material.

Early Mesolithic (Later Sauveterrian) Levels

As with the earlier Sauveterrian period, the later deposits contained limited quantities of bone. A total of 68 animal bones were identified to both species and bone type and 107 were recorded as unidentifiable. Ibex (*Capra ibex*) and Chamois (*Capreolus capreolus*) are not present in these or the later levels.

•

Large Mammals (see Table 8.7)

Red Deer (*Cervus elaphus*)

Red deer are represented by 36 bones. Although butchered fragments of phalange and metapodials are common, there is a greater range of bone types compared to the earlier levels, and to other sites such as Romagnano and Pradestel. Upper leg bones, vertabrae and skull bones are present in equal numbers. A proximal humerus fragment contained a chopmark (Hp2 in Binford 1981:123) and an ulna fragment (RCp2 in Binford 1981;125). Both are associated with dismemberment from the scapula and humerus respectively.

Roe Deer (*Rupicapra rupicapra*) and Wild Boar (*Sus scrofa*)

Roe deer (10) and wild boar (8) are present in the assemblage. Most of the bone material comprises phalange and metapodials with evidence for marrow processing. A roe deer scapula and humerus are also recorded. The scapula fragment had a chopmark around the glenoid cavity indicating dismemberment from the humerus (S1 in Binford 1981:122).

Bone type:	Red Deer	Roe Deer	Wild Boar
Phalanges	9	6	4
Metapodials	7	1	3
Radius/Ulna	- / 1	-	-
Tibia	2	-	-
Calcan/Astrag	2 / 1	-	- / 1
Humerus	2	1	-
Femur	5	-	-
Scapula	-	1	-
Pelvis	2	-	-
Vert/ribs	2 / -	-	-
Mandible	2	1	-
Maxilla	1	-	-
Totals	**36**	**10**	**8**

Table 8.7: Animal bone body part representations from Riparo Gaban Later Sauveterrian Levels

	Pit G				**Pit C**		
Bone type:	**Red Deer**	**Roe Deer**	**Wild Boar**	**Pine Marten**	**Red Deer**	**Roe Deer**	**Wild Boar**
Phalanges	1	-	-	-	-	-	1
Metapodials	6	-	1	-	-	-	-
Radius/Ulna	-	-	-	-	-	1/-	-
Tibia	1	-	-	-	-	-	-
Humerus	-	-	-	-	1	-	-
Femur	3	-	-	-	-	-	-
Mandible	2	-	1	1	-	-	-
Maxilla	-	1?	-	-	-	-	-
Totals	**13**	**1?**	**2**	**1**	**1**	**1**	**1**

Table 8.8: Animal bone body part representations from Riparo Gaban The Sauveterrian Pits

<u>Smaller Mammals and Carnivores</u>

Table 8.6 summarises the smaller mammal and carnivore assemblage. Pine marten, wolf or large dog are included.

Sauveterrian Pits C and G

Two pits date to the Sauveterrian periods (see Table 8.8). Pit C contained three bones comprising single fragments from wild boar, red and roe deer. Pit G contained seventeen bones, thirteen belonged to red deer. The majority of consisted of lower leg bones. A tibia and three femur fragments were also recorded, together with two pieces of mandible. All the material recorded from the pits was highly fragmented and contained little evidence of butchery or other activities.

Bone type:	Red Deer	Roe Deer	Wild Boar
Phalanges	141	110	48
Metapodials	102	105	44
Radius/Ulna	14 / 10	2 / 2	4 / 1
Tibia / Fibula	17	10	1 / 4
Calcan/Astrag	10 / 4	1 / 6	- / 4
Humerus	18	10	2
Femur	49	18	-
Scapula	10	7	1
Pelvis	17	6	-
Vert/ribs	9 / -	1	-
Mandible	27	13	6
Maxilla	10	11	2
Antler	-	1	-
Totals	**438**	**303**	**117**

Table 8.9: Animal bone body part representations from Riparo Gaban
The Early Castelnovian period

Late Mesolithic (Earlier Castelnovian) Period

The later Mesolithic Castelnovian levels contained larger quantities of bone material indicating that occupation was more intensive compared to the earlier Mesolithic periods. A total of 885 identifiable and 10011 unidentifiable bone fragments are recorded. This period probably lasted from *c.*7800 to 7000bp (based on radiocarbon dates from Romagnano III).

Large Mammals (see Table 8.9)

Red Deer (*Cervus elaphus*)

A total of 438 red deer bones consist mainly of highly fragmented phalange and metapodials, indicating marrow processing and possibly bone tool manufacture. Long bone fragments are also recorded in high numbers. The level of fragmentation makes minimum numbers of individual estimations difficult, particularly as the groupings of layers may represent considerable periods of time, rather than individual occupational events. MNI estimations based on proximal left sided ulna fragments suggests a minimum of nine red deer. Within this assemblage there is more evidence for a greater age range, including juvenile animals.

Proximal radius (2) and ulna (9) fragments contain evidence for dismemberment chopmarks associated with their removal from the humerus (RCp3 and RCp2 in Binford 1981:125).

The seventeen tibia fragments contained evidence for dismemberment and possible marrow extraction (Td1 in Binford 1981:125). Two unfused distal tibiae (probably from the same deer) indicate an animal less than two years old. A midshaft tibia fragment showed signs of a wound, possibly a fracture or damage by an arrow that had subsequently healed (Nygaard pers comm.).

Forty-nine fragments of femur were recorded. Although most belonged to mature animals. Four, including two unfused femoral balls, were from juveniles. The level of fragmentation, together with burnt and gnawed pieces, made the identification of butchery traces very difficult. Cutmarks were visible on a single distal articular surface (Fd3 in Binford 1981:117), indicating dismemberment from the tibia. Eighteen humeri consisted of highly fragmented material, with little trace of butchery activity. A single bone from a young adult had filleting marks on the midshaft close to the distal end (Hd3 in Binford 1981:123).

Two scapula fragments contained cut/chopmarks associated with dismemberment from the humerus (S1 in Binford 1981:122). Of the seventeen pelvic fragments, an acetabulum had marks associated with the removal of the rear leg (PS7 in Binford 1981:113).

The majority of the mandible fragments did not contain teeth within the jaw bone, or consisted of hinge fragments. The fragments containing teeth indicated a mainly mature age range, including animal with worn teeth.

Roe Deer (*Rupicapra rupicapra*)

A total of 303 roe deer bone fragments consisted of phalange and metapodials. Many were butchered for marrow, or possibly for the manufacture of bone tools. Long bones were also recorded in greater quantities than at the other sites.

Proximal radius and ulna fragments contained dismemberment marks indicating the removal from the humerus (RCp5 and RCp 3/4 in Binford 1981). Two tibia fragments had dismemberment or skinning marks near their distal ends (see Binford 1981:118-119). The femur and humerus fragments were small, and in some cases were badly burnt and

Animal Species	Early Castelnovian	Later Castelnovian
Beaver	6	9
Wolf / Dog	15	3
Fox	-	1
Pine Marten	6	2
Human	-	1
Totals	**27**	**16**

Table 8.10 Smaller Mammal and Carnivore bone fragment types from Riparo Gaban
The later Mesolithic (Castelnovian) Levels

Bone type:	Red Deer	Roe Deer	Wild Boar
Phalanges	54	28	14
Metapodials	24	34	10
Radius/Ulna	5 / 1	5 / -	- / 1
Tibia/(Fibula)	6	2	- / 1
Calcan/Astrag	3 / 2	- / 2	- / 1
Patella	1	-	-
Humerus	3	6	-
Femur	21	2	1
Scapula	-	2	-
Pelvis	2	-	-
Vert/ribs	1	-	-
Mandible	6	4	3
Maxilla	2	-	-
Totals	**131**	**85**	**31**

Table 8.11 Animal bone body part representations from Riparo Gaban
The Later Mesolithic (Castelnovian) Levels

very little butchery was recorded. Cutmarks were visible on a single distal articular surface of a femur (Fd3 in Binford 1981:117), indicating dismemberment from the tibia. A calcaneus had dismemberment cutmarks on an articular surface (TC3 in Binford 1981: 119-120).

Wild Boar (*Sus scrofa*)

A total of 117 wild boar bones were recorded, the majority consisted of phalange and metapodial fragments. Significant quantities of metatarsals and metacarpals had been split open, and there was evidence that phalanges were also split, presumably for marrow extraction. There was little additional butchery data from the remainder of the bones.

Smaller Mammals and Carnivores

Table 8.10 summarises the smaller mammal and carnivore material. A minimum of two wolves or large dogs were recorded from the earlier Castelnovian levels, one consisted of a young adult.

Late Mesolithic (Later Castelnovian) Period

The layers dating to the later Castelnovian contained lower quantities of bones compared to the Earlier Castelnovian period. This is due to the truncation of the deposits caused by later disturbance. A total of 263 identifiable and 6052 unidentifiable bone fragments are recorded. Age range information indicates juvenile and young, as well as mature animals.

Large Mammals (see Table 8.11)

Red deer (*Cervus elaphus*)

A total of 131 red deer fragments consist mainly of phalange and metapodial material. A large proportion had been split for marrow.

The radius, tibia and ulna fragments reveal traces of dismemberment chopmarks associated with their removal from the upper leg bones and the lower feet bones. The relatively large quantity of femur fragments is considered to be due to a high level of fragmentation, and not to a large number of individual bones. One femur fragment from a juvenile animal had a chop/hack mark on the femoral ball. A mandible fragment had chopmarks on the lower jaw that could relate to marrow extraction.

Roe Deer (*Rupicapra rupicapra*)

Eighty-five roe deer bones consisted of highly fragmented material, most of which were either phalange and metapodials. Apart from marrow extraction, a metapodial splinter appears to have been partially formed into a point.

Two distal humerus fragments had chopmarks on the articular surfaces associated with dismemberment from the radius/ulna (Hd1 in Binford 1981: 123). A scapula had dismemberment cut/chop marks around the glenoid cavity (S1 in Binford 1981:122).

Wild boar (*Sus scrofa*)

Thirty-one wild boar bones consist mainly of phalange and metapodial fragments. Very few of these bones had any evidence for butchery activity, such as marrow extraction and most were badly burnt and highly fragmented.

Smaller Mammals and Carnivores

Table 8.10 summarises the smaller mammal and carnivore material. Most material belonged to beaver.

Castelnovian Pits

Three pits (Pits A, B and 16) date to the Castelnovian periods (see Tables 8.12 and 8.13). Pit A contained most bone material. The range of material included a femur, pelvis and rib fragments.

A fourth pit (with no reference code) dating to the Later Castelnovian period contained five pig bones. These consisted of three metapodials, a fibula and an ulna.

Bone type:	**Red Deer**	**Roe Deer**	**Wild Boar**	**Wolf or Dog**	**Pine Marten**
Phalanges	4	2	2	1	1
Metapodials	1	13	1	-	-
Radius/Ulna	1 / 1	-	1 / -	-	-
Tibia	1	-	-	-	-
Calcan/Astrag	- / 1	-	-	-	-
Femur	1	1	-	-	-
Pelvis	2	-	-	-	-
Vert/ribs	3 / -	-	-	-	-
Mandible	-	-	-	-	1
Maxilla	-	1	-	-	-
Totals	**13**	**17**	**4**	**1**	**2**

Tables 8.12: Animal bone body part representations from Riparo Gaban Castelnovian Pit A

	Pit B	**Pit 16**			**Fourth Pit**
Bone type:	**Red Deer**	**Red Deer**	**Roe Deer**	**Wild Boar**	**Wild Boar**
Phalanges	2	1	2	-	-
Metapodials	2	4	2	1	3
Radius/Ulna	1 / -	-	-	-	- / 1
Tibia / Fibula	-	2	-	-	- / 1
Humerus	-	1	-	-	-
Femur	3	1	-	-	-
Maxilla	-	-	1	-	-
Totals	**8**	**9**	**5**	**1**	**5**

Table 8.13: Animal bone body part representations from Riparo Gaban Castelnovian Pit B, Pit 16 and Fourth Pit

Bone type:	Red Deer	Roe Deer	Wild/Domestic Boar	Sheep/ Goat?
Phalanges	23	1	1	1
Metapodials	9	1	1	2
Radius/Ulna	2 / -	-	-	1 / -
Tibia	1?	3	-	-
Calcan/Astrag	-	1 / 1	-	-
Patella	-	-	-	-
Humerus	-	1	-	-
Femur	2	2	-	-
Scapula	1	1	-	-
Pelvis	1	-	-	-
Vert/ribs	-	-	-	-
Mandible	3	1	-	-
Maxilla	-	-	-	-
Totals	**42**	**12**	**2**	**4**

Table 8.14: Animal bone body part representations from Riparo Gaban Early Neolithic Levels

The Neolithic Levels

Most of the Neolithic levels were removed during earlier excavation projects. The faunal remains from these previous projects are not stored in Trento. The material from the 1982 to 1984 excavations represented the earliest Neolithic period deposited immediately above the later Castelnovian levels. A 'cleaning layer' dating from the late Mesolithic and early Neolithic periods contained a single pig and twenty-three red deer bone fragments. The Neolithic deposits contained red deer and small quantities of roe deer, pig and caprids that may represent sheep. A total of 64 bones were attributed to both animal species and bone type and 224 were recorded as unidentifiable fragments.

Large Mammals (see Table 8.14)

Red Deer (*Cervus elaphus*)

Forty-two red deer bones consisted mainly of phalange and metapodial fragments of which most had been split open for marrow or bone tool manufacture. The lower part of the jaw of a mandible appeared split longitudinally, possibly for marrow extraction. Two radii and a burnt scapula fragment contained butchery marks associated with bone dismemberment (Radii: below RCp5 in Binford 1981: 125 and scapula: S1 in Binford 1981: 122).

Roe Deer (*Cervus elaphus*),

Wild or Domesticated Pig (*Sus scrofa*) and Sheep or Goat

Twelve roe deer bone fragments and small quantities of wild boar and sheep or goat were recorded from the Neolithic levels. Roe deer material included a scapula and three tibia fragments that had clear chopmarks associated with dismemberment.

It was impossible to determine from the two pig bones whether they were from a wild or domesticated animal. The bones show no differences in terms of size from the material dating to the Mesolithic levels. Four bones are tentatively classed as sheep/goat as they were clearly not chamois.

Smaller Mammals and Carnivores

Table 8.15 shows small mammal / carnivore bone fragments:

Animal Species	Number of fragments
Wolf or Large Dog	2
Hare	2

Table 8.15: Smaller Mammal and Carnivore bone fragment types from Riparo Gaban Early Neolithic Levels

Unidentifiable Bone Fragments

The unidentifiable bone fragments (17922 in total) are listed in Table 8.16 and follows a classification method outlined in the Pradestel section in Chapter 7. This table shows the quantities of material for each phase of occupation at Riparo Gaban.

Summary

The five groupings of faunal material for Riparo Gaban are based on a stratigraphical sequence outlined by Bagolini (pers comm.). Although there are no radiocarbon dates to provide a chronological framework, the span of occupation is likely to be similar to Pradestel and Romagnano, in that their use continued into the Neolithic periods. There are general trends in the data that are similar to the Adige valley rock shelters. The most obvious is that ibex disappear from the faunal record during the later Sauveterrian period and hunting concentrates on red deer, roe deer together with pig and chamois.

RIPARO GABAN		OCCUPATIONAL LAYERS				
Animal size	**Bone type**	I	II	III	IV	V
Beaver sized	Small long bones :	300	17	2060	1297	57
	Small skull :	48	2	167	38	3
	Small vertebrae :	11	0	39	28	2
	Small carpal	11	0	49	11	2
	Total	370	19	2315	1374	64
Roe deer, chamois ibex (pig ?)	Medium long bones:	90	7	881	348	34
	Medium ribs :	149	2	638	241	18
	Medium vertebrae :	14	0	172	62	1
	Medium carpal :	24	0	123	42	3
	Total	277	9	1814	693	56
Red deer, (pig?)	Large long bones :	32	0	228	45	9
	Large ribs :	62	2	423	137	9
	Large skull :	154	7	799	239	19
	Large vertebrae :	27	0	116	36	0
	Large carpal :	21	0	60	15	0
	Total	296	9	1626	472	37
Indeterminate	Other :	585	70	4256	3513	67
	Totals:	**1528**	**107**	**10011**	**6052**	**224**

Table 8.16: Total number of unidentifiable bone fragments - 17922

The Riparo Gaban faunal assemblage is the largest within the study area and comprises over 19000 bones, this was due to the highly fragmented nature of the assemblage. Only 1474 fragments were identifiable to bone type and animal species. Pradestel contained 1578 identifiable and Romagnano III 1066 identifiable bones and revealed a similar range of animal species. Riparo Gaban did, however, contain a greater range of bone types, particularly in the later Mesolithic, together with more evidence for butchery marks.

Riparo Gaban has the clearest evidence for wolf or dog gnawing and this may explain why there is such a higher quantity of fragmented bone compared to other sites. These animals could have contributed to the overall character of the faunal assemblage. A lack of proximal humeri and distal tibia may represent evidence to support the presence of dogs (see Binford 1981). Bones with softer parts, and thus more vulnerable to destruction, such as femur and vertebrae are also present in very low numbers.

In terms of the areas excavated, the Sauveterrian levels at Riparo Gaban would appear to contain a similar density of bone material compared to sites such as Pradestel and Romagnano. It is possible that this early Mesolithic occupation was largely of a seasonal nature, with groups dispersing in the summer months to hunt red deer, ibex and chamois in the higher ground. The later Mesolithic (Castelnovian) levels indicate a more intensive form of occupation that could relate to more permanent year round settlement. The fragmented nature of the assemblage, particularly in the early Castelnovian period may represent evidence for more intensive forms of occupation.

We have discussed how settlement patterns changed significantly in the Castelnovian period. High altitude sites ceased to be used in the later Mesolithic, and any corresponding settlement changes need to be seen from the perspective of lower altitude sites like Riparo Gaban. The evidence from Riparo Gaban is that settlement intensity increased during this period, and it will be argued in the concluding chapter that the site was a residential base camp, from where logistically based groups (perhaps even individuals) foraged in a more forested environment compared to the earlier Mesolithic. The fact that a greater range of bone types (e.g. upper leg bones) is recorded at all the rock shelter sites during the later Mesolithic, may be considered as further evidence for changes in hunting strategies.

Late Mesolithic Rock Shelters and Other Sites

Coinciding, with the beginning of the later Mesolithic (Castelnovian) period, when the early Mesolithic high altitude sites were abandoned, there is some evidence for changes in settlement patterns in the valley areas. Some form of settlement change was predicted in Chapter 3, and this consists of an increase in range of site types occupied in the Castelnovian, with no evidence for prior use in the earlier Mesolithic periods. These sites occupy intermediate ground away from the Adige valley, in areas that are likely to have contained red deer and other animals adapted to more forested conditions.

Occupation at these sites was of a much lower intensity, compared to the main rock shelters, and lithic and faunal material appears in smaller quantities. This is the first report on the animal bones for these sites.

Dos de la Forca

The Dos de la Forca Mesolithic deposits occupy the northern side of a large boulder near the village of Mezzocorona *c.*12Km to the north of Trento (see Plate 11). The boulder is located at an altitude of *c.* 240 metres asl in a tributary valley that flows into the Adige

Plate 11: Dos de la Forca during excavations

Valley. The site was originally discovered in 1883 when deposits on the southern side of the boulder were excavated by D Reich and P Orsi. Their results, published in 1885 mention flint tools and cores. Between 1983 and 1988 the northern side of the boulder was excavated (Bagolini *et al* 1985 and 1991).

The site is well known for a series of four late Neolithic human burials and was also used sporadically during the Roman and later periods. Underlying the late Neolithic deposits are a series of late Mesolithic (Castelnovian) and early Neolithic layers that contained lithic and faunal material. The lithic material has yet to be published, but consists principally of a trapeze assemblage, together with Gaban group pottery in the later part of this sequence (Bagolini pers comm. and Bagolini *et al* 1991).

The excavation records were of limited help in understanding the depositional sequence at Dos de la Forca. The main section drawing indicates that there was a long period of disuse prior to the late Neolithic inhumations. Rock falls, from the boulder itself sealed the earlier Neolithic and Mesolithic deposits with 50-80 cm of limestone material. The burials were cut through this material.

The preceding late Mesolithic and early Neolithic levels show a mixed and undulating series of occupational deposits that appear interspersed with natural rock fall material and silty soils. At the base of the deposit there is evidence for two fire places, both occupying the same area of the shelter. There are no further structural features associated with these deposits. At present there are no radiocarbon dates from this period of occupation.

The fauna comprises material from four levels together with bone found against the rock shelter wall. The principal animals recorded in all levels were red deer and wild boar.

<u>Layer D</u>

Layer D consists of the earliest group of deposits and contains a smaller assemblage than the later levels (see Table 8.17 for animal bone listings).

	LAYER D		LAYERS C4-C			
Bone type:	**Red Deer**	**Wild Boar**	**Red Deer**	**Roe Deer**	**Chamois**	**Wild Boar**
Phalanges	3	1	39	5	-	1
Metapodials	2	-	31	3	4	4
Carpal/Tarsals	-	-	2 / -	-	-	-
Radius/Ulna	1 / -	-	3 / -	-	-	-
Tibia	1	-	11	-	-	1
Calcan/Astrag	1 / 1	-	6 / 2	- / 3	-	-
Humerus	1	-	9	2	-	1
Femur	1	-	15	2	-	-
Scapula	-	-	1	1	-	-
Pelvis	-	-	4	-	-	-
Vert/ribs	-	-	8 / 1	1 / -	1	-
Mandible	-	1	6	1	-	-
Maxilla	1	-	-	-	-	-
Teeth	1	1	7	-	-	-
Antler	-	-	1	-	-	-
Totals:	**13**	**3**	**146**	**18**	**5**	**7**

Table 8.17: Animal bone body part representations from Dos de la Forca Levels D and C4-C

Thirteen red deer bones were recorded. These were highly fragmented and half were extensively gnawed, by a wolf or dog. Two fragments were split open for marrow extraction. Three wild boar bones were also recovered. These comprised of single fragments of phalange and mandible, together with a canine tooth. There were no roe deer or caprid bones recorded. Twenty-five unidentifiable bones were also recorded.

Layers C4 - C contained a total of 188 identifiable and 646 unidentifiable animal bones. Red deer dominate and roe deer, pig and chamois are also recorded. The red deer bones are highly fragmented with evidence for both butchery activity and gnawing/tooth marks.

A total of 146 red deer bones were recorded. Teeth fragments indicate that the assemblage contains both very young and mature animals. Both dismemberment and marrow processing are recorded on the bones; phalange and metapodials were split open for marrow. Metapodials may also have worked into bone tools. An acetabulum and calcaneus fragments showed clear cut/chopmarks associated with dismemberment (TC3 and PS7 respectively in Binford 1981).

Compared to other assemblages such as Pradestel and Romagnano, the Dos de la Forca red deer bones contains more extensive traces of gnawing and teeth marks. These traces are considered to be the result of wolf or dog activity, and could be due to the exposed

	LAYERS C4 - 1	LAYERS B3 -B	LAYERS A
Wild cat	skull x 1	-	x 18 (see text)
Pine marten	humerus, femur, tibia, mandible	-	-
Dog / wolf	Maxilla x2, phalange x3 metapodial, mandible	Metacarpal x3, calcaneus, phalange x2	-
Fox	-	Radius	-
Bird	-	Femur	-
Bear	-	-	M2 tooth
Rodent	-	-	Skull
Total	**12**	**8**	**20**

Table 8.18: Smaller mammal, carnivores and bird bone from Dos de la Forca

nature of the site. Over fifteen of the bones were gnawed. These included practically all the calcaneus and astragali fragments, as well as phalanges and metapodials. It is also significant that phalange processing was not as common as in the other rock shelter sites. This could indicate that such bones, being low in meat value, were fed directly to the dogs, who were accompanying the late Mesolithic hunters. Alternatively, occupation at the site may have been less intensive - perhaps a temporary hunting site used for shorter periods of time. The hunters may not have had time for marrow processing. As a result animals such as wolves or dogs scavenged the remains left at the shelter. This suggests that marrow processing was an activity more likely to be undertaken at residential sites.

Although the roe deer and chamois consists of tiny assemblages, they indicate that both young and mature animals were hunted. Table 8.18 summarises the smaller mammal material recorded from the C and later layers.

Layer B3-B and Layer A

Levels B3 - B represent the final Mesolithic deposits and contain a total of 51 identifiable bones and 195 unidentifiable bone fragments. Red deer are still the main animal together with smaller quantities of roe deer, chamois and wild boar.

Level A contains the first Neolithic activity on the site (see Table 8.19). Sheep/goat are recorded from this level (18), together with Gaban pottery which confirms an early Neolithic date for these deposits (Bagolini pers comm.). Although red deer are still the most common bone (47 bone fragments), there are more pig bones (21) from this layer compared to all the earlier deposits. Eighteen phalange, skull fragments and leg bones are

	LAYERS B3-B				LAYERS A		
Bone type:	**Red Deer**	**Roe Deer**	**Chamois**	**Wild Boar**	**Red Deer**	**Sheep/ Goat**	**Wild Boar /Pig**
Phalanges	9	-	-	1	10	-	-
Metapodials	7	-	1	3	11	3	1
Radius/Ulna	1 / -	-	-	-	2 / 1	1 / -	1 / 1
Tibia	3	-	-	-	1	-	-
Calcan/Astrag	- / 1	-	1 / -	-	- / 1	1 / 2	- / 1
Humerus	1	-	-	-	1	6	-
Femur	3	1	1	-	5	1	-
Scapula	-	1	-	-	3	3	-
Pelvis	-	-	-	-	1	-	-
Vert/ribs	4 / -	-	-	-	1 / 1	-	-
Mandible	1	-	-	-	4	1	12
Maxilla	2	-	-	-	-	-	-
Teeth	1	1	-	-	4	-	5
Antler	-	-	-	-	1	-	-
TOTALS	**33**	**3**	**3**	**4**	**47**	**18**	**21**

Table 8.19: Animal bone body part representations from Dos de la Forca Levels B and A

Bone Type	Number of Fragments
Acetabulum	3
Antler	4
Metacarpal	5
Metatarsal	3
Phalange	17
Tibia	1

Table 8.20: Red deer bones from shelter wall.

DOS DE LA FORCA		**OCCUPATIONAL LAYERS**			
Animal Size	**Bone Fragment Types**	Layer D	Layers C4-C1	Layers B3- B	Layer A
Small mammals	Small long bones:	7	205	53	36
	Small ribs :	-	19	5	17
	Small skull:	-	4	-	3
	Small carpal /tarsal :	1	1	2	-
	Total	8	229	60	56
Medium	Medium long bones:	8	63	11	27
	Medium ribs :	-	-	-	9
Chamois, Ibex	Medium vertebrae :	-	10	2	6
	Medium carpal /tarsal :	-	8	-	-
	Total	8	81	13	42
Larger mammals	Large long bones :	-	24	5	8
	Large ribs :	-	23	6	-
Red deer	Large skull :	2	7	1	1
	Large vertebrae :	1	9	1	2
	Total	3	63	13	11
Indeterminate	Other :	6	273	109	77
Total Number of Unidentifiable Fragments		**25**	**646**	**195**	**186**

Table 8.21: Total number of unidentifiable bone fragments = 1052

Key - Layer D Castelnovian Layers C4-C1 = Late Castelnovian, Layers B3-B = Final Castelnovian, Layers A= Early Neolithic recorded from a wild cat (see Table 8.18). A total of 186 unidentifiable bone fragments were also recovered.

Contexts listed as 'rock shelter wall' and 'step' contained a group of red deer bones. These are listed in Table 8.20.

Paludei di Volano

Paludei di Volano is located near the village of Volano 6km north of Rovereto at an altitude of 180m asl. The site was discovered in the 1970s during quarry activity at the base of a vertical cliff between fluvial fans. Parts of the shelter form cave areas that were used during the late Copper Age for human burial (Bagolini pers comm.). Below Medieval and later prehistoric layers (Layers A), a late Mesolithic (Castelnovian) occupation deposit consisted of a black soil containing large quantities of charcoal indicating the presence of a fireplace (Layers B and C).

The full excavations have yet to be published, but Biagi (1981) has examined the lithic material (see Table 8.22). Biagi considers the flint industry as particularly significant. All the trapezes are of the same type. They have a slightly concave base truncation, which are almost completely retouched, with long, oblique, straight or slightly concave 'piquant trièdre' long truncations. All the microburins are of a size to indicate they had been used to make trapezes. Biagi considers this as a very specialised industry that may have been used to make specialised arrows or harpoons (1981:54). Other aspects of the assemblage correspond to Layers AB2-AB1 and AA at Romagnano and Layers D at Pradestel (see Chapter 7). The nature of the trapeze industry represents the form of evidence for arguing for the introduction of specialised hunting technology as discussed in Chapters 2 and 3. It was proposed that the later Mesolithic saw the introduction of <u>encounter</u>, valley based hunting, and that writers like Myers (1989) suggested a move towards more <u>reliable</u> technology in this period. It is possible that Paludei di Volano provides evidence for such strategies.

Two long bone perforators with oval cross section were also recovered. These are believed to have been formed from red deer metatarsals.

Late Mesolithic (Castelnovian) Assemblage - Tool type:	Number
Burin on snapped blade	1
Long end scrapers	5
Nose end scrapers	3
Oblique truncated blade (piquant trièdre)	6
Oblique truncated blades	2
Marginal truncated blade	1
Concave inverse retouched blade	1
Rectang. Trapezes (piquant trièdre)	11
Retouched blades	12
Notched blades	20
Hypermicrolith backed blade	1
Microburins	26
Cores	55
Total	**144**

Table 8.22: Paludei di Volano - Late Mesolithic Lithic Material

Bone Type:	Red Deer	Roe Deer	Caprid?	Badger	Pine Marten
Phalanges	10	1	1	-	-
Metapodials	1	-	-	1	-
Carpal/Tarsals	-	-	-	-	-
Radius/Ulna	-	1 / -	-	- / 1	-
Tibia	-	-	-	1	-
Astragalus	1	-	-	-	-
Humerus	-	1	-	-	-
Mandible	-	-	-	-	3
Teeth	-	-	-	1	-
Antler	1	-	-	-	-
TOTALS	**13**	**3**	**1**	**4**	**3**

Table 8.23: Animal bone body part representations from Paludei di Volano (Late Mesolithic Levels)

The late Mesolithic animals bones are listed in Table 8.23.

Pre Alta

From the point of view of the overall objectives of this thesis it was considered appropriate to choose a site with the potential for providing a different perspective on hunter-gatherer settlement in the Trentino region. Most excavations of hunter gatherer sites have focused on the Adige valley or on the higher grounds to the north east. A site, known as Pre Alta, was therefore chosen to the south of the main area of investigation (see Figure 6.1). Excavation details, including the lithic and faunal data, together with background details to the excavations, have been published in (Clark *et al* 1992). Pre Alta is located approximately 1km north of Lake Garda, on a terrace on the eastern slopes of the Sarca Valley, at an altitude of *c.*190m above sea level. The River Sarca,

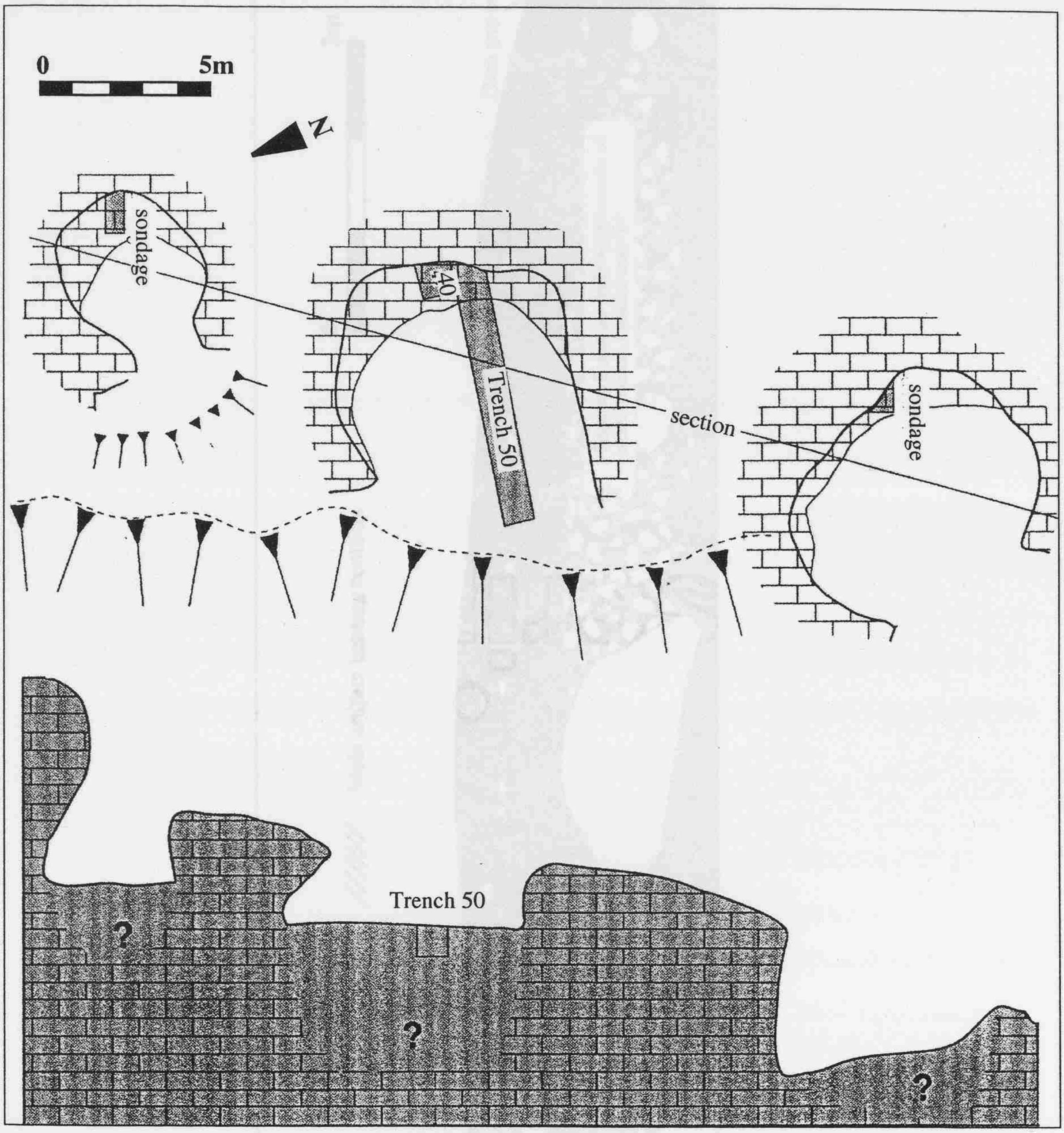

Figure 8.6 Pre Alta
plan and section of three glacial hollows and location
of excavation trenches and sondages

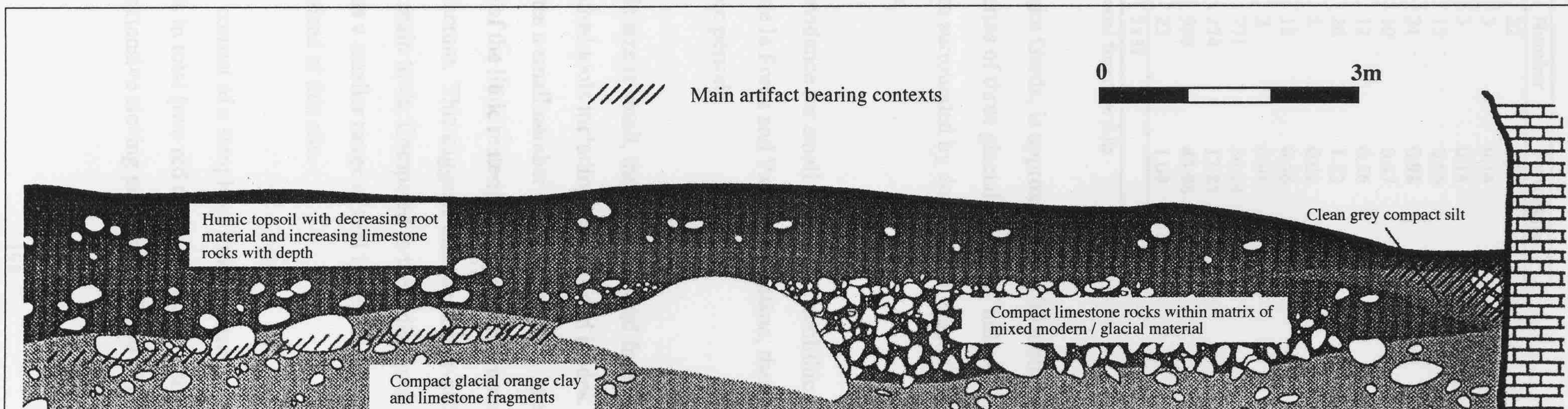

Figure 8.7 Pre Alto section drawing

Lithic type:	Number	Percentage
Trapezes	22	1.03
Microliths	3	0.14
Burins	3	0.14
Scrapers	12	0.56
Truncations	21	0.98
Notches	10	0.47
Other retouched	12	0.56
Microburins	26	1.22
Burin spalls	2	0.01
Cores	12	0.56
Rejuvenation flakes	2	0.01
Flakes	771	36.24
Blades	274	12.85
Chips	938	43.98
Chunks	23	1.08
Total	**2131**	

Table 8.24: Lithic material from Pre Alta

which flows into Lake Garda, is approximately 100 metres down slope from the site. Pre Alta consists of a series of three glacial 'solution' hollows in the limestone bedrock of the valley slopes and are surrounded by dense scrub vegetation. One hollow contained late Mesolithic deposits.

Pre Alta produced evidence for small scale late Mesolithic (Castelnovian) occupation. In common with Dos de la Forca and Paludei di Volano, the shelter was not occupied during the earlier Mesolithic periods.

Although the sample size is small, the lithic material from Pre Alta contains a high proportion of retouched tools including trapezes and blades. The quantity and range of this material indicates a small number of short term task-specific visits to the site. Little primary processing of the lithic material took place and none of the local limestone was used for tool manufacture. This suggests that the hunter-gatherers arrived at the site prepared with their main tools. Compared to the Adige rock shelters, the lithic assemblage contains a smaller range of tool types indicating that a more limited range of activities were practised at this site.

The faunal remains consist of a sample of limited quantity and species range: possibly as few as three animals in total (two red deer and one roe deer). Detailed excavation procedures and an extensive sieving programme failed to locate any small mammal, fish or bird bones.

Bone type:	Red deer	Roe deer
Calcaneum	1	-
Metatarsal	5	1
Metacarpal	-	1
Metapodial	7	1
Tibia	6	2
Radius	2	1
Femur	2	-
Humerus	2	-
Pelvis	1	-
Scapula	1	-
Maxilla	1	-
Mandible	3	-
Teeth	8	-
Total	**39**	**6**

Table 8.25: Animal bone body part representations from Pre Alta

Although the red deer bones are represented by a small sample, the main meat bearing bones such a humerus, femur, scapula and pelvis are all present. Phalanges are, however, entirely absent. This is in contrast to the Adige valley rock shelters which contained a greater range of animal species and phalanges were without exception the most common bones in all phases at each of the sites. Metapodials are, however, present in the assemblage. Although these bones are also often associated with marrow extraction, none of the Pre Alta assemblage were utilised. This indicates that the activity that produced split phalanges or metapodials was not practised at Pre Alta. Together with the limited range of animal species it is clear that the use of the site, or activities practised within the shelter was more limited.

From both the lithic and animal bone evidence, it is likely that the site functioned as a short term camp, perhaps for a small hunting group making an extended visit into the mountains above Lake Garda.

Discussion: Late Mesolithic Valley Based Sites

The three sites discussed above are all located at lower altitudes compared to the mountain sites, and none were occupied in the earlier Mesolithic. These sites therefore represent a time when later Mesolithic subsistence was almost entirely focused in the lower altitudes: high altitude sites had largely been abandoned. Dos de la Forca contains the largest faunal assemblage from this group of sites, however, Paludei di Volano and

Pre Alta share a common feature in that all the sites represent evidence for short term occupation.

Compared to the main rock shelters, these sites have been ignored in terms of interpreting subsistence change through the lithic and faunal material. Biagi (1981) has examined the microlithic trapeze industry at Paludei di Volano, and it is clear that this assemblage was used for specialised hunting. Such material may represent evidence for encounter hunting within increasingly wooded environments, and animals may also have included smaller mammals, as well as red and roe deer and wild boar.

The animals identified at Dos de la Forca include deer and wild boar. As is the case in all later Mesolithic deposits, ibex is not present and reflects the fact that these are lower altitude sites. The Dos de la Forca faunal remains consist of a relatively small assemblage, but is larger than Zambana. Compared to the bigger assemblages from Pradestel and Romagnano III, proportionately there is a greater range of bone types, including scapulae and femora and other prime meat bearing bones. Although it could be argued that this is due to less compaction caused by later activity, this is unlikely due to the extent of later Neolithic, Roman and Medieval occupation. The Mesolithic deposits are at the bottom of the sequence.

Alternatively, the greater range of bone types could reflect different activities being practised compared to main rock shelter sites. Dos de la Forca is located away from the Adige valley, it is likely that the site functioned as a temporary camp, perhaps for summer months. Activities practised within the site may have been more limited or different compared to Riparo Gaban or Pradestel. Animals such as red deer may have been hunted and consumed at the Dos de la Forca, but intensive bone processing appears not to have taken place. Fewer of the phalanges and metapodials had been split open for marrow extraction (a feature common to Paludei di Volano and Pre Alta), and a greater number of bones displayed evidence for gnawing. Bones that were usually processed for marrow at the main rock shelters, were instead given to the dogs, or scavenged by wolves. The hunters did not process the feet bones, possibly because occupation at the site was restricted in terms of the activities carried out. Short term occupation may have precluded activity, such as marrow processing. Marrow extraction or consumption may have been embedded into other forms of subsistence activity that was normally practised at longer term residential sites.

These site assemblages are therefore considered to differ from the main rock shelter assemblages for the following reasons. The smaller assemblages represent shorter periods of late Mesolithic occupation. It is likely that these sites were short term hunting camps, possibly used for overnight camping and field butchering of animals including red deer, roe deer and wild boar. If these sites were occupied in the summer, the need to extract bone marrow for nutritional purposes may not have been so great as in the winter months, when alternative foods sources such as plants, were in less abundance. This may explain why there is less bone processing evident at these sites compared to the main rock shelters.

Rock Shelters and Subsistence Change

General Issues

The main Adige Valley rock shelters cover the entire Mesolithic period and represent some of the longest sequences of occupation recorded in Europe. As spatial information is limited due to the truncated nature of the rock shelter deposits, as well as the methods of excavation recording, these sites represent diachronic rather than synchronic records of past activity. Evidence for specific activities relating to the spatial characteristics of the faunal and lithic material is, in most cases, absent. Although there are some deposits where these are clear signs of a particular form of activity, such as increases in the number of smaller mammal bones (representing more generalised hunting strategies) coinciding with increases in scraper type tools (Pradestel Layers G and F), these are exceptions to a database best suited to studying change through time. As this thesis examines Mesolithic subsistence changes, these deposits are considered valuable data-sets. The long term perspective offered by this study is a virtue that most other European Mesolithic research projects do not share (e.g. Jochim 1976 and 1998, Rowley-Conwy 1983).

The rock shelter information can be contrasted with the Colbricon data, which provides evidence for specific forms of activities, or even possible 'events'. Apart from the fauna from Grotta d'Ernesto, which will be presented in Chapter 9 as an 'occupational event', the animal bone material provides evidence for broad trends in subsistence data. Gamble has recently referred to approaching these various levels of archaeological evidence as 'tacking' between different scales and qualities of data (1996). This is one way of developing a regional perspective of archaeological change, especially when particular classes of data are poor or incomplete.

As we are examining broad changes in subsistence patterns within the rock shelter deposits, each with their own set of depositional and post-depositional processes, it is necessary to consider sampling issues in order to have confidence in the interpretations of the data. These include the effect of sample size on animal species diversity and whether there are any structural relationships between the animal bone and lithic assemblages. Appendix 6 provides a study of sample size issues. It broadly concludes that sample size does not affect animal species or lithic diversity, in any way that could undermine the interpretations outlined in Chapters 7 and 8. This conclusion, together with the discussions in Chapter 7, in which it was demonstrated that the pattern of unidentifiable bone fragments from Pradestel broadly reflects the characteristics of the identifiable material, provides a confident basis from which to interpret subsistence change as seen in the faunal record from the rock shelters.

The Main Characteristics of Rock Shelter Faunal Deposits

There are three characteristics of the faunal material from Pradestel, Romagnano III and Riparo Gaban that are seen as broad trends in the later stages of the Sauveterrian and the Castelnovian later Mesolithic deposits. These consist of :

- an increase in species diversity - more smaller mammals exploited,
- an increase in younger animal bones, particularly of red deer,
- and a general increase in the range of bone types.

Whereas the earlier Mesolithic levels contained predominantly distal feet bones, such as phalanges, metapodials and radii and tibiae, the later deposits have more evidence for bones such as humeri, femora and pelves and scapulae. There are two ways of interpreting this trend. We could dismiss this pattern as entirely taphonomic - the upper deposits are less trampled or eroded and therefore fragments of these upper leg bones are better preserved and more visible to the faunal analyst. The increase in the visibility of younger animal bones could also be considered from this perspective. I do not believe that trampling caused major bone fragmentation in the lower levels. This view is supported by the fact that small mammal bones from the same contexts were not as fragmented. Due to their smaller size and bone density, I would expect these to have been as highly fragmented if trampling and compaction were major contributing factors to the bone assemblages. Indeed, as a faunal analyst, I would have expected to be able to identify small fragments of upper leg bones, if they had been present in the earlier Mesolithic periods in greater quantities.

With regard to the 'trampling effect' on lower deposits as a reason why upper leg bones are not so visible in the early levels of the rock shelters, an interesting counter argument to this case concerns Dos de la Forca. The late Mesolithic (Castelnovian) levels are the earliest deposits at this site, with a long sequence of later material that could have trampled and compacted the Mesolithic material beyond recognition. The later Mesolithic material, including fragments of pelvis, scapula, humerus and femur were all clearly identifiable. If rock shelters such as Romagnano III and Pradestel had contained similar material in their lower levels, it would have been recognised.

The second interpretation is that this patterning represents changes in subsistence strategies that were predicted in Chapter 3. At the end of the early Mesolithic (Sauveterrian) period, the high altitude sites like Colbricon became redundant, and animals such as ibex ceased to be hunted. This relates to the beginning of the Atlantic pollen zone, which saw an increase in both the altitude of the timber-line and in forest density in general. In Chapters 3-5 this period was characterised in terms of a transition from <u>intercept</u> to <u>encounter</u> hunting. Population densities of red deer and ibex are likely to have reduced as a response to more forested conditions (Jochim 1989 and 1998), and large scale hunting, as practised at the high altitude sites will have been replaced by valley based <u>encounter</u> hunting. Such transitions could have resulted in new characteristics to the faunal deposits within these valley based rock shelters. The obvious example is the decline in ibex bones. Ibex bones indicate a strong relationship between the rock shelters and the high altitude territories of this mountain animal. Carcasses (including red deer) were probably field butchered and large /heavy bones such as femora and humeri would have been left at the primary processing sites, such as at Colbricon.

Lower leg bones, because of their value as marrow sources and as raw material for bone tools and sinew, could have been transported to the rock shelters together with the filleted meat (the so-called schlepp effect).

If later Mesolithic red deer hunting was focused more in the immediate vicinity of the rock shelters, and hunters operated from these sites without field butchery sites, it is possible that less primary butchery took place and a wider range of bone elements such as humeri and femora were incorporated into the rock shelter assemblages.

Apart from an increase in upper leg bones, the higher levels of juvenile bones could also be part of the general change to encounter hunting. Intercept hunting would have provided opportunities for age selection in terms of the animals killed or processed. The environmental conditions of later Mesolithic encounter hunting may have made 'selective hunting' more difficult, as animals are likely to have been hunting individually and therefore selective hunting may have been less advantageous. If a hunter chooses to ignore a younger animal, he will not necessarily know what the age or condition of the next animal encountered will be like. Pressures to be less selective may therefore have increased during the later Mesolithic period.

I believe that support for the transition to valley based <u>encounter</u> hunting in the later Mesolithic can also be seen from evidence for the use of new occupational sites that were never used in the earlier Mesolithic. Sites such as Dos de la Forca, Paludei di Volano and Pre Alta all occupy the lower altitudes and date only to the later Mesolithic period. These can be interpreted as short term base camps, perhaps used in the summer months. Although the sample size is smaller, the animal bones from Dos de la Forca share the same late Mesolithic characteristics as the larger rock shelters, in that upper leg bones are a common element of the faunal assemblages.

Rock Shelter Lithics

Although the data from the main rock shelters cannot provide the same level of behavioural information as that from the early Mesolithic areas at Colbricon, these sites do have the advantage of showing transitions into the later Mesolithic period. Trapezes form an important element of the microlithic industry, and may relate to new aspects of maintainable or reliable technology introduced to minimise the risk of failure in more forested, valley based hunting (Torrence 1989, Myers 1989). These new weapons may have continued to function if damaged through deflection from trees. In addition, trapezes may have provided more 'cutting edges' to projectiles, thus creating more muscle damage or bleeding. It is argued here that this may have been important when tracking wounded animals through woodland.

A shift towards encounter hunting equipment in the later Mesolithic can be seen in the trapeze industry at Paludei di Volano. Biagi (1981) considers these projectiles to represent specialised projectiles - perhaps for hunting smaller mammals, or killing red deer in more difficult forested conditions.

None of the lithic assemblages from the rock shelters have been examined in terms of provenancing the source of the raw materials as with sites like Colbricon. The Chapter 4 and 5 studies could be enhanced by examining if there are changes in the provisioning of raw materials from the early and later Mesolithic periods. If, as it is argued, the territories in the earlier Mesolithic were larger to accommodate ibex hunting, it is possible that high quality raw materials were imported to the Adige valley, as occurred at Colbricon. With a reduction in hunting territories in the later Mesolithic, it is possible that raw material procurement may have altered. If subsistence, as seen in the faunal record, was more valley based, it is possible that more local flint sources, such as those reputed to be located to the south of Trento were exploited. Geochemical analysis of the kind undertaken by Benedetti (1994) could answer questions relating to any changes in lithic procurement. If localised sources of flint were exploited the general provisioning of places, such as at Colbricon, could have been replaced by more opportunistic provisioning of people.

Summary

The rock shelters are considered important sites with regard to interpreting broad changes in subsistence strategies. The decline of ibex in the later periods coincides with the abandonment of the high altitude sites such as Colbricon. It is also argued that the increased use of new site types (with evidence of specialised hunting tools), in the later Mesolithic, together with a greater range of animal bone types in the rock shelters, is good evidence for changes in subsistence to a more valley based settlement system.

It was noted at the beginning of this section that the rock shelter sites only offer a broad characterisation of Mesolithic subsistence. This is due to the lack of spatial data, or specific 'events' in these deposits. Before this study is concluded, the following chapter will provide some evidence for clear 'events' or activities that have been recorded in the Mesolithic of the Trentino. It will show, however, that even with clear evidence for hunter-gatherer activity, there are interpretation problems that make isolating human activity as difficult as understanding the rock shelter histories.

CHAPTER 9

ISOLATING THE EVENT: MESOLITHIC CAVE DEPOSITS AT GROTTA D'ERNESTO

Introduction

The previous chapters presented the faunal and to a lesser extent, the lithic material from a series of rock shelters in the Adige valley. These sites are important for a number of reasons. Due to the depths of deposits, they provide information on trends or processes over a long period of time, and are the only sites where lithic and faunal material survive together in significant quantities. Although the faunal remains from the rock shelters indicate the range of animals hunted and how these changed through time (e.g. ibex were not hunted in the later Mesolithic period), there is, however, little information on specific events or activities. We can only create a generalised picture of the activities that were practised at these sites, even though specific events clearly took place. An example is the human burial recorded at Vatte di Zambana.

Grotta d'Ernesto

Apart from a small lithic assemblage that dates to the early Mesolithic (Sauveterrian) period, Grotta d'Ernesto has a well preserved faunal assemblage that contains significant taphonomic information (Clark 1989, Awsiuk *et al* 1994, Cavallo *et al* 1994, Dalmeri 1985 and 1994 and Riedel 1994). Much of the material was found on the cave palaeosurface, close to a fireplace (see Plates 12-15). Further quantities of bone and lithic material are buried in the cave floor in hardened calcareous deposits.

The cave has clear evidence for a variety of different agents that contributed to the formation of archaeological deposits. Previous interpretations of Grotta d'Ernesto have focused on the role of carnivores in accumulating the bone assemblages (Cavallo *et al* 1994). It is important to review the significance of human activity, as dismissing the role of the hunter-gatherer denies the opportunity of placing Grotta d'Ernesto into its early Mesolithic context. Due to the lack of fragmentation

Plate 12 Grotta d'Ernesto - The fireplace

the bones also provide more information on the sex and age range of the animals hunted than the rock shelters. The evidence from Grotta d'Ernesto can therefore add further to this regional analysis of subsistence change.

Grotta d'Ernesto was discovered in 1983 when a new road was constructed. The cave is located near the village of Grigno in the upper Valsugana valley. The Valsugana is a major valley system that follows a broad east-west direction from Trento that links the Adige Valley at Trento with the eastern parts of the Veneto. It is also likely that this valley was an important route for both animals and hunter-gatherers, who would have moved seasonally (in the summer months) from the less exposed foothills of the sub-Alpine Veneto area and the Po plain into the higher altitude mountains of the Lagori Chain, to the north of the Valsugana (and the area near Grotta d'Ernesto). This area contains a significant number of late Epigravettian and early Mesolithic (Sauveterrian) high altitude hunting sites (Chapter 5).

The Cave System

The entrance to the cave opens at a height of 1130m asl on the western slope of the Monte Asiage in the Val d'Antenne. The caves occupies a position 100m up a forested slope on a plateau covered with Alpine grassland.

Due to tectonic movement and rock falls, creating debris near the cave opening, the full size of the original entrance is unknown, but it is likely that it received a limited amount of natural light. The cave system is approximately 60 metres in length. From the cave entrance the floor gradually slopes down by 15m until it reaches the first 'gallery'. The cave has two galleries that open out to a height of *c.*3-4 metres and about 5 metres in width. Within these areas there is a minimal amount of head room. In the first and largest gallery, known as The Hall of the Fireplace ('Sala della Focolare'), were found the remains of a fireplace associated with quantities of animal bone and lithic material. This gallery is about 15 metres long. The floor of the gallery was relatively flat and ideal for a temporary camp. The northern side of the gallery had a raised ledge which also contained limited quantities of bone material.

The second and innermost gallery was located at a lower level that looped around so that it was almost parallel with the rest of the cave system (see Figures 9.1) and is known as The Torch Hall ('Camera della Torcia'). In this area were found the remains of a brown bear together with a thick deposit of charcoal (Clark 1989 and Awsiuk *et al* 1994). The bear is likely to have died in hibernation. Access to the inner area would have been limited and there was little evidence to suggest that it was intensively occupied by human groups. The inner depths of the cave were impossible to explore due to the narrow system, but it is clear that solifluxion deposits (including the charcoal material with flowstone material sealing it) were washed through into this part of the cave system. Collagen from the bear skeleton is dated to 11900±200bp and is therefore significantly older than the Mesolithic deposits (Awsiuk *et al* 1994).

According to the lithic material and radiocarbon dates, Grotta d'Ernesto was occupied in the early Mesolithic (Sauveterrian) period. The radiocarbon dates indicate several phases of human occupation, with the latest activity relating to two dates: 8140±80bp (Gd-5481) from charcoal in the Hall of the Fireplace and 8520±190bp (Gd-4510) from collagen from the same area of the cave. A second date from charcoal material of 9110±70bp indicates earlier human occupation. The 9th millennium BP dates equate to the later Sauveterrian rock shelter deposits of Layers AC2 and AB3 at Romagnano III and Layers H-H2 at Pradestel in which red deer and ibex were the main animals hunted. The 10th millennium BP date compares with Layer AC7 at Romagnano III and Layers L7-8 at Pradestel corresponds with the earliest levels of occupation at these sites.

Charcoal from The Torch Hall dating from 9300±110bp (Gd-6132) and 8270±90bp (Gd-5492) is indicative of material washing from the Hall of the Fireplace into The Torch Hall. Further radiocarbon dates of speleotherms from flowstone material covering the charcoal from The Torch Hall area provide confusing additional dating evidence that is likely to relate to post depositional processes. A full listing of radiocarbon dates is given in Appendix 2 (see Awsiuk *et al* 1994).

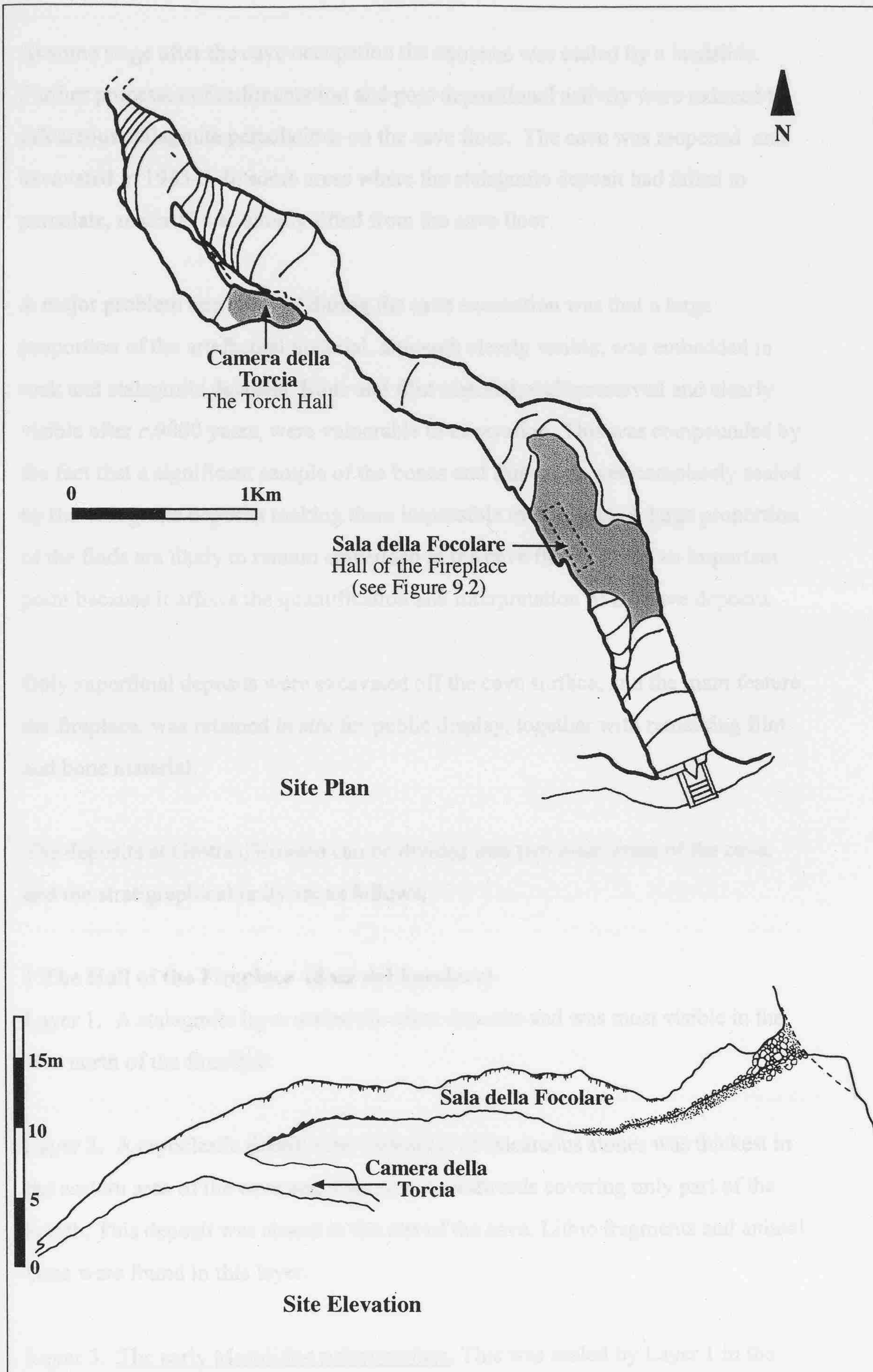

Figure 9.1 Grotta d'Ernesto
site plan and elevation

At some stage after the cave occupation the entrance was sealed by a landslide. Further processes of sedimentation and post-depositional activity were reduced to calcareous stalagmite percolations on the cave floor. The cave was reopened and excavated in 1983-5. In some areas where the stalagmite deposit had failed to percolate, material was simply lifted from the cave floor.

A major problem encountered during the cave excavation was that a large proportion of the artefactual material, although clearly visible, was embedded in rock and stalagmite deposits. Bone and flint material, well preserved and clearly visible after *c.*9000 years, were vulnerable to excavation. This was compounded by the fact that a significant sample of the bones and flint work was completely sealed by the stalagmite deposits making them impossible to excavate. A large proportion of the finds are likely to remain embedded in the cave floor. This is an important point because it affects the quantification and interpretation of the cave deposits.

Only superficial deposits were excavated off the cave surface, and the main feature, the fireplace, was retained *in situ* for public display, together with remaining flint and bone material.

The deposits at Grotta d'Ernesto can be divided into two main areas of the cave, and the stratigraphical units are as follows:

1 The Hall of the Fireplace (Sala del Focolare)

Layer 1. A stalagmite layer sealed the other deposits and was most visible in the area north of the fireplace.

Layer 2. A cryoclastic debris cone formation of calcareous stones was thickest in the eastern area of the cave and thinned out westwards covering only part of the hearth. This deposit was absent in the rest of the cave. Lithic fragments and animal bone were found in this layer.

Layer 3. <u>The early Mesolithic palaeosurface</u>. This was sealed by Layer 1 in the north and north-west area and by Layer 2 in the remaining areas. It was a few centimetres deep in the north area and increased to 15 centimetres in the south of the cave, excluding the hearth area. The animal bones collected from this surface were precisely gridded and numbered.

Layer 3A. This debris material was associated with the sealing up of the cave (and some possible later activity). The material had naturally subsided just inside the left wall of the cave entrance.

Layer 4. The fireplace. Much of the material excavated from this area was combined with Layer 3.

Layer 5. A sandy layer with altered calcareous clastic fragments below Layer 3.

Layer 6. A formation with calcareous blocks below Layer 5.

2 The Torch Hall (Sala della Torcia)

Layer 7. A loess deposit with calcareous stones in the inner cavity. Brown bear bones were found within this deposit.

The lithic Material

The lithic assemblage is very small and consisted of fifteen tools, primarily microlithic armatures and found in close proximity to the hearth in the Hall of the Fireplace.

The tools consisted of 12 trapezoidal segments, truncated backed bladelets, segments and triangles. In addition two retouched flakes and a core were recovered. The lithic material is typologically of the early Mesolithic (Sauveterrian) period, with some elements characteristic of the Final Epigravettian period (Dalmeri 1994). The quantity of material and its composition indicates short term activity, with no evidence for intensive butchery or lithic production / maintenance activity.

Plate 13 Grotta d'Ernesto - animal bones within fireplace area

Plate 14 Grotta d'Ernesto - ibex mandible

Plate 15 Grotta d'Ernesto - animal bones

The Fauna

The writer was given the opportunity to examine the Grotta d'Ernesto animal bones in 1986 and preliminary observations were presented (Clark 1989). In 1988 the writer discussed his findings with A Riedel, who was to study the assemblage for the excavation report (Riedel 1994). It was suggested that the bone surfaces were so well preserved that marks caused by butchery, carnivore activity and possibly trampling, were clearly visible and warranted microscopic analysis. In some instances it was thought possible to see butchery marks 'stratified' below animal gnawing marks. As a result, a team from Turin University undertook SEM analysis of a sample of the bone and provided an interpretation of the taphonomic history of the assemblage (Cavallo *et al* 1994). The Grotta d'Ernesto bones have undergone three separate studies. My examination of the butchery and relative bones present in the assemblage (Clark 1989 and this chapter); secondly, Riedel's report provides useful information relating to modern comparative skeletons (Riedel 1994). Riedel's report was then commented on by this writer (as a member of the Comitato di Lettura of *Preistoria Alpina*) for the main excavation report published in 1994. Finally, to date, the work by Cavallo *et al* (1994) presented scanning electron microscope (SEM) results and discussion of the relative formation of the assemblage from both human and animal activities.

The following section will present the results of my faunal analysis. Additional observations by Riedel will also be noted. Riedel compared bone measurements from Grotta d'Ernesto with both modern animals and also bones from other archaeological sites (1994 and pers comm.). This provides important comparative material with regard to the size of the early Holocene animals. The results of the SEM analysis will also be discussed in terms of arguing for a complex site formation history.

A total of 513 animal bones identifiable to species or bone types were recorded from the two cave galleries (see Table 9.1). Most bones were recorded within the Hall of the Fireplace (Layers 3 and 4) and concentrated between the fireplace and the south-west

Bone type:	Ibex	Red Deer	Brown Bear	Caprids	Wolf
Phalanges	27	7	7	3	-
Metapodials	7	4	2	1	-
Carpal/Tarsals	1/	-	-	-	-
Radius/Ulna	1/1	4/4	1/1	-	-
Tibia	4	3	1	1	-
Calcan/Astrag	2/3	1/1	1/1	-	-
Humerus	5	3	1	-	-
Femur	7	3	2	-	-
Patella	-	-	-	-	-
Scapula	9	9	1	-	-
Pelvis frags	1	-	1	-	-
Acetabulum	3	1	-	-	-
Vertebrae	31	27	3		-
Ribs	*	*	22	-	-
Skull frags	3	1	1	1	-
Mandible	9	11	3	-	-
Maxilla	6	2	-	-	1
Teeth	1	-	-	5	1
Antler / Horn	5	-	-	-	-
Totals	**126**	**81**	**48**	**11**	**2**

Table 9.1: Animal bone types from Grotto d'Ernesto
(* 245 ibex / red deer ribs = total of 513 bones)

wall of the chamber. These consisted of ibex and red deer and were well preserved and information on the size, sex and age of the animals was visible.

Parts of a brown bear skeleton were recovered. Wolf and sheep/goat bones were also recorded. It is likely that these bones were the result of later activity and indicates that the cave entrance was not fully sealed by the landslide.

Figure 9.2 shows the distribution of the bones in relation to the typography of the main gallery with the fireplace. Ibex bones were the most numerous and were distributed around the main gallery, particularly near the hearth and the south-western wall of the cave. Ibex were less represented near the eastern wall and the northern area of the gallery. While there were fewer red deer bones, their distribution was more general and many were grouped closer to the entrance of the cave and in the eastern side of the Hall of the Fireplace.

The brown bear bones were concentrated in the The Torch Hall, although a few teeth were also found near the entrance to the cave.

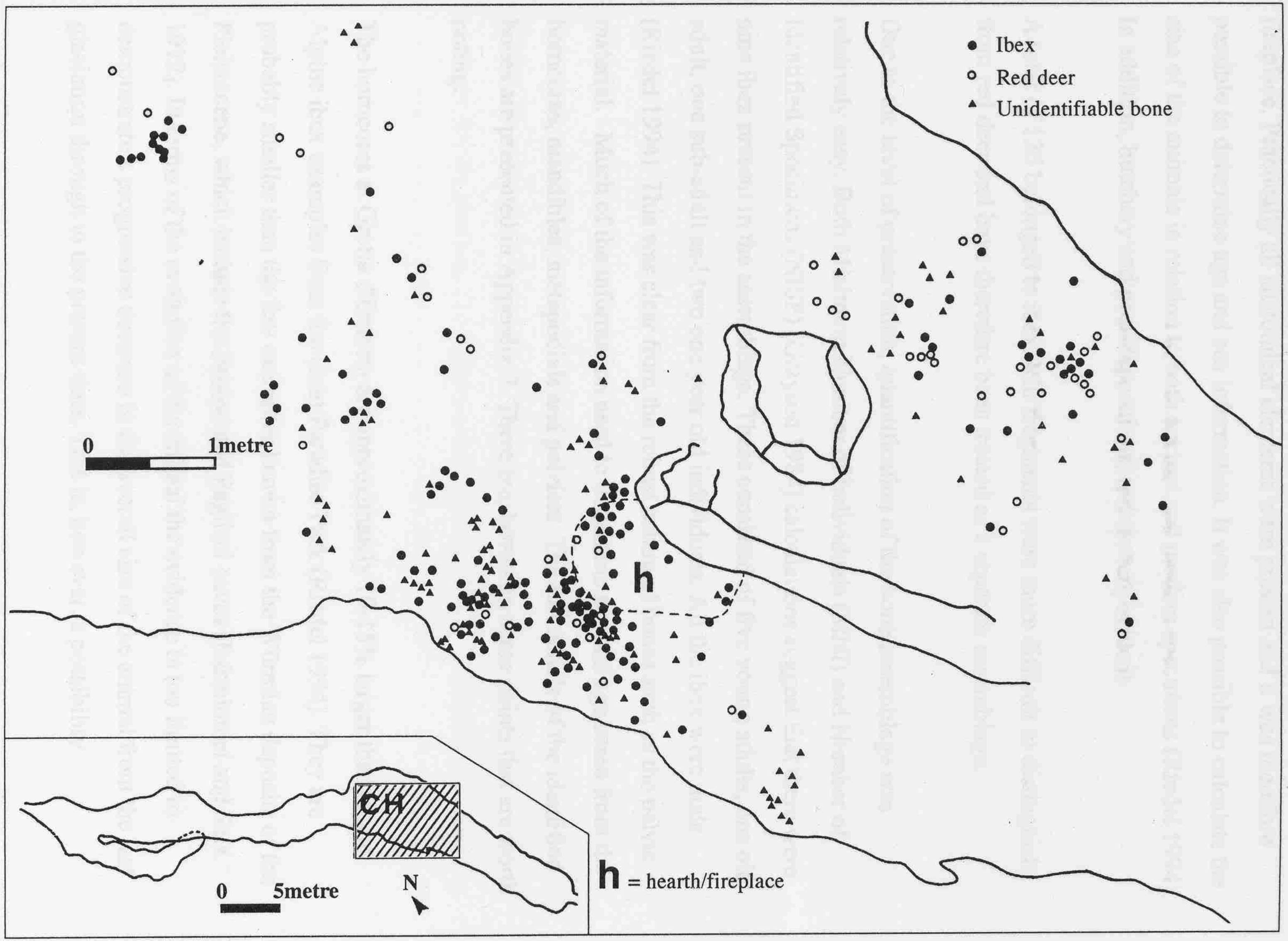

Figure 9.2 Hall of the Fireplace - distribution plot of animal bone material

Ibex (*Capra ibex*)

Ibex was the most common animal bone recorded and most came from near the fireplace. Practically all anatomical elements were present and it was therefore possible to determine age and sex information. It was also possible to calculate the size of the animals in relation to both ancient and modern specimens (Riedel 1994). In addition, butchery and post-depositional traces were evident.

A total of 126 belonged to ibex. Rib fragments were more difficult to distinguish from red deer and have therefore been treated as a separate assemblage.

Due to the level of preservation, quantification of the bone assemblage was relatively easy. Both Minimum Number of Individuals (MNI) and Number of Identified Specimens (NISP) (Grayson 1984) calculations suggest that there were nine ibex present in the assemblage. These consisted of five young adults, one old adult, one sub-adult and two one year old individuals. All the ibex were male (Riedel 1994). This was clear from the robust nature of bones such as the pelvic material. Much of the information used to determine sex and age came from the horncores, mandibles, metapodials and pelvises. The full details of the identified bones are presented in Appendix 7. There are, however, some points that are worth noting.

The horncores at Grotta d'Ernesto are approximately 10-15% larger than recent Alpine ibex examples from the Gran Paradiso Park (Riedel 1994). They are probably smaller than the few examples known from the Würmian deposits of the Pleistocene, which include the Broion and Paglicci caves (Bartolomei and Sala 1972). In terms of the evolution of the animal the evidence is too limited to demonstrate a progressive decrease in the overall size of the animal from the last glaciation through to the present time. This is, however, a possibility.

The age structure indicates that the ibex, apart from one juvenile, are all sub-adult or young adult and physically at their prime with good quality meat. Apart from Mesolithic hunters armed with arrows, it is difficult to see brown bears (or wolves), cited as the predator at Grotta d'Ernesto (Cavallo *et al* 1994), being capable of capturing such agile animals, then taking them to a cave and then depositing the animals primarily within a fireplace area.

Red deer (*Cervus elaphus*)

Excluding rib bones, 81 bone fragments were attributed to red deer. In common with ibex, practically the whole anatomical range of bones were present. There were a relatively high number of mandible fragments compared to long bones and estimation of the MNI is based on these jaw bones. This indicates a minimum of six animals. In addition, the age structure of the red deer can best be calculated through the combined analysis of the fusion of the long bones and dentition in the mandibles. The results suggest that the red deer were all relatively young adults of a similar age to the ibex found in the cave. This is based on the fusion data from the humeri and femora in combination with the knowledge that full dentition is completed at *c.*28 months (Habermehl 1985). Most of the vertebrae were fused and indicate that the animals were about 3 years old (Habermehl 1985).

The sex of the red deer was more difficult to ascertain. One pelvis belonged to a male and a skull without pedicels was identified as belonging to a female (Riedel 1994). The young adult range makes other bones very difficult to ascribe to either male or female animals. For instance, one maxilla canine could belong to a young adult male, but equally belong to an older female.

The size range of the red deer can be compared to animals from other archaeological deposits in the region, as well as in Europe (Riedel 1994). Riedel has compared the metapodials from Grotta d'Ernesto with other red deer (Riedel in press). The wither heights for Grotta d'Ernesto are *c.*112 and 113cm, and the Bronze Age red deer at Ledro are 111.9cm. These are very similar is size. Wither heights from the later Neolithic deposits further north, in Switzerland and southern Germany (Polling) and in the Bronze Age in the Po plain (Barche), are between 118.5 and 119cm. It is thought that during the Neolithic, the red deer increased in size and that during the last glacial and the immediate post-glacial period, the animal size was smaller because of restrictions caused by climate and mountainous environments (Sala pers comm.). One problem with addressing the question of size at Grotta d'Ernesto is that we cannot be sure of the sexual dimorphism of the animals and therefore any firm conclusions would be misleading.

The age determinations, particularly as they are similar to those of the ibex, are used to support an interpretation that hunting strategies based on killing the most optimum animals in terms of nutritional quality were practised, without endangering the population structure through killing off productive elements of the herd. Such sustainable strategies could well have taken place during the early Mesolithic in the form of intercept hunting (Chapter 5).

Ibex and Red Deer Rib Bones

A total of 245 ibex and red deer rib fragments were recorded. Owing to the difficulties of distinguishing ibex from red deer ribs, Riedel (1994) only briefly describes these bones. The Cavallo *et al* (1994) report believes that no rib bones were found (145 and Figure 3B 1994). Ribs cannot be ignored as they represent an important skeletal element in terms of meat sources. Binford's Modified General Utility Index (MGUI) classes rib as one of the principal meat sources from sheep and caribou (1978a and 1981). There are a lower proportion of ribs in relation to other bones, and it is possible that some were exported from the site.

During the animal bone identification work in Trento, there seemed little reason to spend valuable time attempting to identify animal species from the ribs, particularly as it is already clear what was the minimum number for each animal. It was considered possible that these bones could provide additional detail concerning the taphonomic history of the assemblage. A full listing of these rib bones is presented in Appendix 7.

My study divided the ribs into three categories. The first consisted of a group that could be measured and which were not too fragmented (178). For these I measured their length and width and any further details such as butchery marks. The other groups consisted of small rib fragments due to trampling or other taphonomic processes (including post-excavation fragmentation). These ribs were broadly divided into small (25) and large (42) sized bones. One rib fragment showed evidence of chopmarks in the form of five splinters of bone removed from the edges of the rib, perhaps the result removing meat from the bone. Some proximal ends contained evidence that they had been chopped through to separate them from vertebrae bones. Analysis of the vertebrae bones confirms that this butchery process occurred (e.g. Red Deer bone 16- see Appendix 7).

A further 22 brown bear rib bones were recovered from The Torch Hall.

None of the ribs showed evidence of carnivore gnawing. It is surprising that the evidence from the rib bones was not studied by the other analysts. If carnivores were the primary factor in accumulating the Grotta d'Ernesto bones major damage to these bones would be expected.

Brown bear (*Ursus arctos*)

A brown bear skeleton was found in The Torch Hall. This was located in the deepest recess of the cave system, and away from the fireplace and main concentration of ibex and red deer bones. Two lower canines were also found in the debris area at the entrance to the cave. These belonged to an animal less than 19 months old (Riedel 1994). It is very likely that the bear entered the cave for hibernation and died. According to the excavator the skull was found in a niche cavity (Dalmeri pers. comm.). There has therefore been some speculation that the skull was 'a ritual deposit' (Lanzinger pers comm.). Although it is unlikely that human factors caused the death, a small hole in the skull has been attributed to human activity (Riedel 1994).

The mandible and teeth indicate a young adult female. Fusion information from the long bones suggests an age of between 3 and 5 years. Compared to Bronze Age brown bears from Ledro (Riedel 1994) and Stenico (Clark forthcoming), the Grotta d'Ernesto specimen is larger.

Most of the skeleton of the bear was embedded in the stalagmite deposits, but it is clear that a full range of anatomical elements were present. A total of 26 brown bear bones (excluding the 22 rib bones) were studied. The skeleton was not found in an articulated state and it is probable that a range of post-depositional processes 'disarticulated' the bones within the cave. The bear bones were found in three groups: the skull and a scapula together, the mandible with an ulna, tibia, femur and ribs and another group containing the rest of the skeleton. These groups can be explained by a gradual slope in the ground surface of the cave together with percolations of water moving loose sandy material and bone. The head and scapula remained in the higher part of the slope, while the heavier, more dense long bones only moved slightly. The less dense bones moved further down slope. Additional bone modifications are also evident. These include carnivore gnawing (probably wolves) and possibly some human activity.

Other Animals

A small number of additional bones were also recorded. These were all found near the main gallery of the cave and represent the remains of a young wolf, and possibly those of sheep and other caprids. The wolf bones consisted of a deciduous upper tooth and a maxilla.

Eleven fragments of sheep/goat were also recorded (although it is possible that some belong to chamois). These consisted of one sheep skull, a first phalange and a possible second phalange. Four sheep/goat teeth and a metatarsal were also recorded. Other caprid bones are more difficult to determine as they belong to young animals and consist of one tibia, a second phalange and a premolar tooth. It is certain that these bones are of more recent date, and date to a period when the cave entrance was not completely sealed. It is possible that a carnivore brought the caprid bones into the cave. It is clear that only limited activity associated with these animals (and also rodents) occurred once the cave had been sealed.

Isolating the Events: Butchery Evidence and Post-Depositional Processes

Due to the level of preservation, the animal bones at Grotta d'Ernesto have provided important information regarding the depositional and post-depositional processes that contribute to the character of the faunal assemblage as outlined above.

During the past 15 years there have been a number of a important studies of faunal remains showing how complicated post-depositional processes are, particularly when they operate simultaneously (Gifford 1981, Binford 1981 and Brain 1981). Many of these processes are natural, such as the working and re-working of deposits by water activity and soil chemicals. We have already noted how this may have affected the distribution of brown bear bones in the cave. Other processes are caused by carnivores, which might accumulate animal bone in lairs in a way that resembles archaeological deposits (e.g. Bunn 1983). The faunal assemblage at Grotta d'Ernesto clearly underwent a series of depositional and post-depositional process. The challenge is to determine this history, to decide how the bones were originally deposited in the cave, and then to follow the subsequent taphonomic processes and events that formed the overall character of an assemblage discovered after *c.*9000 years of burial.

By isolating the carnivore and post-depositional processes, we can begin to understand the bones in terms of hunter-gatherer subsistence. This is a particularly worthwhile exercise because the material from Grotta d'Ernesto is less fragmented, and contains more information than the rock shelter material.

Hunter-Gatherers or Carnivores

A sample of the Grotta d'Ernesto bones underwent SEM analysis. The aim was to determine whether the bone assemblage was the result of Mesolithic hunting or carnivore accumulation and the researchers have interpreted the assemblage as being primarily the result of carnivore activity (Cavallo *et al* 1994). It is argued here that the SEM results are far from conclusive, and that the assemblage was the result of human hunting, with later scavenging (by brown bear or wolf). It is accepted that natural processes or disturbances clearly contributed to the formation of the faunal assemblage.

In order to put their taphonomic study into a wider context, Cavallo *et al* (1994) compared the results with Bunn's work on hyena den accumulations of bone material (1983). The hyena den assemblages cited consisted of almost complete skulls, mandibles and unbroken long bones, together with a low number of ribs. However, Brain's extensive work on hyena dens noted in detail the remarkable "ability to crack bones with their teeth" (1981:69). This creates large numbers of bone splinters and heavily gnawed proximal and distal ends of long bones. This appears to contradict the Bunn (1983) analogy used by Cavallo *et al* (1994). Complete skulls as found at Grotta d'Ernesto are, however, found in hyena assemblages. If anything the bones at Grotta d'Ernesto compare more favourably with cheetah kills (an animal unknown in Europe).

Although little work has been carried out on brown bear denning behaviour, it is likely to be very different from that of the hyena, especially as brown bear is an omnivore. Brown bear are likely to damage bone to a lesser extent than hyenas. Two aspects of the Grotto d'Ernesto assemblage that make it different from hyena (or most other carnivores) denning is that both ribs and vertebrae are present in the assemblage: these would have been largely destroyed by gnawing. Secondly, there is little gnawing of the long bone epiphyses and no remnant bone cylinders. These factors suggest that carnivore activity was not as great as argued by Cavallo *et al* (1994). It is also dangerous to assume that the survival of complete skulls and long bones contrast with human modified assemblages. Bone fragmentation at rock shelter sites is largely due to intensive processing activities such as marrow extraction, which would not necessarily have occurred at short-term camps, such as Grotta d'Ernesto. This has been demonstrated from late Mesolithic sites such as Dos de la Forca (Chapter 8). It is also possible that bones such as phalanges and metapodials, which are under-represented in the overall assemblage, were taken from the site, together with filleted meat to more permanent Mesolithic sites, where they were then processed for marrow.

Arguing that carnivores were the prime suspects in accumulating the animal bone assemblage does not explain why most of the bones were found in close proximity to the fireplace, and how at least nine ibex and six red deer, most of which were male and all young adults in their prime, were first brought to the site. Riedel's (1994) speculation that the animals entered the cave and died of illness, or were trapped due to rock falls is highly improbable, particularly as the rockfalls would have stopped carnivores entering the cave to consume the animals.

A simple model for understanding this faunal assemblage that fits the general hunter-gatherer subsistence framework of this study, would be to see the cave as a temporary shelter. Parts of the animals were consumed on site, while the main meat bearing bones (including long bone and ribs) were butchered into 'packages', to be taken to more permanent settlement areas, such as valley based rock shelters. The low numbers of phalanges and metapodials may mean that these bones were taken as well. Grotta d'Ernesto occupies a significant location in the Valsugana valley which links the Trentino with the eastern Veneto hills. The valley contains Alpine pastures suitable as hunting grounds, and similar to the Lagori Chain area which has many examples of sites associated with the hunting of ibex and red deer. A cave such as Grotta d'Ernesto is therefore in a likely area for short-term camping during the expeditions from hunting territories to base camps or residential sites.

If occupation in the cave was kept to a minimum, and only specific meat processing tasks were undertaken (dismemberment and creating packages of meat to be taken to more permanent base camps), marrow extraction, or any other processing involving breaking the bones open, might not have been practised. The result would be a relatively 'undisturbed' bone assemblage. Cracking of bones for marrow has often been considered as an activity relating to the availability of time. There may have been more time available at residential sites, such as rock shelters, so that feet bones were transported to these sites and systematically processed for marrow. Marrow processing may also be related to boredom, when waiting at kill sites for the arrival of the animals. Such behaviour is referred to as an 'embedded activity', as in Binford's Mask Site model (Binford 1978b and 1983).

SEM examination of the bone assemblage indicates a number of visible types of 'modifications'. Apart from butchery traces and carnivore activity, there is evidence for rodent gnawing of long bone fragments. Abrasion, probably caused sedimentary processes, or possible trampling, resulted in exfoliation of the bone surfaces were also identified. Trampling was not a major contributor to the taphonomic history of the assemblage because so few bones were broken. Instead, it is suggested that wolves or bears, possibly scavenging the ibex and red deer remains (as well as hibernating) caused some trampling, while sedimentation and rock movement would also have contributed to surface abrasion. SEM analysis suggests that abrasion marks were made on bone when some were relatively fresh, while others had already lost their organic content (Cavallo *et al* 1994).

In one example, it is difficult to see how an ibex thoracic vertebrae with a 'cut mark' on its dorsal spine, could have survived as a complete bone, if it had been trampled to the extent of leaving a mark 1cm long. Cavallo *et al* (1994) regard this as a trample mark mimicking a cut mark because it has a fragment of coarse grain stone (quartz/limestone ?) within the mark. This grain could have become incorporated into the bone at a later date. It is suggested here that it is a cut mark of the type used to strip back the muscle from the tenderloin (e.g. TV2 in Binford 1981: 110-113). Such marks are commonly observed in hunter-gatherer bone assemblages. Binford indicates that such marks are known from Combe Grenal and the American Plains (Binford 1981:111-112) as well as from Klasies River Mouth (Binford 1984: 113-115). Such marks are typical of field butchery where the animal is dismembered ready for transport back to a residential site. Comparable cut marks on the surface of the ribs, also part of the process of removing the tenderloin, are visible on some of the Grotta d'Ernesto ribs.

Clearly the nature of the activities carried out in the cave would determine the effect on the bone material. If occupation was extended it is likely that the bone would have been more fragmented. This would be due to trampling across the occupation area and perhaps more intensive processing of the bone, for example, from marrow extraction or tool making. At Grotta d'Ernesto very few bones were fragmented and this demonstrates that the cave was not inhabited over long periods of time.

With regard to the relative significance of butchery and carnivore activity, one criteria used by Cavallo *et al* (1994) is that only 2% on the bones sampled showed signs of cut marks, while 14% showed traces of carnivore activity. Such percentage counting is misleading. It is impossible to compare one mechanical activity, the strength of carnivore teeth with another; the refined use of tools. Tools are used to reduce physical exertion. A skilfully used tool, such as a flint blade or knife, would not necessarily leave a mark on the bone. This is particularly true if the tool was used to dismember the animal and the meat was then eaten on the bone or removed entirely from the cave to a secondary location. It is significant to note that from the waterlogged Bronze Age settlement site of Fiavé, there was evidence for meat processing, particularly the use of heavy chopping tools, but less than 16% of bones showed clear butchery marks (Clark 1985). These bones were in excellent condition and the minutest of marks were visible. A settlement site such as Fiavé would have also contained a greater range of domestic and butchery processes associated with meat processing than a site such as Grotta d'Ernesto.

Some evidence for carnivore activity is clearly apparent. The mandibular angle of two red deer mandibles are severely gnawed with ragged edges. Other traces of carnivore activity are typical: the removal of one trochanter of a femur, tooth marks on scapula and pelvic bones and the chewing of an ulna olecranon and other long bone epiphyses. Such evidence clearly demonstrates carnivore activity, but it does not explain the full history of the cave fauna. Carnivore traces could equally relate to scavenging of the bones <u>after</u> field butchery. The fact that few butchery marks are visible is compounded by the fact that carnivore scavenging could have masked significant butchery evidence. For example, butchery traces associated with bone disarticulation tends to occur at proximal and distal epiphyses - the same areas of the bone that are subjected to carnivore gnawing. It is also significant that the brown bear, thought to have entered the cave to hibernate and which subsequently died, had also suffered from gnawing. This is argued as further evidence that carnivore activity was secondary to the primary events at Grotta d'Ernesto.

One further point, that in my opinion argues against carnivores being the main agent for accumulating the bones, is that most of the animals found in the cave were physically in their prime. They were either young adults or sub-adults and would have been difficult prey for wolves or bears. The theory that at least 15

Bone Type	Ibex	Red Deer
Femur	3	1
Horn	1	-
Humerus	1 - Burnt	1
Ileum	2	-
Metacarpal	1	-
Metatarsal	1	-
Phalange	-	1
Ribs	Yes	Yes
Scapula	1	3
Tibia	1 (+1 Burnt)	2
Vertebrae	1	1
Total	**13 + Ribs**	**9 + Ribs**

Table 9.2: Animal bones with evidence for butchery.
Red deer and ibex ribs are grouped as a single assemblage

animals, all in their prime, to have 'accidentally' fallen victim in the cave is also difficult to believe (Riedel 1994).

The Butchery Evidence

There were three aspects of evidence that support the case for human activity: tool marks, bones fractured with 'impact notches' and burnt material. This represents three separate sources of evidence to support the idea that ibex and red deer were initially processed by hunters. The fact that the quantity of lithic material recorded was not of the type used to process animal carcasses, but rather to kill them, suggests that only limited forms of butchery took place (i.e. field butchery). Table 9.2 summarises the ibex and red deer bones with butchery evidence.

<u>Ibex Bones</u>

Butchery cutmarks are the main group of human modifications to the bone. Two ibex metapodials show clear evidence of cut marks. These were located close to the distal ends and are likely to relate to skinning rather than disarticulation. Disarticulation cut marks tend to occur toward the proximal end of the bone (Binford 1984:140). The age estimates indicate sub-adults and would have been ideal skin material for winter clothes (Binford 1991:59). It seems unlikely that Mesolithic hunters would skin animals already consumed by other carnivores.

A third bone with a clearly identifiable mark was an ibex left tibia. This bone had a single cutmark on the medial side which was just over 1cm long. It probably relates to meat stripping from a young sub-adult animal. This bone was also burnt and found in association with the fireplace. Again, unless the hunters were extremely impoverished for food, it seems unlikely that leg bones would be scavenged after a carnivore had consumed the ibex. A thoracic vertebrae, (already discussed as evidence of trampling), is also interpreted here as the result of meat/muscle stripping. It shows similarities with cutmarks recorded by Binford (1981:110-113). If meat was removed in the form of rib slabs to be taken away from the site, such marks could be expected on the vertebrae, and it would also explain the low numbers of rib bones at Grotta d'Ernesto.

There are a number of further bones with butchery marks including three femurs. One femur has two chopmarks on the distal medial end which could have related to meat stripping (Fd4 Binford 1981:132). The trochanter also appears to have been gnawed by a carnivore. A second femur had a single cutmark on the distal end and a chopmark on the midshaft. These butchery marks suggest dismemberment followed by meat stripping activities.

A third femur belonging to a young animal was broken into three (URN 76, 93 and 94). The three fragments were scattered on the cave palaeosurface in close proximity to the hearth. From the fracture points it is clear that the midshaft received a heavy impact, producing fracture lines radiating out from this point (Cavallo *et al* 1994). Two of the femur fragments also contained butchery evidence. The proximal end contains cut and chop marks around the neck of the bone (FP6 Binford 1981:131). These are believed to be the result of filleting meat off the bone. The distal end of the same bone produced similar filleting marks. This bone therefore contains undisputed evidence for human modification in the form of meat filleting and possible marrow extraction.

Two pelvis bones also contained butchery traces around the acetabulum (PS7 / 9 Binford 1981:113). These marks are produced by the removal of the leg bones from the main skeleton, and according to Binford, are often made during processing for either storage or consumption (Binford 1981:114). An ibex scapula also had a cutmark that probably related to meat stripping from the shoulder blade. One rib bone also had chopmarks.

None of these butchered bones appear to have been in the sample of 201 bones studied by Cavallo *et al* (1994), or considered from the perspective of being the result of trampling or carnivore activity.

An ibex humerus showed clear evidence of burning on the distal end and a metatarsal with cutmarks on was also burnt. This represents convincing evidence that meat was consumed inside the cave.

Red Deer Bones

Three red deer scapulae contained butchery evidence. One had a chop mark around the neck of the articular surface (S2 Binford 1981:122). This is likely to have resulted from dismemberment, while the two other scapulae contained marks associated with filleting.

An unfused femur contains a possible single chop or cut mark on the distal condyle. This mark could have been the result of the dismemberment from the tibia. It is possible, however, that it represents a trample mark. Two tibia contained chop or cut marks, one had a similar mark as recorded on the ibex specimen. The second tibia had a cut mark on the proximal articular surface Tp1 in Binford 1981:116-118). Such a mark is achieved by inserting a tool between the articulator surfaces of the femur and tibia, and is a result of dismemberment.

A single second phalange was split longitudinally, presumably for marrow extraction. This is a rare incidence compared to the Mesolithic rock shelter sites where such activity is the most common form of bone processing. A thoracic vertebra had clear chop marks used to remove the rib section.

A humerus from a young adult contains unusual cutmarks. These consist of nineteen roughly parallel lines, orientated transversally to the main axis of the bone. Although the SEM analysis confirms that cut marks on the medial and lateral epicondyles relate to dismemberment activity, most of the marks appear as scoring formed by a point rather than a cutting instrument (Cavallo *et al* 1994). The SEM images suggest that on each line the initial mark is where a point compressed the bone surface before moving across the bone and gradually stopping this action. The SEM indicates that the same point was used (except for the dismemberment marks) for most on the lines. Microflaking suggests that the bone was no longer fresh when the marks were made, and trampling marks appear stratigraphically above these lines. The activity on this bone therefore suggests the following three events which may have been separated by a considerable amount of time:

Initial dismemberment

Scoring or engraving of the bone

Trampling

It is unclear as to what the scoring on the red deer humerus represents. It could simply have been the result of fine tuning a flint tool such as one of the points recorded in the lithic assemblage, or the lines could be something more abstract. Parallel lines on stone material have been recorded from elsewhere in the Trentino. The Terlago lake-side Epigravettian site has produced a series of stones containing similar lines (Dalmeri 1985). The lines appear in groups of fives, and have been interpreted as a counting system or some form of decorative art.

Interpreting Grotta d'Ernesto

Although the Grotta d'Ernesto animal bones show a complex sequence of taphonomic processes, it is possible to provide a clear indication of the events that took place within the cave.

Even after consideration of the SEM analysis and the behavioural attributes of carnivorous animals and trampling activity, it is considered unlikely that carnivores were the initial agents for accumulating the bones. It is argued here that the bones were brought to the cave and processed by early Mesolithic hunters. It is also likely that primary butchery activities were conducted in the cave and that parts of the animals were taken elsewhere for consumption; perhaps to a residential site similar to Pradestel or Romagnano III. Several observations support this view.

Firstly, most of the animal bones were found in the area of a fireplace, with lithic material used for hunting. The ibex and red deer were precisely the sort of animals that we would expect early Mesolithic hunters to kill, especially if intercept hunting strategies were used (see Chapters 3 and 5). It is argued that intercept hunting would provide more opportunities for selecting the most appropriate animals to kill or process. These would include male animals in their prime in terms of age - such as those recorded at Grotta d'Ernesto, and not females, as this could, in the longer term, jeopardise the red deer and ibex population structures (e.g. Speth 1983).

Secondly, some of the bones had clear butchery marks, as well as evidence for burning, and it seems highly unlikely that Mesolithic hunters would process and eat the scavenged remains of other carnivores. Although only a small number of bones did have butchery evidence, this should not be considered to weaken this interpretation. The specific function of the site is likely to have been a short term camp. The lithic evidence (mainly projectile points) suggests that the Mesolithic groups who used the fireplace were hunters. The range of bones and the limited traces of marks on them are indicative of field butchery. It is argued that the small number of ibex and red deer phalanges and metapodials in relation to long bones and skull material is good evidence that these were exported from the site. The reduced number of ribs, together with cut and chop marks on the remaining ribs and the vertebrae is used to argue that ribs of meat were taken for the cave, possibly with metapodials and phalanges Very few of the recorded tools were suitable for meat or bone processing, probably because this activity was practised at more permanent sites.

The contrasting view that carnivores were the major agents in forming the assemblage has limitations. Although the tooth marks on most of the bones is taken to suggest bear, what little we know about this animal's behaviour suggests that they do not transport bones. A bear primarily enters a cave to hibernate, and as such does not accumulate animal remains. The argument that these young adult ibex and red deer met a fate by being trapped in the cave is difficult to believe, as is the idea that the bears were able to capture such animals. The fact that most of the bones together with flint tools, were found around a fire place, while some were burnt and others contained butchery marks, indicates more systematic activity than human groups simply scavenging the remains left by a bear.

The Grotta d'Ernesto deposit will continue to offer debate over the relationship between human and animal groups in forming faunal assemblages. The view taken here is that the material is principally an archaeological assemblage that had been modified by later carnivorous activity, possibly that of brown bear or wolves. However, the limited damage, such as no bone cylinders or heavily gnawed articular surfaces, suggests that by the time animals entered the cave, the meat and other nutritional material within the bones had largely disappeared.

It is argued that the site was used as a short term camp and that the bones were brought to the cave by the Mesolithic hunters-gatherers from nearby kill sites, processed and parts of the skeletons were then taken to other, more residential sites. The age and sex details of the animals is precisely what is anticipated if selective intercept hunting took place in the early Mesolithic period. The concluding chapter will demonstrate how the material from Grotta d'Ernesto fits into this subsistence framework.

CHAPTER 10

CONCLUSIONS: HUNTERS IN THE LANDSCAPE

In this dissertation I have presented a regional case study of Mesolithic subsistence change for the Trentino, a mountain region in northern Italy. The period under examination represents a time of significant environmental change, which started with the end of glacial conditions and broadly finished with the adoption of farming techniques. The study has examined the archaeological evidence from a number of different scales of analysis and offers both spatial and temporal perspectives on hunter-gatherer adaptations. Although these focus on the sites, the analysis is also extended beyond site based data to offer a regional perspective and issues such as raw material procurement and various hunting strategies have been explored.

Good preservation of hunter-gatherer deposits is rarely found and excavation techniques can often been seen, at least in retrospect, to compromise overall site interpretations. For these reasons an analytical approach has been chosen that, as Jochim has stated in his comparable study, offers a "general impression ... rather than spuriously precise quantification" (1998:193). In order to provide an overall framework for understanding changing subsistence patterns, a combined study of the two main forms of archaeological evidence available from Mesolithic sites -animal bone and lithic material has been presented. My view is that by combining the two data types, it should be possible to have more confidence in the overall conclusions, than if analysis had concentrated solely on animal bones.

The dissertation set out to examine how risk based models could be applied, through time, to site and regional data. Risk management offers an interpretative framework that allows both lithic and faunal material to be linked together. Lithic material represents the tools used to reduce the risk of dietary failure (e.g. Torrence 1989) and animal resources are used to minimise the risk of not securing the necessary nutritional levels to sustain a population (Speth 1991). In terms of the positioning of sites within the landscape, the concept of the Resource Use Schedule applies (Jochim 1976). This proposes that subsistence strategies determine the location of settlement and associated demographic arrangements. Residential mobility and logistical mobility (in which hunters operated from more residentially based sites in order to hunt) are further concepts of settlement strategies used for interpreting settlement patterns within this study (Binford 1980).

The Environment as a Framework for Subsistence Change

Most studies of the Mesolithic involve referring to specific responses to local environmental conditions (e.g. papers in Zvelebil (ed) 1986). Whether or not these include sea level rises or the development of mixed oak forests, more recent writers have been cautious not to offer a too extreme 'environmental deterministic' perspective (e.g. Jochim 1998), even if evidence for other factors such as social processes are not visible in the archaeological record (e.g. Mellars 1998). A major characteristic of Mesolithic archaeological assemblages throughout Europe is the lack of 'art' and other socially determined artefacts. This has led some writers to refer to the Mesolithic as culturally degraded compared to the Upper Palaeolithic or Neolithic periods (e.g. Morrison 1980), and to rely more on environmental factors as a framework for analysis.

Bones and lithics form the main currencies for understanding the Mesolithic, and trends and variations in these data represent the evidence for changes in subsistence strategies. Mesolithic subsistence change needs to be considered from the perspective of evolving post-glacial conditions during the Boreal and Atlantic climatic phases, simply because the effects of these environmental processes were too great not to have been important factors. For the Trentino, these included a reduction in mountain pasture and a corresponding increase in the altitude of the tree-line in the mountains, as well as in forest density in general. Animal and plant populations and behaviour changed as a result (e.g. Jochim 1989 and 1998). The population densities of red deer, a main food source, are likely to have declined from large herds exploiting the more open mountain conditions to smaller groups adapted to the forested environments, in which edible resources for both man and animal are likely to have declined (e.g. Mitchell *et al* 1977 and Myers 1989). Other animals such as ibex and chamois also adapted to the increased forest by moving to more marginal mountain territories, and thus became more difficult to hunt. Population numbers would also have declined. At the same time, resource diversity in the valley bottoms, especially in ecotonal situations near rivers or lakes, are likely to have increased with a greater range of smaller mammals, water fowl and birds, as well as fish and other water and plants resources (e.g. Clarke 1976, Jochim 1998). Such areas would also have attracted larger mammals including red deer.

There are two undisputed archaeological facts relating to the study area and its changing environment. Firstly, the high altitude sites were occupied mainly in the early Mesolithic period. Although there is some evidence for later Castelnovian use at these altitudes (e.g. Baroni *et al* 1990), most of this occupation dates to the very early Castelnovian period and is associated directly with earlier Sauveterrian material (Broglio 1994). The second fact is related. There is a sharp decline in mountain ibex and chamois bones in the rock shelters during the later Mesolithic (Castelnovian) period. This supports the interpretation that the high altitudes were no longer exploited during this later period.

These two basic facts are supported by a trend seen in the pollen, plant macro-fossil and associated charcoal record. These studies indicate fire management within the mountain forests during the early Mesolithic, with no evidence that similar strategies were used by later Mesolithic populations. It is suggested here and elsewhere (e.g. Oeggl and Wahlmüller 1994), that fire was used by the early Mesolithic hunters as a means of adapting to increasingly forested conditions during the later Boreal period. Areas of (burnt) open woodland are likely to have attracted populations of red deer and other animals and plants (Simmons 1996). Comparable evidence from Star Carr provides some of the best information available for early Mesolithic environmental management. The burning of reed-swamp, probably on an annual basis, encouraged protein-rich new growth and is likely to have increased the numbers and predictability of animals feeding on this material (Law 1998, Mellars 1998). We can envisage similar strategies of encouraging red deer and other animals to congregate in predictable places within the increasing forested conditions as the early Mesolithic period progressed. 'Fire ecology' can be viewed from the perspective of a risk management strategy in terms of guaranteeing hunting successes. As forested conditions intensified during the Atlantic period, even fire was not used to facilitate hunting in the later Mesolithic. Settlement and subsistence became a valley based strategy.

It is in studying this transition from high altitude summer hunting to more valley based subsistence strategies that my data are considered.

Mesolithic Settlement and Subsistence in the Trentino

The archaeological data within this dissertation can be examined in terms of different conceptual scales of analysis. The first scale is temporal and relates to how Mesolithic subsistence and settlement changed through time. The second, or spatial scale, starts with the archaeological site and then extends into the region and beyond. Different analytical issues come into play at each stage, and by tacking from one scale to another we can understand the underlying processes of Mesolithic settlement and subsistence change.

The Sites

The site provides the basic unit of analysis for this study. There are two main settlement forms that provide the evidence for changing subsistence strategies. These consist of the high altitude hunting sites and rock shelters. Each site type contributes a different element to reconstructing the Mesolithic subsistence strategies. The rock shelters, for example, provide good long term, temporal data-sets, while the open air high altitude sites offer complementary spatial information that allows hunting tactics to be determined with some confidence. Compared to other parts of Europe, these combined data-sets offer good insights into changing Mesolithic subsistence strategies.

Activity Areas: High Altitude Sites

Colbricon provides good site based data in terms of the spatial scale of analysis. The Colbricon site areas have been used as a model for understanding high altitude hunting, as it is the most well documented site of its kind. There are numerous other sites that demonstrate that these were an important component of early Mesolithic hunting strategies.

The undisturbed nature of the Colbricon site areas means that tools and debitage are found more-or-less where they were left by the early Mesolithic hunters. Intra-site studies show that a range of different subsistence activities were practised on a repeated basis. This is particularly evident with regard to comparing tool composition between the different activity areas. Colbricon thus provides evidence for a range of site activities that took place during the late spring to late summer period. These sites would have been inaccessible due to the snows for the rest of the year. On this basis it is likely that occupation coincided with a time when animals such as red deer and ibex were nutritionally in their prime (e.g. Speth 1991), and processed meat and bones could then have been used for later (i.e. winter) consumption.

The distribution of flint scatters in relation to the topography or 'natural facilities', such as behind rock crags leading to the mountain pass, is used to argue for intercept hunting. Animals were ambushed as they headed to the Colbricon lakes. Similar evidence is seen from numerous other sites including those at Cresta di Siusi and Val di Dona (see Figure 5.3), as well as in other parts of Europe (Straus 1993). Indeed, it is likely that large scale intercept hunting took place (e.g. Clark and Straus 1983). The density of lithic material in relation to the sites suggests that significant numbers of animals, rather than individuals, were killed at one time. It is doubtful whether such concentrations of material would have been created if hunting was focused on individual kills. Moreover, we know that red deer in open conditions, as prevailed at this time, would have congregated in groups, as opposed to the more solitary behaviour of animals adapted to forested conditions.

Chapter 5 outlines other forms of subsistence activities that took place at Colbricon. Again, these interpretations are based on site location in relation to the lakes and other topographical aspects, as well as the tool types recorded in each area. Other activity would have involved general subsistence, butchery and processing of hides and other animal products (sinews, antler). The proximity of the lakes may have been important for these activities. It is possible that the lakes were used to soak antler and hide, prior to working into tools, clothes and other crafts. It has been suggested, for example, that the caches of red deer antler found in the lake deposits at Star Carr were being soaked to facilitate antler processing (Mellars 1998). Unfortunately, as animal bone material has yet to be found at these sites, there is little conclusive proof for such activities.

The structure and composition of the tool assemblages, particularly from the intercept sites, suggests that 'gearing up' activity as well as maintenance of broken tools were important aspects of site activity. These sites represent some of the best Mesolithic evidence available for maintainable technology, as a risk management strategy against hunting weapon failure (e.g. Torrence 1989) that has been found in archaeological contexts undeniably used for hunting. Most evidence used to model archaeological behaviour is derived from ethnographic situations.

In terms of defining specific activities, the evidence from Colbricon is strong and conclusive. We can, for example, compare these data with that from Star Carr, where, although artefact preservation was good, there is still uncertainty about the precise activities within the site area. Debate continues as to whether Star Carr was a base-camp (Clark 1954, Mellars 1998), or a primary or secondary butchery area and what other activities took place (Andresen *et al* 1981 and Legge and Rowley-Conwy 1988). It is also uncertain whether the Star Carr lithic scatters were 'toss zones' (Legge and Rowley-Conwy 1988), or the result of more specific activities and working areas (Mellars 1998). After over 45 years of archaeological analysis and debate, the Star Carr data are less conclusive in terms of its site function and activities than the discrete site patterns that are clearly recorded at Colbricon. This is largely because the main occupational zones at Star Carr were beyond the areas that have been excavated.

Most high altitude sites were abandoned by the later Mesolithic, and in order to further understand subsistence change, we need to turn attention to the rock shelter sites. Unlike Colbricon, which offers good spatial data, the rock shelters offer, as an alternative, a temporal perspective that covers the entire Mesolithic period. In terms of site based studies, we can therefore tack from the 'events' at hunting camps to the longer term processes seen in assemblages that accumulated during *c.*5000 years of post-glacial hunting and gathering.

Long Term Evidence: Rock shelters

Apart from the cave site of Grotta d'Ernesto, these shelters do not provide clear spatial data concerning Mesolithic subsistence. Instead they provide a temporal perspective on faunal and lithic data. Inter-site comparison between the shelters, particularly with regard to animal bones, provides confirmation for broad subsistence trends evolving throughout the early and later Mesolithic periods. The rock shelters offer good evidence for the species of animals that were hunted throughout the Mesolithic period, as well as trends in the faunal data relating to age ranges and how the animals were processed. Events, or specific information such as minimum numbers of animals for each layer, are not clearly definable in most of these deposits. There are, however, some evidence that increases in small mammal processing coincided with increases in scraper type tools at Pradestel.

The main Adige valley rock shelters provide consistent evidence that, apart from red and roe deer, ibex and chamois were hunted during the earlier Mesolithic period. There is also evidence that smaller animals such as beaver, pine marten and badger were hunted or trapped. Brown bear and wolf are also recorded. A large element of the mammal faunal remains consisted for lower leg bones such as phalanges, metapodials and radii and tibia . These bones were extensively processed for marrow, as well as for their meat value. Chapters 2 and 3 referred to the high nutritional value of marrow and bone grease in terms of their carbohydrate and Vitamin C food value. As a means of reducing the risk of winter dietary problems, marrow fat is likely to have been an important nutritional source (e.g. Speth 1991).

During the later Mesolithic period ibex and chamois cease to be represented in the bone assemblages. This was due to the fact that high altitude hunting was no longer taking place on the scale previously recorded. Instead, there is a greater reliance on deer and wild boar. This evidence reflects the increased density of forest conditions. At the same time that ibex disappear from the record, there is a broad increase in the range of recorded anatomical elements from other large mammals, including upper limb bones such as humeri, scapulae, femora and pelvises. There is also an increase in younger animals, particularly of red deer. This evidence is taken to reflect a change in hunting strategies.

In the same way that the lithic scatters at Colbricon can indicate particular forms of hunting strategies (through the location of intercept sites within the mountain topography), the character of faunal material can help illustrate a change in hunting tactics. This form of analysis moves us away from site specific data to issues relating to how hunters were exploiting their territories; either in terms of large areas including the mountains, or smaller, more valley based strategies.

The increase in anatomical elements is interpreted as a result of increasingly localised subsistence strategies. Hunting territories were closer to the rock shelters, with more evidence that complete carcasses were taken back to the rock shelters with little field butchery. In the earlier Mesolithic, when animals were largely hunted from the high altitudes, it is likely that field butchery removed many of the larger upper leg bones before the meat was transported to the lower altitude sites. Marrow bones (phalanges and metapodials) may also be been brought to these sites for further processing, when time constraints were not as great. These bones may also have been a convenient form of transport for the marrow. Support for this interpretation is derived from the Grotta d'Ernesto (Chapter 9), where meat bearing bones were butchered and filleted meat 'exported' from the cave. The comparatively low numbers of metapodials and phalanges indicates that these bones were also taken.

An increase in younger red deer could represent evidence for less selective hunting strategies. This may be expected in forest based <u>encounter</u> hunting, where the risk of not killing a particular animal is compounded by the uncertainty of not knowing what age, sex or species the next animal encountered will be. Earlier intercept mountain hunting strategies would have provided more opportunities for selective killing.

There is also good evidence for increased use of the lower altitude areas in the form of 'new sites' with no previous early Mesolithic use (e.g. Dos de la Forca, Paludei di Volano and Pre Alta). As the high altitude sites went out of use, new forms of lower altitude camps were utilised. It is suggested that these small shelters were specialised logistical sites used in association with more permanent residential bases such as the Adige valley rock shelters. Jochim argues for similar late Mesolithic special purpose camps functioning as logistical sites from the residential bases for south-west Germany (1998:210). As an example, Biagi interprets the lithic material from Paludei di Volano, with its unusual 'piquant trièdre' trapeze industry, as relating to specialised arrow manufacture (1981:54). This could represent a form of encounter hunting, perhaps relating to smaller mammals.

From Rock Shelter Deposits to an Occupational Event

The early Mesolithic Grotta d'Ernesto deposits provide a means for tacking back from the long-term rock shelter processes to a cave occupation that can be portrayed in terms of clear short-term events or activities. Once the taphonomic history has been unravelled (Cavallo *et al* 1994), we can envisage a small group of hunters camping in the cave and undertaking primary butchery activity before travelling back to their more permanent settlement.

Aspects of the faunal material, interpreted in the rock shelter deposits, can also be clearly seen in the ibex and red deer remains from Grotta d'Ernesto, albeit from a single event. It is suggested that the lack of phalange material at Grotta d'Ernesto is the result of a butchery strategy that included the removal of these bones to the base or residential camps, together with meat from the upper leg bones. The Grotta d'Ernesto bone material represents the material not found at rock shelter sites such as Pradestel and Romagnano III, in the same way that these early Mesolithic rock shelter deposits contain the missing phalange material from Grotta d'Ernesto.

The Grotta d'Ernesto animal bones belong predominantly to young adult males. It is argued that early Mesolithic hunters would have been relatively selective in the types of animals killed in order to sustain population levels. Intercept hunting, as practised at early Mesolithic sites such as Colbricon, are likely to have provided opportunities for selectively choosing appropriate animals to kill. These would have included young adult males rather than females. If female animals had been hunted excessively, this would have jeopardised the red deer and ibex population structures.

Most faunal material from the early Mesolithic rock shelter deposits indicates young adult or more mature animals, and thus corresponds to the Grotta d'Ernesto evidence.

The later Mesolithic levels include more younger animals and may represent a less selective strategy toward sustaining deer populations. As previously suggested, if red deer groups were in lower population densities because of increased forested conditions, encounter hunting may not have offered the same scope to selectively kill only male animals.

The process of tacking from specific events or occupations (Colbricon or Grotta d'Ernesto) to trends in data seen in long term rock shelter deposits, can also be applied to the next level of analysis, that of the region. Central to this is how Mesolithic hunters used and adapted to their landscape and environment.

From the Site to the Region: Towards Model Building

By moving or tacking from the site to the regional level, we increase our scale of analysis. It is then possible to examine further archaeological aspects in terms of a wider landscape perspective and to offer a model for Mesolithic subsistence change for the Trentino. In previous sections we demonstrated that Mesolithic hunters were skilled in the use of their environment. Sites were positioned at key points in the topography to facilitate hunting successes. 'Fire ecology' is also likely to have been part of early Mesolithic hunting strategies. The provisioning of raw material for tool manufacture is an important further aspect of hunter-gatherer subsistence that allows the scale of analysis to move to a regional approach.

The early Mesolithic hunters were extensive in their regional use of the landscape. The mountain animals hunted at the high altitude sites such as Colbricon are recorded within the valley bottom rock shelters. It is therefore possible to argue for a link between summer mountain sites, and valley sites, which probably provided the best winter shelter in the region. If extended periods of time were spent at mountain sites, such as during the late spring to late summer months, a certain amount of planning would have been needed in order to provision these sites with the raw materials required for relatively large scale hunting. These hunting areas were rich in animal resources but lacked good deposits of raw materials needed to make tools. The limited sources of flint in the Dolomites (e.g. Marne del

Puez and the Livinallongo Formation) are only found in small quantities due to its poor flaking quality (Broglio 1994).

In terms of raw material exploitation, there is good evidence, at least from the early Mesolithic, that lithic procurement was a regional phenomena. Geochemical analysis of lithic samples from Colbricon and similar hunting sites indicate that high quality raw materials were imported from the Malga Dotessa area to the south (Benedetti *et al* 1994 and Figure 4.1). Within this area there are late Upper Palaeolithic / Mesolithic quarry sites recorded. Val Lastari and Riparo Battaglia provide good evidence that raw materials were quarried at sources containing good quality flint, processed into rough-outs or flakes and then 'exported', including to hunting sites such as Colbricon. At sites such as Colbricon, caches of partly processed flint without cortex support the case that material was 'imported'. The large quantities of processed material, such as debitage, without cortex is further support for this interpretation.

A system of 'provisioning places' (e.g. Kuhn 1995) within the early Mesolithic hunter-gatherer landscape is therefore proposed. Epigravettian quarry evidence from Val Lastari indicates that late Upper Palaeolithic hunters were practising similar lithic provisioning. Although evidence from the Trentino prior to this time is poor, the Aurignacian site of Monte Avena (e.g. Lanzinger 1990) suggests that lithic procurement may have been embedded into hunting strategies. It is suggested here that the extraction of poor quality stone at this site represents evidence for a more opportunistic exploitation of raw material during hunting trips (- a strategy that may also have become more common in the later Mesolithic). Higher quality raw materials were available in this same area.

From a regional perspective, the later Mesolithic populations exploited much smaller hunting territories. High altitude exploitation was much reduced compared to the earlier periods and subsistence was more intensified in the valley areas, which were rich in ecotonal resources. This coincides with the introduction of the later Mesolithic trapeze lithic industries. With its regular blades, this has been interpreted in terms of increased efficiency, both in the use of raw materials (Jochim 1998) and as a <u>reliable</u> technology (Myers 1989) suited to forested conditions (e.g. arrows damaged through tree deflection may continue to operate due to stand-by components). It is suggested here that the regular blade format for tools could also have been a response to more restricted flint sources. More efficient use of raw materials may have been necessary if flint exploitation was 'embedded' into other activities rather than specialised procurement, as has been argued for the earlier Mesolithic period. If later Mesolithic subsistence was limited in its spatial territory, it is likely that more local flint sources were used. Such material may have been limited in supply and lower in quality compared to the high quality flint sources discussed in Chapter 4. Geochemical analysis of flint from sites like Romagnano could clarify this possibility. In the same way that the Atlantic forested conditions increased the travel costs for hunting, these conditions would also have increased the costs for obtaining raw materials.

A Regional Model for Mesolithic Settlement and Subsistence in the Trentino

A regional settlement model for the early and later Mesolithic periods is therefore proposed. This represents a generalised model that relates high altitude sites with the lower valley areas. It does not necessarily argue for a direct link between the specific sites, but recognises that sites like Colbricon were related to valley sites such as Pradestel. We are seeing two elements of the same settlement system type, and although it is possible that Colbricon was linked with the Adige valley rock shelters, it is also possible that sites in the Valsugana area to the south (so far not located) were their valley counterparts. Moreover, a potentially significant factor is that the two river systems (Avisio and Brenta) linked the Trento rock shelter area with the high altitude areas of the Lagori Chain. It is suggested here that the river valleys may have been important routes for Mesolithic hunters gaining access to the higher altitude areas.

The model argues for extensive use of the high altitude sites during the late spring to late summer months, which coincided with the movements of red deer to these altitudes. Red deer, ibex and chamois needed access to fresh water, and Mesolithic hunters therefore positioned themselves at such locations. As large-scale hunting was taking place in areas without flint raw materials, these sites were provisioned with raw materials from the rich sources such as in the Malga Dotessa area to the south. Such provisioning is likely to have been a specialised strategy due to the quantities and quality of materials required, rather than being directly embedded in the hunting routine.

During the late autumn and winter months, the early Mesolithic populations would have moved down to the more sheltered altitudes, such as the rock shelters in the Adige valley. Although these sites may have been occupied throughout the year by some groups (with other logistical groups hunting in the mountains), it is likely that the entire Mesolithic populations would have been based in these areas during the winter months. Hunting probably continued at these lower altitudes, as animals such as red deer would also have migrated to the lower valleys for winter shelter. The nutritional quality of animals killed in the winter months would, however, have been lower and potentially dangerous in terms of excessive levels of protein (see Chapter 2 and Speth 1991). Although there is no direct evidence, it is suggested that stored meats and marrow from the late summer hunting were important nutritional supplements for the winter months. Summer hunting could therefore have played an important risk minimising strategy in terms of securing much needed vitamins and carbohydrates during the cold winter months.

The later Mesolithic period saw a reduction in the size of the subsistence territories. Subsistence was focused in the valley bottoms. Increased environmental diversity in these lower altitude valley areas would have offered new opportunities for hunting, fishing and gathering, with rock shelters such as those recorded in the Adige valley forming the main residential sites. It is argued that logistical sites operated from the rock shelters within a much smaller overall territory, and that the scattered distribution of large mammal prey resulted in greater hunter-gatherer mobility and flexibility in settlement forms. Sites such as Paludei di Volano or Pre Alta are likely to have been camps used for encounter hunting, in some cases to hunt deer and pig that were adapted to the forest environment. Similar sites are likely to have been used to exploit fish, waterfowl and other smaller mammals and birds. As many of these sites would have been near rivers and other favourable locations, it is likely that subsequent development has largely destroyed these low density sites.

Together with the main rock shelters, these sites were probably used throughout the year and hunting of animals resulted in a greater age range of deer and other animals being present in the assemblages. As hunting was more localised in terms of valley based settlements, it is considered probable that field butchery used at more remote hunting sites may not have been practised. As a result a greater range of anatomical elements are present in the later Mesolithic bone assemblages.

Beyond the Region

As discussed previously, the Trentino region witnessed major environmental change and the Mesolithic settlement and subsistence changes make sense in terms of adaptations to the local ecological transformations relating to increased forested conditions. Post-glacial environmental change occurred throughout Europe during the Mesolithic period. This study has drawn attention to Britain (Myers 1989) and south-western Germany (Jochim 1989 and 1998) as comparative areas that show significant differences in adaptations to the specific regions. Britain was characterised by an increasing homogeneous environment in which smaller late Mesolithic sites exploited a greater range of areas. In contrast south-west Germany and northern Italy witnessed greater environmental heterogeneity. The fact that environment and cultural adaptations appear to be closely related, receives support from elsewhere in northern Europe, where environmental changes included significant land loss due to sea level changes. This is likely to have resulted in population packing. Hunter-gatherer mobility would have been restricted due to greater population densities and subsistence adaptation resulted in increased sedentism and intensification of certain resources types (e.g. Binford 1968, Rowley-Conwy 1983, Price 1985 and Jochim 1998). The appearances of shell middens, cemeteries and elements of social differentiation are likely to have been related to these changes. It is into this context of greater population densities and intensification of subsistence strategies, that there is more evidence for hunter-gatherer 'complexity' and social processes (e.g. papers in Brown and Price (eds) 1985).

These changes represent the extremes in subsistence adaptations during the Boreal and Atlantic periods. The Trentino does not show such extremes. This is largely due to the fact that land loss was limited to the mountain regions becoming less accessible and to greater densities of forest cover. Instead, we see the a transition from high altitude intercept hunting to more valley based encounter subsistence in terms of a clear ecological adaptation. Although the loss of high altitude sites in the earlier Mesolithic is partly offset by a greater range of lower altitude sites in the later Mesolithic, we do not known if population densities declined as a result, as has been suggested for south-west Germany by Taute (1984).

By extending the study beyond the region, we can also move away from geographical or spatial boundaries into that of social organisation (e.g. Bender 1978). As end-notes to recent Mesolithic studies, both Jochim (1998) and Mellars (1998) briefly discuss these issues. The post-processual view that hunter-gatherer decisions making cannot be divorced from its social environment, and that their region or landscape is likely to be 'socially constructed' is not entirely dismissed in this study. However, as Mellars points out, the main problem in such approaches "... is that of developing research agendas which in some way bring the theoretical speculations into contact with the observable archaeological data - except as a kind of last resort, 'residual' explanation when more traditional ecological or functional models fail" (1998:228). It is hoped that this study of more traditional ecological models is firmly placed in sight of observable and available archaeological data, regardless of any methodological shortcomings.

This study has recognised the limitations of much of the Mesolithic data, both in terms of taphonomic factors and in excavation techniques. My data analysis in Chapters 7-9 and Appendix 7 included examination of factors such as biases caused by fragmentation and sample sizes. It concluded that although there was undoubtedly some fragmentation caused by processes such as trampling, there is little need for concern that the data are not showing the broad trends that are interpreted. We can take support from other studies which offer both site based and regional perspectives on Mesolithic subsistence.

Compared to Jochim's (1998) study, the faunal and lithic assemblages from the Trentino are relatively large. Most of Jochim's faunal and lithic samples, such as from the Henauhof sites in the Federsee in south-western Germany , are very small and in poor condition. In most cases the full range of identifiable large and small mammal bones total between 50 and 80 fragments per phase of occupation. Jochim's lithic samples are also small in comparison with both the rock shelter deposits and Colbricon. Moreover, they contain no clear spatial or topographical information concerning their function (other than mainly as lake-side sites), as is so clear from Colbricon. These small samples, however, have not prevented Jochim from presenting a large amount of interpretation for Mesolithic subsistence change on what are, compared to the Trentino assemblages, very inconclusive data-sets. Other Mesolithic sites in Europe suffer from small sample sizes (e.g. Pupicina in north-eastern Istria - Miracle 1997). From the perspective of sample size and quality of data the Trentino faunal and lithic assemblages are considered as significant contributions to the study of Mesolithic subsistence.

The level of stratigraphical information in Jochim's study is also poor compared to the Trentino data. Most of the rock shelter sites that he outlines the excavation history of (e.g. in the Swabian Alb - 1998: Figure 24), contain very limited amounts of stratigraphy. Furthermore, his own fieldwork at the Henauhof sites produced little clear evidence for sequences of occupation. Jochim's study contains no deposits comparable to Pradestel or Romagnano III, which, apart from providing good ranges of radiocarbon dates, also offer direct stratigraphical evidence for changes in animal hunting and processing activities.

Future Work

As a final note, this thesis offers some suggestions for further work that may provide an even more substantive framework for understanding subsistence change within the Mesolithic of the Trentino. Further reconnaissance work is required to locate rock shelters in the hope that more extensive 'talus' deposits can be excavated. These could provide spatial information to complement the diachronic data that is already available. In addition, detailed stratigraphical excavation may provide a better level of interpretation than the spit methods previously used. Some caution is, however, necessary as such detailed excavations are costly and very time consuming. As the recent excavations at Klithi have demonstrated, obtaining fine grained stratigraphical information is almost impossible, and this frustration can be compounded by the monotony of the faunal and lithic assemblages recorded within them (e.g. Gamble 1997).

The information collected from well provenanced deposits, can, however, provide opportunities for more detailed analysis. Faunal remains could be examined in more detail for aspects of seasonality. This should include analysis of teeth, as well as fetal, neonatal and juvenile bones, as has been successfully carried out for Badanj in Bosnia-Herzegovina (Miracle and O'Brien 1998). Seasonality data are crucial for understanding Mesolithic subsistence, and are a shortcoming of this study. Such information, which was not available for this study, could help confirm the inferred seasonality of site occupation, and how this may have changed during the transition from the early to the later Mesolithic periods.

More detailed sampling strategies for bird, fish and small mammal bones, as well as botanical materials are also required. By examining trends in these data from both earlier and later Mesolithic deposits, it may be possible to confirm that later Mesolithic hunting was more encounter based, and that a greater range of animals and plants were hunted throughout the seasons.

With regard to stone tools, there is good evidence that special purpose hunting sites were provisioned with raw materials. It would benefit the overall study of Mesolithic subsistence if the geochemical study of raw materials, and their sources were extended to include rock shelter deposits such as those in the Adige valley. Detailed analysis of material from all occupational layers could be compared with bigger samples from the high altitude hunting sites, as well as from other raw material sources. This analysis may provide important evidence for direct links between the valley and high altitude sites during the early Mesolithic period, as well as further information on aspects of provisioning sites with raw materials. By examining if raw material use changed in the later Mesolithic, we may also be able to confirm that more local resourcing took the place of extensive procurement strategies.

This broad or generalised approach to hunter-gatherer studies could then increase in focus to provide more detailed perspectives on the faunal and lithic data. This would allow more scope for 'tacking' between the *c.*300 year units of study, as seen in this study, and clearer evidence for specific activities. Such an approach may make studying the processes of change more visible in the archaeological record.

As a final thought, Colbricon was the site that initiated the exploration of the early Mesolithic high altitude sites, and undoubtedly similar sites will continue to be discovered. It is possible that Colbricon deserves revisiting. The lake sediments may hold further information relating to hunter-gatherer subsistence, such as butchery waste, as well as the lake pollen deposits. These could provide more information on the relationship between environmental change and Mesolithic subsistence in the Trentino.

APPENDICES

CONTENTS

APPENDIX 1

AN ENVIRONMENTAL HISTORY OF NORTHERN ITALY (THE TRENTINO)

This Appendix outlines the main climatic processes from the period dating from the last glacial maximum until the periods prior to the Holocene in Section I. It therefore supplements the environmental information provided in Chapter 3. Section II briefly outlines some of the interpretative problems related to the study of pollen diagrams from mountain regions. Sections III and IV present environmental data from Val Lastari (Chapter 4) and a more detailed description of the pollen data from Colbricon (Chapter 5).

I: From the Late Glacial Maximum to the Early Holocene

Prior to the Alleröd interstadial, the late glacial maximum (*c.*18000BP) saw cool-dry winters and warm dry summers, in which there was likely to have been significant seasonal variation (e.g. Castiglioni *et al* 1990, Cremaschi 1990 and Cattani 1990 and 1994). Cold temperatures in the Po Valley were not as severe as further north in the mountains, and seasonal freezing did not include permafrost conditions. Prairie and steppe pollen (with pine) is also recorded with rare occurrences of thermophilic trees including oak, alder and ash. These trees grew to about 1000m asl. Above this limit the vegetation comprised of more open prairie Artemisia conditions with a snow line of between 1300 and 2000m asl (Rosingnol-Strick *et al* 1992).

<u>The Older Dryas</u>

By the time of the Older Dryas (radiocarbon dated to *c.*14000 BP) the climate experienced wetter and more temperate winter conditions and it is likely that summer temperatures were lower (e.g. Miracle and O'Brien 1998). Tree pollen including pine, birch and alder are, however, more common, particularly from the Adriatic and Po Valley region, which was still a large open plain. The pollen record for the sub-Alpine region indicates a more open environment in which juniper and Scotch dwarf pine appear to be colonising (e.g. Riparo Tagliente - Cattani 1994).

The Alleröd Interstadial

The Older Dryas was succeeded by a period of rapid warming. Mediterranean temperatures were similar to the present day and winter precipitation would also have decreased. From this period, until the beginning of the Holocene, there is evidence for rapid and unstable climatic conditions. Ice cores from Greenland indicate rapid fluctuations or pulses in global warming (Johnson *et al* 1992), which resulted in temperature and precipitation changes. Miracle and O'Brien (1998) provide a good summary of these events, including the processes relating to the earth's orbit (insolation). They argue that these processes created a markedly more unpredictable environment in the periods between the Alleröd interstadial and the Younger Dryas (*c.*12500 - 10000BP). Human populations would have adapted accordingly.

During the Alleröd interstadial there was an increase in deciduous trees indicating warmer conditions and longer growing seasons. It was at this stage that sea level rises resulted in significant loses to the Adriatic Plain. Although the Po Valley may have been affected by these changes, as well as from increased alluviation from the rivers taking melt waters from the Alpine glaciers to the north, there is very little environmental information available to gauge how hunter-gatherers would have responded to any changes. At Riparo Taglienti juniper disappears, while pine increases and hazel and elements of mixed oak forest also appear (Cattani 1994). At Riparo Biarzo (a rock shelter in the Friuli Pre Alps - *c.*80km NW of Trieste and outside the main study area), more humid conditions prevailed and *Fagus*, linden and hornbeam are present in these deposits (Cattani 1985 and 1994). The Bölling interstadial is not identifiable within most of the pollen records (e.g. Cattani 1994), and is not considered within this discussion.

Although the fluctuation of temperatures resulted in vegetational displacement in the colder phases, it is also probable that the mountain regions contained microclimates which created refugia, from which trees and plants could rapidly re-colonise once conditions improved (e.g. Riparo Biarzo - as discussed above and Willis 1994 and 1997). This factor alone makes reconstructing the history of vegetational fluctuations and change, as well as providing evidence for increased seasonality, a very complex process. This is particularly the case as pollen records cores are unlikely to provide the chronological and spatial resolution to show such detail. The problem is compounded in northern Italy by the limited number of good pollen deposits.

The Younger Dryas

The Younger Dryas (*c.*11000 - 10000 BP) saw dryer and cooler winter temperatures and hotter summers. Rainfall in general is likely to have reduced significantly during this period, and there was an overall reduction in tree and non tree pollen. Loess soils containing pollen are recorded from the Val Lastari site in the sub Alpine area to the north of the Po Valley (see Chapter 4 and below). Pollen from these soils indicates the following tree species: *Fagus sylvatica*, *Juglans regia*, *Picea/Larix*, *Pinus sylv./mont.*, *Salix sp.*, and *Betula sp.* (Castelletti and Maspero 1994).

The cooler winters and hotter summers are also likely to have resulted in a more seasonal climate in which reduced precipitation caused a shorter growing season. This also resulted in a decrease in the amount of moisture available for plants to grow. Unfortunately the direct evidence for increased seasonality, in the form of floral and faunal data is poor for the periods prior to the Holocene (e.g. Miracle and O'Brien 1998: 46-47) and we can only surmise that increased seasonality was taking place.

Although the climatic conditions of the Younger Dryas may have caused a pause in the sea level rises, as well as related changes in the Po Valley, most of the Adriatic Plain was drowned by this stage. These reduced foraging areas, together with a more widespread reduction in the growing season, would also have resulted in a reduction in the quantity and quality of foraging material. In terms of animal foraging and prehistoric subsistence, a reduced growing season would have resulted in less prime foraging time (in which animal such as red deer would build up fat levels), and greater lean periods, in which they would have to use these fat reserves. It has been argued that if there were fluctuations in available resources, animals may not have been able to buffer themselves accordingly and populations may have crashed in lean years (e.g. Miracle and O'Brien 1998). Even if populations did not totally crash, the nutritional quality of hunted animals, such as fat and carbohydrate content are likely to have been affected (e.g. Speth 1991).

The rises in sea level may have affected the area immediately to the west of the Adriatic sea, in what is now the Po Valley. This area was also a fertile plain and sea level rises affecting water tables in the low lying areas, as well as increased alluviation caused by run-off from the sub Alpine river systems (the rivers Adige, Brenta and Piave) during the early post glacial periods, is likely to have resulted in significant environmental change. These combined processes created a very marshy topography, and it was only in the last century that effective reclamation took place (Barfield 1971). Although the area was not flooded to the same extent as the Adriatic, the plain was replaced by a wetter environment, which may have been less suitable to large mammals. An increase in insects like mosquitoes would also have contributed to making this area less attractive to animals and hunters. Unfortunately there is little environmental evidence for this area during the Alleröd interstadial, when climate fluctuations could have resulted in unstable and unpredictable conditions. It is argued that such conditions made the sub-Alpine regions more attractive to animals and hunter gatherers displaced from both the Adriatic and Po areas during the early Holocene.

II: Problems in Interpreting Pollen from Mountain Regions

There are difficulties with regard to interpreting vegetational histories through pollen analysis. Each context that contains surviving pollen has undergone taphonomic (i.e. post depositional processes of decay) as well as various factors affecting the accumulation of pollen. This section will not discuss in detail the general interpretative issues relating to pollen analysis, as these issues have been addressed by Willis with regard to her work in the Klithi area of NW Greece (1997).

It is, however, important to note that the pollen catchment area in mountain zones can be affected by regional pollen rain that is bought in by wind action in the upper atmosphere, thereby distorting the pollen sequences. Some pollen material can travel up to several hundred kilometres before being deposited in lake sediments. These are known as anabatic, katabatic and convection winds, and can in extreme cases lead to long distance pollen surpassing the quantity of local pollens (e.g. Willis 1997). There is a possibility that the Colbricon pollen samples (see below and Chapter 5), were contaminated in this way (Cattani 1994). The dispersal characteristics of pollen also vary according to species. For example, *Pinus* (pine), *Quercus* (oak) and *Corylus* (hazel) pollen disperse well, while *Fagus* (beech), *Picea* (spruce) *Abies* (fir), *Tilia* (lime) and *Juglans* (walnut) are poor with regard to dispersal. Pollen from this latter group is likely to be of a more localised source than material such as pine (Willis 1997).

III: Environmental Information from Val Lastari

Table A1.1 provides the data from charcoals analysed from these soils (based on Castelletti and Maspero 1994). Most samples were taken from the loess soils that sealed the main archaeological deposits and thus represent material dating from the Dryas III cold stage. A total of 300 charcoal fragments have been analysed (Castelletti and Maspero 1994) and the following tree species have been identified - *Fagus sylvatica*, *Juglans regia*, *Picea/Larix*, *Pinus sylv./mont.*, *Salix sp.*, and *Betula sp.*. The cold stages of the Dryas III produced complicating factors that affected the earlier archaeological deposits. Soil analysis indicates that bioturbation and cryoturbation processes, such as chemical leaching and frost heave have made it impossible to recognise distinct temporal activity zones, such as layers or levels, within the site areas investigated.

Val Lastari	1	2	3	4	5	6	7	8
Level 3a	5	7	20	5	3	-	43	17
Level 3b	-	6	23	4	11	-	56	-
Level 3c	8	38	46	-	8	-	-	-
Level 3d	8	58	20	4	2	-	8	-
Level 3e	2	75	17	-	2	4	-	-
Features								
Feature 3	-	64	33	-	3	-	-	-
Feature 4	-	100	-	-	-	-	-	-
Feature 5	-	90	10	-	-	Total sample = 300		

Table A1.1 Val Lastari - charcoal samples recorded by percentages: - 1. Conifers, 2. *Pinus sylvestris / montana*, 3. *Picea / Larix*, 4. Latifoglia, 5. *Salix* sp., 6. *Betula* sp., 7.*Fagus sylvatica*, 8. *Fraxinus* sp. (Note: Levels 3a - 3e represent the loess soils sealing the archaeological deposits).

IV: An Environmental History for Colbricon

The anaerobic conditions on the edge of the main lake at Area 3 produced peat deposits. These contained enough pollen to provide a framework to understand the environment prior to, during and after the occupation of the archaeological sites (Cattani 1983). A 30 cm pollen core was extracted between 20cm and 50cm below the ground surface and the samples were studied at 10cm intervals. At the *c.*40cm point, a dense concentration of charcoal relates to the human activity at Area 3. The charcoals did not produce any radiocarbon dates. This is unfortunate because Area 3 contained the earliest typologically identifiable lithic types at Colbricon. It is argued here that sedimentation rates would have been relatively low and dividing the core into 10 cm units of analysis is a coarse level of resolution for a period of time that saw major environmental change. The information is clear enough to divide the sequence into three broad stages:

- Before human occupation at Colbricon
- During occupation periods
- After occupation

Before human occupation

Prior to the levels that contained the charcoal, the pollen record indicates a gradual rise in the ratio of tree to non-tree pollen from 40:60% to 60:40%. This relates to early post-glacial tree colonisation. The dominant tree species began with *Alnus*, *Corylus*, *Picea* and *Pinus* respectively. *Fagus* also appears in small quantities. As time progressed, *Alnus* drops in percentage and there was a corresponding rise in the quantity of *Picea*. At the same time *Pinus*, *Corylus* and *Fagus* gradually increase. *Tilia* steadily drops in quantity, having reached its peak at the beginning of the pollen sequence.

Alnus may have been present due to the wet conditions of the lake margin and was one of the first post-glacial species to colonise the mountains. It is, however, difficult to compare *Alnus* with other tree types as it produces greater quantities of pollen than other trees (D Piggot pers comm., Moore and Webb 1978). The close proximity of these trees to the sample source could also enhance the quantity of this pollen type. It is therefore argued that *Alnus* was not as dominant as the pollen diagram suggests. If this factor is considered, it is possible to see both a gradual increase in tree species diversity and also a general rise in the tree cover to non tree species ratio.

In terms of herbs, *Gramineae*, *Caryophyllaceae* and *Ranunculaceae* drop slightly in quantity, while *Ericaeae* rises steeply to the point when the charcoal indicates human presence. Other herbs like *Cruciferae*, *Labiatae* and *Leguminosae* continue to have a steady presence.

Mesolithic Occupation

During the levels that contained charcoal material, the ratio of tree to non-tree pollen was about 50:50%.

Alnus drops to its lowest point before climbing again once human activity ceased at Colbricon. It is argued here that this reduction could be anthropogenic. Hunter-gatherers would have cleared such wood for burning on the camp fires and creating access to the lakeside as well as making shelters and drying racks for animal hides. *Corylus* shows a similar drop in quantity as does *Tilia* and *Picea*. *Pinus* and *Fagus* continue to establish themselves in the tree percentages without any impact caused by humans.

Non-tree pollen remained relatively stable, the only drop coinciding with a human presence is a fall in *Ericaceae* and possibly a sharper drop in *Graminaceae* than in the earlier period. It is possible that grazing by larger mammals like red deer and ibex caused these fluctuations.

This period is likely to have seen localised human impact around the lakes, while in general the tree canopy continues to establish itself. The tree line would have gradually increased in altitude. This is likely to have had an impact on habitats for animals such as the large mammals that were the prime target to the early Mesolithic hunters.

After Human Occupation

This broad phase relates to the later periods when there is no evidence for human occupation at Colbricon. During the Atlantic pollen zone, the timber line was higher than it is today and is likely to have resulted in a severe reduction in natural open woodland / meadow, where herds of red deer and other animals would have grazed. In Chapter 3 it is suggested that this would have resulted in a lower carrying capacity for large herds at this altitude, as well as a possible reduction population densities. Strategies would have concentrated in encounter hunting and possibly smaller game are likely to have focused at lower altitudes. Evidence for this can be seen by the fact that rock shelters in the lower altitude Adige valley continued to be occupied (and probably more intensively (e.g. Riparo Gaban)) throughout the Castelnovian.

The later pollen sequence does demonstrate a gradual rise in the tree:non-tree pollen ratio. Although the period immediately after human occupation sees a drop in *Picea*, the general rise in *Pinus* and *Fagus* continues. The drop in *Alnus* which corresponds with evidence of charcoal shows a steady rise once human activity at Colbricon ceases. The drop in *Corylus,* also seen during the phases of human occupation, continues. Once its position in the tree cover was affected by human activity, it was very difficult for the tree to re-establish itself in the face of competition from *Pinus* and *Fagus*. *Betula* appears for the first time at this stage and continues at a relatively low ratio.

Apart from *Graminaceae*, which initially fell in quantity at the time of human presence on the mountain, herbs and non-tree pollen drop as a relative proportion of the total pollen count.

The pollen records from Colbricon reflect the broad knowledge regarding vegetational history elsewhere in the Trentino region of the southern Alps (e.g. Oeggl and Wahlmüller 1994).

APPENDIX 2

RADIOCARBON DATES FOR THE MAIN SITES IN THE STUDY AREA

Appendix 2 lists the main radiocarbon dates available for the study area. Most dates are given in uncalibrated radiocarbon years.

Val Lastari	Sample Number	AMS dates bp
Level 3b	UtC-1773	11,390 ±110
Level 3b	UtC-2041	11,010 ±90
Level 3c	UtC - 2040	9,130± 80
Features		
Feature 3	UtC-2087	11,800±150
Feature 4	UtC-2686	13,450± 130
Feature 5	UtC-2685	10,280±110

Table A2.1: Val Lastari AMS radiocarbon dates (from Broglio *et al* 1994)
Note: Levels 3b represent the loess soils sealing the archaeological deposits.

Colbricon	Sample Number	Date bp
Site 1	R - 895	9370±130

Table A2.2: Colbricon (from Bagolini and Dalmeri 1987)

Romagnano III	Sample Number	Date bp
Layer AA	R-1136	6480±50
Layer AB1.2	R-1137	7850±60
Layer AB1.2	R-1137A	7500±160
Layer AB1.2	R-1137B	7800±80
Layer AB3	R-1138	8140±80
Layer AC1	R-1139	8220±70
Layer AC2	R-1140	8560±70
Layer AC3	R-1141	8590±90
Layer AC4	R-1142	8740±90
Layer AC5.6	R-1143α	9090±90
Layer AC7	R-1144α	9100±90
Layer AC8.9	R-1145	9200±60
Layer AC8.9	R-1145α	9200±60
Layer AE1.4	R-1146A	9580±250
Layer AE1.5	R-1146α	9420±60
Layer AE	R1146B	9490±80
Layer AF	R-1147	9830±90

Table A2.3: Romagnano III (from Alessio *et al* 1983)

Pradestel	Sample Number	Date bp
Layer D1-3	R-1148	6870±50
Layer H-H2	R-1149	8200±50
Layer L1	R-1150	8240±200
Layer L7-8	R-1151	9320±50

Table A2.4: Pradestel (from Alessio *et al* 1983)

Vatte di Zambana	Sample Number	Date bp
Layer 2-3	R-487	7250±110
Layer 5	R-488	7540±75
Layer 5	R-488α	7585±75
Layer 7	R-489	7860±75
Layer 7	R-489α	7810±95
Layer 10	R-490	7860±110
Layer 10	R-490α	7960±100
Layer 10 burial	R-491	8000±110
Layer 10 burial	R-491α	7740±150

Table A2.5: Vatte di Zambana (from Alessio *et al* 1983)
Layer 10 includes two dates for the female inhumation

Grotta d'Ernesto:	Material Dated	Sample Number	Age bp
Hall of Fireplace	charcoal	Gd-5481	8140±80
Hall of Fireplace	charcoal	Gd-5618	9110±70
Hall of Fireplace	collagen	Gd-4510	8520±190
Hall of Torch	charcoal	Gd-5492	8270±90
Hall of Torch	charcoal	Gd-6132	9300±110
Hall of Torch	collagen	Gd-6182	11900±200
Hall of Torch	flowstone	Gd-5479	7870±70
Hall of Torch	flowstone	Gd-6153	6550±150
Hall of Torch	flowstone	Gd-5639	6460±70
Hall of Torch	flowstone	Gd-6154	6000±140
Hall of Torch	flowstone	Gd-5613	7660±100
Hall of Torch	flowstone	Gd-6155	7280±150

Table A2.6: Radiocarbon dates from Grotta d'Ernesto (Awsiuk *et al* 1994). Speleotherms from the flowstones were sampled.

EARLY MESOLITHIC HIGH ALTITUDE HUNTING SITES IN THE TRENTINO

See Figure 5.1 for location map of site areas.

Area A	Altitude	Date
Pian dei Laghetti I-II	1490	Late Upper Palaeolithic
Malga Rolle II	1880	Mesolithic indeterminate
Malga Rolle I	1890	Mesolithic indeterminate
Malga Fosse di Sopra Loc. Sorgente	1922	Mesolithic indeterminate
Colbricon I	1922	Early Mesolithic
Colbricon II	1922	Early Mesolithic
Colbricon III	1922	Early Mesolithic
Colbricon IV	1935	Early Mesolithic
Colbricon VI	2050	Early Mesolithic
Colbricon VII	1910	Early Mesolithic
Colbricon VIII	1975	Early Mesolithic
Colbricon IX	1940	Early Mesolithic
Malga Buse	1935	Mesolithic
Lago Cavallazza	2142	Mesolithic
Area B		
Alpe Miesnotta Laghetto II	2045	Mesolithic indeterminate
Alpe Miesnotta Laghetto I	2052	Mesolithic indeterminate
Passo Sadole I	2066	Mesolithic indeterminate
Passo Sadole II	2066	Mesolithic indeterminate
Lago delle Trute Costa Boccioni	2103	Mesolithic indeterminate
Area C		
Bualon di Cima d'Asta	1800	Mesolithic?
Lago del Lagorai	1870	Mesolithic indeterminate
Passo val Cion	2070	Mesolithic indeterminate
Col S.Giovanni I-II	2101	Early Mesolithic
Bualon Cima d'Asta – Capanna del Pastore	2130	Mesolithic indeterminate
Laghi delle Buse Basse I	2193	Early Mesolithic
Lago delle Stellune – Forcella Valsorda	2200	Early Mesolithic
Forcella Ravetta	2219	Mesolithic indeterminate
Area D		
Pian dei Cavai in Val Montalon I-II	1919	Mesolithic?
Lago delle Buse I-IX	2060	Early Mesolithic
Lago del Montalon	2089	Mesolithic indeterminate
Forcella di Montalon	2125	Later Mesolithic
Maddalena di fronte al Pian della	2127	Mesolithic indeterminate
Sopra il Piano delle Fave	2131	Mesolithic?

Area E	Altitude	Date
Malga delle Buse del Sasso I-III	1906m	Early Mesolithic
Malga Buse	1935	Mesolithic indeterminate
Passo cadino o del Manghen Vecio	1954	Mesolithic indeterminate
Pian dei Mirafiori	1965	Mesolithic indeterminate
Busa delle Val di Mattio	2000	Mesolithic indeterminate
Passo di Palu versanti Calamento	2010	Mesolithic indeterminate
Passo Manghen laghetto Cadinello	2050	Mesolithic indeterminate
Val Ziolera	2050	Early Mesolithic
Pian del Sasso Rotto I-V1	2060	Mesolithic indeterminate
Sette Laghi Lago Grande	2070	Mesolithic indeterminate
Lago d'Ezze o d'Erze	2106	Mesolithic indeterminate
Passo di Cadino di Fiemme	2108	Mesolithic indeterminate
Area F		
Plan de Frea	1903	Early and Later Mesolithic
Sella Joch	2121	Mesolithic
Sella Joch II	2160	Later Mesolithic
Sella Joch VIII	2170	Mesolithic
Sella Joch IV	2180	Mesolithic
Passo Pordi II	2180	Mesolithic
Sella Joch III	2250	Mesolithic
Sella Joch V	2250	Mesolithic?
Passo Sella (Alb. Valentini)	2250	Mesolithic?
Passo Sella	2250	Mesolithic?
Area G		
Cislis	1990	Mesolithic
Brogles Sattel	2100	Mesolithic
Raschotz	2120	Mesolithic
Cuca Sattel – Pic Berg 6G	2200	Mesolithic
Wurz Joch I	2004	Later Mesolithic
Wurz Joch II	2006	Mesolithic
Wurz Joch III	2006	Mesolithic
Area H		
Val Duron Rifugio Micheluzzi	1750	Mesolithic indeterminate
Val Duron Rifugio Malga Micheluzzi Campitello	1840	Mesolithic
Seiser Alm VII Wegkreuz	1845	Mesolithic
Seiser Alm VI Kompatsch	1850	Mesolithic
Seiser Alm I Cionstoan	1855	Late Palaeolithic
Seiser Alm XI Molignon	2075	Late Mesolithic
Val Dona 3TJE1	2100	Late Mesolithic
Seiser Alm II Zallinger	2150	Mesolithic
Seiser Alm XVI Schneid	2150	Early Mesolithic
Seiser Alm XV Schneid	2160	Early Mesolithic
Val Dona TVU1	2180	Early and Later Mesolithic
Val Dona CLM1	2183	Early and Later Mesolithic
Seiser Alm III Schneid	2197	Later Mesolithic
Seiser Alm XIII Mahlknecht Joch	2199	Mesolithic
Seiser Alm X Schneid	2200	Early Mesolithic
Area H		
Seiser Alm XII	2205	Later Mesolithic
Val Dona	2210	Mesolithic
Passo Sella	2250	Mesolithic?

Area H		
Sasplat (Camitello di Fassa	2290	Mesolithic
Val Dona S. Dos	2300	Mesolithic
Fassa Joch (Campitello di Fassa)	2300	Later Mesolithic
Area I		
Passo di S Pellegrino Malga Campo d'Orso	1810	Mesolithic indeterminate
Passo di S Pellegrino Loc. Cava	1919	Mesolithic indeterminate
Passo di S Pellegrino Soraga	1925	Mesolithic indeterminate
Passo Lusia (Moena)	2055	Mesolithic indeterminate
Laghi di Lusia	2056	Mesolithic indeterminate
Passo Valles I-III	2050	Mesolithic indeterminate
Canazei - Ciampac	2200	Mesolithic
Ciampac	2250	Mesolithic
Area J		
Passo di Costalunga-Vigo	1750	Mesolithic indeterminate
Lavaze	1810	Mesolithic indeterminate
Reiter Joch II	1950	Mesolithic indeterminate
Jochgrimm	2000	Early Mesolithic
Reiter Joch I	2010	Early Mesolithic
Sattel Joch	2121	Mesolithic indeterminate

APPENDIX 4

COLBRICON FLINT ANALYSIS

Appendix 4 provides a fuller description of lithic material recorded from Colbricon, particularly with regard to debitage and other waste material (see Tables A4.1 - A4.4). Interpretation of the lithic material is presented in the main text. Tables A4.5 - A4.8 need to be read in conjunction with Figures 5.4a and 5.4b in Chapter 5.

Introduction

Apart from microlithic material and other tools such as scrapers, a very large proportion of the lithic assemblages consists of residue including debitage, microburins, trimming flakes, core rejuvenation flakes as well as blanks used for the production of retouched tools. The remainder of waste material is typologically unidentifiable and consists of chipped stone splinters with no trace of retouch. This residue has been broadly classed by Bagolini and Dalmeri in terms of its length and shape and ranges in size from pieces between 0.5 to 3-6cm in length. The smaller length pieces tend to be proportionately broader in terms of length to width ratios and are defined as small splinters or flakes. The longer and thinner pieces are classed as blade/bladelets or blade shaped flakes. In addition, Bagolini and Dalmeri (1987) class this waste material in terms of its overall size - most splinters being microlithic or smaller in size ('hypermicrolithic'), while other fragments are classified as larger blades. In many respects the scale of the analysis of the waste material can be considered as excessive. The broad conclusions at the end of the study provide no further information other than the material demonstrates large-scale microlithic production. Tables A4.1-A4.4 present this material for all the excavated areas at Colbricon.

A confusing aspect of the original report was that the percentages for each type of tool or microlith was given as a ratio of the whole range of material attributable to particular lithic classes, including diagnostic waste material such as microburins or armature processing fragments. This waste material occurs as a high proportion of identifiable material and therefore skews the percentage figures for the proper tool classes. Flakes and cores - not real tool types - were also included in these figures and further contribute to the bias in percentage recording. It would appear from the presentation of the report that the main objective of Bagolini and Dalmeri (1987) was to present a typological exercise rather than an attempt to understand human behaviour at the sites. It is therefore regarded as necessary to revise the method of calculating the percentage figures and to present the data in a clear tabular way.

Tool Processing and Subsistence Sites

Area 3A

Area 3A contained a total of 6746 lithic fragments. This included typologically identifiable material, as well as debitage and blocks or plates of flint that were imported to the site as raw material. A total of 1115 lithic fragments are to some extent typologically identifiable. A further 920 chipped stone bladelets are measurable waste fragments with no retouch. This material is likely to have been largely the result of microlith manufacture.

In terms of clearly identifiable artefact types, 315 fragments are recorded of which the largest proportion of material consists of microliths (233 or 74.4% of the identifiable tools). Other tool types are represented by 82 fragments. Residue associated with the manufacture of microliths or tool maintenance includes 783 microburins. A further point of interest is that 63.5% of the microliths are broken and therefore represent material rejected as waste. Unidentifiable microliths number 99 (42.49%) of the microlithic assemblage. The majority of identifiable microliths consist of points (86). These are followed by backed blades (19) and truncated points (15). Symmetrical and asymmetrical points are poorly represented (9).

Eighty-two identifiable tools other than microliths are also recorded. These include nine burins, seven scrapers, seven truncated blades and further non-measurable fragments of blades, points, blade scrapers, denticulates and material with steep retouch. Further identifiable material consists of 17 core fragments.

Most of the waste material is associated with the manufacture of microliths. Microburins totalled 664 fragments and 119 flakes with notches close to fracture points are also recorded. Therefore 783 fragments or 70% of the typologically identifiable material belongs to a class of material interpreted as relating to the production or maintenance of microliths.

A total of 920 fragments are classified as splinters and waste material (see Table A4.1 and A4.2) The bulk of this material consists of tiny bladelet and splinters. The size and overall form of this residue indicates activity associated with projectile point manufacture. Over 76% of this material is "hypermicrolithic" or microlithic in size.

The final lithic category consists of raw material. Approximately 400 pieces of nodules and tabular flint were recorded from Site 3A. Very little of this flint contained cortex material (6.6%) and indicates that flint was partially worked before arriving at the site.

<u>Area 3B</u>

Area 3B was a much smaller area of activity and had a correspondingly smaller lithic assemblage. A total of 518 lithic fragments are recorded of which 34 are attributable to a typology and 80 consist of measurable splinters of waste. The small numbers of worked stone means that it is difficult to interpret the significance of percentages for each tool class. Microlithic remains total eight pieces, of which five could be classified. These consist of truncated points, backed blades and symmetrical points. No projectile points or triangles were recorded. Tools other than microliths consist of three scrapers and a truncated blade. Three fragments of non-measurable tools are also recorded. These probably consist of blade fragments. One core is also recorded. Measurable residue associated with microlithic manufacture is limited to 18 fragments, of which 17 were microburins. Chipped stone splinters with no trace of retouch consist of 80 fragments. This material consists of tiny flakes related to the manufacture or processing of microlithic material. Over 85% of this material was microlithic or smaller in size. Approximately 500 nodules of flint are also recorded.

Lithic Processing / Subsistence Sites				
Area	Complete blade	Blade shaped flake	Flake (splinter)	Total
1A	228 (30.8%)	161 (21.8%)	350 (47.3%)	739
1B	167 (31.5%)	103 (19.4%)	260 (49%)	530
1C	21 (30%)	20 (28.5%)	29 (41.5)	70
1D	25 (26.3%)	24 (25.3%)	46 (48.5%)	95
1E	43 (37.7%)	23 (20.2%)	48 (42.1%)	114
3A	369 (40.1%)	207 (22.5%)	344 (37.4%)	920
3B	17 (21.3%)	13 (16.3%)	50 (62.4)	80
4	42 (42.4%)	19 (19.2%)	38 (38.4%)	99
7	14 (26.4%)	16 (30.2%)	23 (43.4%)	53

Table A4.1: Lithic Processing / Subsistence Sites - Residue quantified in terms of shape

Lithic Processing / Subsistence Sites						
Area	Hyper-microlithic	Microlithic	Small size	Medium size	Macro size	Total
1A	402 (54.3%)	261 (35.3%)	63 (8.5%)	12 (1.6%)	1 (0.3%)	739
1B	321 (60.6%)	165 (31.1%)	37 (7.0%)	7 (1.3%)	-	530
1C	19 (27.1%)	30 (42.9%)	16(22.9%)	5 (7.1%)	-	70
1D	53 (55.8%)	31 (32.6%)	6 (6.3%)	4 (4.2%)	1 (1.1%)	95
1E	44 (38.6%)	51 (44.7%)	14 (12.3%)	4 (3.5%)	1 (0.9%)	114
3A	428 (46.5%)	326 (35.4%)	106(11.5%)	47 (5.1%)	13 1.4%)	920
3B	41 (51.3%)	27 (33.8%)	8 (10%)	2 (2.5%)	2 (2.5%)	80
4	46 (46.5%)	30 (30.3%)	17 (17.2%)	4 (4%)	2 (2%)	99
7	27 (50.9%)	13 (24.5%)	11 (20.8%)	2 (3.8%)	-	53

Table A4.2: Lithic Processing / Subsistence Sites - Residue quantified in terms of size

Area 1

Out of a total of 4165 lithic fragments, 521 were attributable to a typology and were to some extent measurable. This number included microburins and other material associated with microlithic manufacture. A further 1548 lithic fragments of chipped stone splinters with no retouch were also recorded (see Tables A4.1 and A4.2). This material is similar to the lithic waste recorded from Areas 3 and is undoubtedly the result of processes associated with microlithic manufacture. The bulk of this material was microlithic or smaller in size range.

In terms of clearly definable artefact types, the largest proportion were microlithic projectile points (57.1%). Microliths numbered 112 while other tool types were represented by 84 fragments. Residue associated with the manufacture of microliths included 311 microburins and flakes with notches close to the fracture. In addition, about 75.7% of the projectile points were broken and therefore represent further material rejected as waste. A total of 76 microliths were typologically identifiable (67.86%) and the majority consisted of projectile points (32) (see Table 5.2). These were followed by backed blades (20) and asymmetrical points (19). Five truncated points and a symmetrical point were also recorded.

Eighty-four tools other than microliths were recorded. These include 22 scrapers, six burins, and a range of 52 truncated blades, other blades, points, scrapers and denticulates that were not measured precisely. Fourteen cores were also recorded.

The remainder of the lithic material consisted of waste and raw flint, most of which included residue associated with the manufacture of microliths. A large proportion of this material consisted of microburins and flakes with notches close to the points of fracture. This material consisted of 311 fragments or 59.7% of the identifiable material. Out of the material that was not attributable to a type, a large proportion (1548) consisted of chipped stone splinters with no trace of any retouch. These were mainly microlithic or smaller in size and consisted largely of blade shaped flakes and splinters (Tables A4.1 and A4.2).

Approximately 1250 fragments of flint nodules were recorded. Most contained no cortex and indicates that flint was imported to the site partially worked.

Area 4

Area 4 contained a total of 1293 lithic fragments of which 132 were typologically attributable and 99 were measurable waste fragments (see Table 5.1). Out of 76 identifiable lithic types 45 (59.2%) are microliths and 31 (40.8%) are other tool types.

Twenty-three microlith fragments are identifiable. A significant aspect of this assemblage is the complete absence of triangular projectile points. In all the other Colbricon site areas they form the dominant proportion of identifiable microliths. In contrast, the dominant form at Area 4 are symmetrical/asymmetrical points, these total 11 of the identifiable assemblage. In addition eight backed points and four truncated points are also recorded.

Thirty-one other tool types are recorded. These consist of three burins and 15 blade tools. Eight denticulates and five blade/scrapers and a point are also recorded. This higher than normal figure of non-microlithic tools suggests a site related to subsistence activity rather than microlithic manufacture.

The remainder of the lithic material consists of waste, cores and nodules. Fifty-five fragments of microburin and material with notches close to fracture points were identified. In addition, 99 fragments of chipped flint with no retouch are also recorded. This material is classed in terms of size range as tiny bladelet and splinters. Tables A4.1 and A4.2 present this information and show that a high proportion of material (over 76%) is microlithic or smaller in size range.

In terms of the raw materials, only 7.8% of all flint has any trace of cortex. Raw materials consisting of plate and nodule flint is also very rare. There is, however, a much higher number of flints with flake scars suggesting knapping activity. Cores themselves are almost absent.

Area7

A total of 47 lithic fragments were recovered, of which 31 were identifiable (see Table 5.1 and 5.2). Twenty-four consist of microliths (77.4%) and seven (22.6%) fragments comprise of other tools. Fifteen of the microliths are identifiable and ten of these are triangular projectile points. Also recorded are two symmetrical points and two backed points and one truncated point.

The remaining seven tools consist of two truncated blades, one point, one blade with steep retouch and three denticulates. Two cores are also present in the assemblage.

The remainder of material consists of waste and residue (Tables A4.1 and A4.2). Fourteen fragments of microburins and material with notches close to fracture points are recorded. Fifty-three fragments of chipped flint splinters with no retouch are also recorded. This material is classified in terms of splinters and bladelet shaped flakes. Over half of this material consists of microlithic or smaller fragments.

Intercept Sites

Area 8A

Out of a total of 2032 lithic fragments 257 were attributable to a lithic typology (see Table 5.4). In terms of definable tools types, the largest proportion were microlithic projectile points (89% of the identifiable tools). Microliths numbered 105 and other tools types totalled 13 fragments. Residue associated with the manufacture of microliths included 135 microburins and notched fragments. There were also 340 fragments of chipped stone with no evidence of retouch.

Fifty-three out of the 105 microliths are identifiable and are dominated by 23 triangular projectile points (43.4%) and 15 asymmetrical points (28.3%) (see Table 5.5). A further 12 backed points (22.7%) and two truncated points (3.8%) and one backed blade (1.9%). A large proportion of the microliths are reported to be fragmented (Bagolini and Dalmeri 1987: 187). This may have been the result of the maintenance of weapons for hunting.

The remaining 13 tools consist of four scrapers, three burins, a truncated blade and five tools with steeps retouch and denticulates. Four cores are also recorded.

A total of 135 fragments of microburin and material with notches close to fracture points are recorded and 340 fragments of chipped flint with no retouch are also counted. These consist of splinters and blade shaped flakes and a very high percentage are microlithic or smaller in size grouping (90%) (see Tables A4.3 and A4.4).

Area 8B

The total lithic assemblage comprises 2457 fragments of which 453 are measurable and 408 are typologically assigned. In terms of identifiable tools types, the largest proportion are microlithic projectile points (86.11%). Microliths numbered 155 and other tools types totalled 25 fragments. Out of the 155 microliths 85 were identifiable. These were dominated by 51 triangular projectile points (60.1%) and 21 backed points (24.7%). The rest of the material consisted of nine asymmetrical points and four truncated points. A large proportion

Ambush / Intercept Sites				
Area	Complete blade	Blade shaped flake	Flake (splinter)	Total
2A	27 (29.3%)	23 (25%)	42 (45.6%)	92
2B	17 (41.4%)	9 (22%)	15 (36.5%)	41
6	22 (40%)	16 (29.1%)	17 (30.8%)	55
8A	114 (33.6%)	71 (20.9%)	155 (45.5%)	340
8B	119 (26.3%)	112 (24.7%)	222 (49.1%)	453
8C	148 (32.1%)	100 (21.6%)	214 (46.3%)	462
8D	84 (30.9%)	73 (26.8%)	115 (42.3%)	272
9	148 (25.4%)	127 (21.8%)	307 (52.8%)	582

Table A4.3: Ambush / Intercept Sites - Residue quantified in terms of shape

Ambush / Intercept Sites						
Area	Hyper-microlithic	Microlithic	Small size	Medium size	Macro size	Total
2A	39 (42.4%)	29 (31.5%)	19 (20.7%)	4 (4.3%)	1 (1.1%)	92
2B	12 (29.2%)	22 (53.7%%)	4 (9.8%)	3 (7.3%)	-	41
6	44 (80%)	8 (14.5%)	3 (5.5%)	-	-	55
8A	190 (55.9%)	116 (34.1%)	28 (8.2%)	6 (1.8%)	-	340
8B	279 (61.6%)	148 (32.7%)	20 (4.4%)	5 (1.1%)	1 (0.2%)	453
8C	206 (44.6%)	176 (38.1%)	62 (13.4%)	14 (3%)	4 (0.9%)	462
8D	117 (43%)	96 (35.3%)	49 (18%)	8 (2.9%)	2 (0.8%)	272
9	288 (49.5%)	211 (36.2%)	67(11.5%)	12 (2.1%)	4 (0.7%)	582

Table A4.4: Ambush / Intercept Sites - Residue quantified in terms of size

of the microliths are recorded as fragmented (Bagolini and Dalmeri 1987:187). This may have been the result of the maintenance of weapons for hunting.

The tools other than microliths consist of 25 fragments including one burin, six scrapers, five truncated blades and a series of 13 non-diagnostic blades with retouch. Eight cores are also recorded.

The remainder of the lithics consist of waste and raw material, of which a total of 220 fragments of microburins and notched flakes are recorded. In addition, 453 fragments of chipped stone with no trace of retouch were recorded. Table A4.4 shows that a very high proportion are splinters of microlithic or even smaller in size (94.3%).

<u>Area 8C</u>

The total lithic assemblage consists of 6141 fragments of which 462 are measurable and 555 typologically attributable (Table 5.4).

As with all the other assemblages studied, the largest proportion of identifiable tool types comprise microlithic material (78.34%). Microliths total 246 of which 143 were identifiable (Table 5.5). These consist largely of triangular projectile points (85) and backed points (27). In addition smaller quantities of truncated points (14) and asymmetrical points (12) are also recorded. In addition to the microliths 68 fragments of other tools are recorded. These consist of 20 scrapers and 15 burins, as well as truncated blades and blades fragments which were too damaged for clear identification. Nineteen cores and four large flakes are also recorded.

Waste material or residue associated with the manufacture and maintenance of microliths consist of 218 fragments of microburin and other notched flakes. A further 462 fragments of chipped stone with no trace of retouch are also recorded, of which a high proportion were bladelets or splinters of flake and were microlithic or smaller in size (82.7%) (see Table A4.3 and A4.4).

Area 8D

The total lithic assemblage for Area 8D consisted of 3083 fragments of which 272 were measurable and 260 typologically attributable (see Table 5.4).

The largest proportion of identifiable tool types consist of microlithic projectile points (78.81%), comprising 119 microliths and 32 other tools (see Table 5.5). Sixty-three microlith fragments were identifiable. As with practically all the microlithic assemblages, Area 8D was dominated by 25 triangular projectile points and 17 backed points. Smaller quantities of backed blades (4), truncated points (8) and asymmetrical points (8) and other fragments are also recorded.

Thirty-two fragments of other tool types are recorded consisting of seven burins and six scrapers. Non diagnostic fragments of blades with steep retouch and denticulates. as well as eleven cores are also recorded.

Waste material and residue associated with the manufacture and maintenance of microliths consist of 98 microburins and other notched flakes. Additionally, 272 pieces of chipped stone flake splinters and bladelets with no trace of retouch are recorded. These are microlithic or smaller in size (see Tables A4.3 and A4.4).

Area 2A

Area 2A contained a total of 1080 lithic fragments of which 106 are typologically attributable and 92 consist of measurable waste (see Table 5.6). The remaining material was non measurable waste. Out of 39 clearly identifiable tools 28 (or 71.79%) are microliths, of which 18 are typologically identifiable (see Table 5.7). Eight microliths (44.3%) were triangular projectile points and six (33.4%) were symmetrical and asymmetrical points. Two truncated points, one backed blade and one backed point were also identified in the assemblage.

Eleven tools other than microliths were recorded including three scrapers, two truncated blades, a single burin and five less clearly diagnostic fragments with steep retouch and denticulation. Three cores are also identified.

The remainder of the material consists of waste and raw material. Sixty four fragments of microburin and material with notches close to fracture points were identified. In addition 92 fragments of flint with no retouch are recorded. These are classed as flake splinters and tiny bladelets and also by their size: over 73% are microlithic or smaller (see Tables A4.3 and A4.4).

Flint with traces of cortex is rare (5%) and nodules and plate flint were numerically insignificant. However, about 350 pieces of flint were used for cores.

Area 2B

Area 2B contained a total of 667 lithic fragments of which 70 were attributable to a typology and 41 fragments consisted of measurable waste (see Table 5.6). Out of 28 clearly identifiable tools the majority (23) are microliths (see Table 5.7). Seven fragments are classed as triangular points and six as backed points. Two consist of truncated points and symmetrical or asymmetrical points comprise of two fragments. Backed blades were not present in this assemblage.

In addition to microliths five tools are recorded, consisting of two scrapers and three undiagnostic pieces with steep retouch and denticulation. Three cores were also identified.

The remainder of the lithic material consist of waste and raw material. Thirty-nine fragments of microburin and notched flakes are recorded. In addition 41 fragments of flint with no retouch are recorded consisting mainly of complete bladelets and flake splinters; 34 are microlithic or smaller in size (see Tables A4.3 and A4.4).

Flint with traces of cortex were rare (8.7%) and plates and nodules of flint were almost absent. Flint fragments used for cores were fairly low in number (c200). Nuclei were also scarce and consisted of three fragments and represented 4.3% of the typologically identifiable assemblage.

Area 6

Area 6 contained a total of 874 lithic fragments of which 96 were attributable to a typology (see Tables 5.6 and 5.7). Thirty-eight typologically definable tools comprise of 25 (65.8%) microliths and 13 (34.2%) other tools types. Seventeen of the microliths were identifiable. These consisted of 12 triangular projectile points and three backed points. One symmetrical point and a truncated point were also found. There were no backed blades present in this assemblage.

A total of 13 tools other than microliths were recorded. These included four burins, two scrapers and six truncated blades. No flakes or cores were recorded.

The rest of the assemblage comprises of waste and raw material. Fifty-eight fragments of microburins and material with notches close to fracture points were recorded. In addition 55 fragments of chipped flint with no trace of retouch were recorded. Tables A.4.3 and A4.4 present this information and shows that a very high proportion of the material consists of complete bladelets and flake splinters and 76.8% is microlithic or smaller.

In terms of raw materials none of the flint had traces of cortex and plate and nodules were absent from the site. From the quantities of waste material and the absence of raw materials and cores, it appears that very little lithic processing was carried out at Area 6.

Area 9

A total of 2124 lithic fragments were recorded, of which 356 were typologically attributable and a further 582 were measurable fragments with no retouch (see Table 5.6). The central area of the site produced a very high density of lithic material and burnt stone and it is possible that two fireplaces occupied the area. Spatial distribution of the lithics showed that cores and projectile points are concentrated within the central area of the site, while other tools tend to occupy the peripheral parts of the site.

Out of the 356 fragments that were identifiable, 163 comprise of residue such as microburins associated with the manufacture of microliths. Twenty cores are also recorded. The remaining material consists of tools (173) comprising 137 (79.2%) microlith fragments and 36 (20.8%) other tools types (see Tables 5.6 and 5.7).

A total of 84 microliths were typologically identifiable (Table 5.7). These included 42 triangular projectile points and 17 backed points. Twelve truncated points were also recorded together with a eight asymmetrical points and two backed blades. Three trapezoids indicate a late Sauveterrian or possibly early Castelnovian date for Area 9. The 36 non-microlithic tools consisted of six truncated blades, seven burins and seven scrapers. In addition 16 fragments of non diagnostic blades, blade scrapers and denticulates were recovered from Area 9. Twenty cores and a single flake were also recorded.

The remaining pieces consisted of raw materials and waste. A total of 163 fragments of microburin and material with notches close to fracture points are recorded. In addition a further 582 fragments of chipped stone with no retouch are recorded (see Tables A4.3 and A4.4). This material comprised of splinters and bladelet shaped flakes and a high proportion (499 or 85.7%) were microlithic or smaller in size.

Raw	Site Type	Microliths	Residue	Microliths %	Residue %	Total
1A	Tool proc	66	193	25.48%	74.52%	259
1B	Subsistence	27	32	45.76%	54.24%	59
1C	?	2	1	66.66%	33.33%	3
1D	Subsistence	6	11	35.3%	64.7%	17
1E	Tool proc	11	74	12.9%	87.1%	85
2A	Intercept	28	64	30.4%	69.6%	92
2B	Intercept	23	39	37.1%	62.9%	62
3A	Tool proc	233	783	22.9%	77.1%	1016
4	Subsistence	45	55	45%	55%	100
6	Tool proc	25	58	30.1%	69.9%	83
7	Tool proc	24	14	63.2%	36.8%	38
8A	Intercept	105	135	43.8%	56.2%	240
8B	Intercept	155	220	41.3%	58.7%	375
8C	Intercept	246	218	53%	47%	464
8D	Intercept	119	98	54.8%	45.2%	217
9	Intercept	137	163	45.7%	54.3%	300

Table A4.5 Data used to calculate Figure 137 in Bagolini and Dalmeri 1987 and Figure 5.4a in main text. Percentages of Microliths v Residue.
(Area 7 not included in plots)

Area	Site Type	Microliths	Other Tools	Microliths %	Other Tools %	Total
1A	Subs/ tool	66	28	70.2%	29.8%	94
1B	Subsistence	27	27	50%	50%	54
1C	?	2	16	11.1%	88.9%	18
1D	Subsistence	6	10	37.5%	62.5%	16
1E	Tool proc	11	3	78.6%	21.4%	14
2A	Intercept	28	11	71.8%	28.2%	39
2B	Intercept	23	5	82.14%	17.86%	28
3A	Tool proc	233	82	74%	26%	315
4	Subsist.	45	31	59.2%	40.8%	76
6	Tool proc	25	13	65.8%	34.2%	38
7	Tool proc	24	7	77.4%	22.6%	31
8A	Intercept	105	13	89%	11%	118
8B	Intercept	155	25	86.1%	13.9%	180
8C	Intercept	246	68	78.34%	21.66%	314
8D	Intercept	119	32	78.8%	21.2%	151
9	Intercept	137	36	79.2%	20.8%	173

Table A4.6 Data used to calculate Figure 137 in Bagolini and Dalmeri 1987 and Figure 5.4a in main text. Percentages of Microliths v Tools.
(Area 7 not included in plots)

Area	Site Type	Microliths	Residue	Microliths %	Residue %	Total
1	Sub/ tool.	112	311	26.5%	73.5%	423
2A	Intercept	28	64	30.4%	69.6%	92
2B	Intercept	23	39	37.1%	62.9%	62
3A	Tool proc	233	783	22.9%	77.1%	1016
4	Subsist.	45	55	45%	55%	100
6	Tool proc	25	58	30.1%	69.9%	83
7	Tool proc	24	14	63.2%	36.8%	38
8A	Intercept	105	135	43.8%	56.2%	240
8B	Intercept	155	220	41.3%	58.7%	375
8C	Intercept	246	218	53%	47%	464
8D	Intercept	119	98	54.8%	45.2%	217
9	Intercept	137	163	45.7%	54.3%	300

Table A4.7 Data used to calculate Figure 5.4b in main text. Percentages of Microliths v Tools. (Area 7 not included in plots)

Area	Site Type	Microliths	Other Tools	Microliths %	Other Tools %	Total
1	Subs/ tool	112	84	57.14%	42.86%	196
2A	Intercept	28	11	71.8%	28.2%	39
2B	Intercept	23	5	82.14%	17.86%	28
3A	Tool proc	233	82	74%	26%	315
4	Subsist.	45	31	59.2%	40.8%	76
6	Tool proc	25	13	65.8%	34.2%	38
7	Tool proc	24	7	77.4%	22.6%	31
8A	Intercept	105	13	89%	11%	118
8B	Intercept	155	25	86.1%	13.9%	180
8C	Intercept	246	68	78.34%	21.66%	314
8D	Intercept	119	32	78.8%	21.2%	151
9	Intercept	137	36	79.2%	20.8%	173

Table A4.8 Data used to calculate Figure 5.4b in main text. Percentages of Microliths v Tools. (Area 7 not included in plots)

APPENDIX 5

TEETH FRAGMENTS FROM PRADESTEL

All teeth are from mature animals unless otherwise stated. See Chapter 7 for full data analysis.

CONTEXT	PHASE	ANIMAL	NUMBER	TOOTH DATA
	L5	Bear	1	Incisor
13	L6	Beaver	1	Canine
	L6	Beaver	1	Canine
13-15	L8	Pig	1	Canine
13-15	L8	Red	1	Incisor
		Total	**5**	
45	L1	Bear	1	Incisor
23	L4	Beaver	1	Canine
24	L3	Beaver	3	2x Incisor, M2
45	L3	Beaver	2	Incisor and Molar
34	L1	Beaver	3	2xM2 1x Incisor
23	L1	Beaver	1	Incisor
	L1	Beaver	1	Canine
	L	Beaver	1	
III	L4	Ibex	1	M1
	L1	Ibex	6	Molars
	L4	Pig	1	Incisor
16	L4	Pig	1	M2 (Grant F)
16	L4	Pig	2	Incisors
23	L1	Pig	6	Incisors
25	L4	Red	2	M2
45	L4	Red	1	M1 young
45	L4	Red	1	
34	L3	Red	1	M3 v young
16	L3	Red	1	M2
II	L1	Red	1	M1 worn
16	L1	Red	3	1pm 2M1s
14	L4	Roe	1	M1
15	L4	Roe	1	Incisor
16	L4	Roe	2	M1 and M2
		Total	**44**	
	H2	?	2	Fragments
	H	?	7	Fragments
16	H	Beaver	1	Canine
II	G-H	Caprid?	1	M2
	H1	Ibex	1	Canine
II	G-H	Ibex	1	M2
24	H	Red	1	M3 Young
III	H	Red	1	Incisor
III	H	Red	2	4pm

TEETH FRAGMENTS FROM PRADESTEL				
CONTEXT	**PHASE**	**ANIMAL**	**NUMBER**	**TOOTH DATA**
III	H	Red	1	M1
Esterno	H	Red	1	M1
II	G-H	Red	2	M1 and M2
Esterno	G	Red	2	M1 and M2
16	H2	Roe	4	2x M2, 2xM3
16	H	Roe	1	Molar young
III	H	Roe	2	M2
Esterno	H	Roe	3	M1
			33	
Q15	F3	?	1	1 molar
24	F3	?	2	Molars
Int	F2	?	2	
26	F1	?	3	
Int	F	?	11	
15	F2	Pig	1	Incisor
interno	F	Pig	1	Incisor
14	F2	Red	1	young
34	F3	Red	1	M2 young
25	F3	Red	1	M2 mature
Sotto	F3	Red	1	M2 max
Est	F2	Red	3	1 incisor, 1PM, 1 M2
45	F2	Red	1	M1 young
	F2	Red	1	M3 young
16	F1	Red	1	M2 mature
Interno	F	Red	1	M2 max young
Interno	F	Red	2	M2 and M3 young
34	F1	Red?	2	M2 burnt
24	F3	Roe	1	Incisor
	F2	Roe	1	M1 mature
24	F2	Roe	4	3 incisor, 1 M2
76	F1	Roe	3	M1 or M2
16	F1	Roe	3	M1 or M2s
Interno	F	Roe	1	M3 mature
		Total	**49**	
26	E1-3	?	5	
Int	E1	?	3	3 molars
16	E1	?	3	
25	E1	?	2	
Est	E1	?	6	
25	E	?	1	
16	E1-3	Small Mam	3	molars?
ii	EF	Bear	1	Incisor
	E2	Beaver	2	Molars
26	E1-3	Red	1	M2 young

TEETH FRAGMENTS FROM PRADESTEL				
CONTEXT	**PHASE**	**ANIMAL**	**NUMBER**	**TOOTH DATA**
15	E1	Red	2	Molars
Esterno	E1	Red	2	M2x2 young adult
Esterno	E1	Red	1	M1 young adult
55	E	Red	1	M2 max mature
	E2	Roe	2	Incisor and Molar
16	E1-3	Roe	4	2x inccisor, 2x M2 young
16	E1-3	Roe	7	2xInc, 2x M2+ 3xM3
23	E1	Roe	1	max - mature
Tutti	E,F,G	Roe	1	M1
Interno	E	Roe	1	M2
Interno	E	Roe	1	M2
16	E	Roe	1	M2
		Total	**51**	
	D3	?	1	
	D3	?	3	
Int	D3	?	1	
35	D3	?	1	
	D123	?	20	Fragments
	D	?	3	Fragments
iv	D	?	2	Fragments
16	D	?	1	
111	D3	Canid	2	incisor
35	D3	Red	1	P4
iv	D3	Red	1	Incisor
	D2	Red	1	
	D1	Red	1	M3 young
15	D1	Red	1	M2 yound adult
34-35	D	Red	1	M2 young
	D	Red	2	M2 mature
25	D	Red	1	M1 Young
15	D1	Rodent	1	
Int	D	Roe	2	M3 all v worn
111	D3	Roe?	3	Incisors
		Total	**49**	
	C	Red	2	Molars
Destra	A1	Roe	1	incisor
	A	?	3	
		Total	**6**	

SAMPLE SIZE AND ANIMAL SPECIES AND LITHICS DIVERISTY

By comparing various attributes of the rock shelter lithic and faunal material it is possible to evaluate the impact of taphonomic processes such as trampling and compaction. Once the overall effect of sample size and taphonomic processes are understood, we can begin to interpret the broad trends in Mesolithic subsistence change.

Pradestel and Romagnano are the most suitable site for study because they contain the greater range of animal species, as well as having the best lithic assemblages. Both Vatte di Zambana and Riparo Gaban offer further insights into variations in faunal material. Data from these sites, including rank order of assemblage size and species diversity is presented in Tables A6.1 - A6.6. The following sections summarise the main aspects.

Sample Size and Diversity: Fauna

Although sample size may affect the number of identifiable bones present, it does not necessarily affect the species diversity in an assemblage. Layers G3-G1 at Pradestel are a good example, in that this grouping has the highest species diversity (14), but is the fourth smallest sample in terms of overall bone numbers (see Table A6.1). This deposit is examined in more detailed with regard to lithic material (Table A6.6). At both Pradestel and Romagnano III (Table A6.2) the larger assemblages per grouping of Layers generally contain more identifiable bones (Pradestel Layers F3-F1 and EF-E and Romagnano AC8-AC4). The smaller assemblages have fewer identifiable bones (e.g. Pradestel L8-6 and D-A) and are from the base of the deposits and from the final layers. The final Layers may have suffered from particular post-depositional processes that did not effect the underlying layers. After the site was completely abandoned, surface material would have been left exposed to natural elements for a more indefinite period.

At Romagnano III, Layers AC8-AC4 has the greatest quantity of animal bones (290 identifiable or 697 all fragments). Although species diversity is highest in Layers AC8-AC4, with nine species, the next largest assemblages of identifiable bones (Layers AC3-AC1 with 283 bones and AA2-AA1 with 195 bones) each contain eight species (Table

ANIMAL BONES	L8-6	L4-L1	H2-H	G3-G1	F3-F1	EF-E	D3-D1	D-A
Red deer	7	42	82	57	176	152	108	43
Roe deer	-	17	17	15	58	117	71	18
Ibex	-	8	18	38	9	2	-	-
Chamois	-	5	41	4	10	12	-	2
Wild boar	3	14	38	7	6	8	6	1
Bear	-	-	7	3	-	3	1	-
Beaver	2	90	-	9	53	42	26	-
Pine marten	1	8	-	2	23	17	6	-
Fox	-	2	3	7	4	-	-	-
Wolf	-	2	7	5	2	-	5	-
Lynx	-	-	-	2	1	-	2	-
Wild cat	-	-	-	1	1	-	-	-
Hare	-	3	4	2	2	-	-	-
Otter	-	1	1	-	-	-	-	-
Badger	-	-	-	-	3	6	3	-
Bird	-	1	-	6	-	2	-	-
TOTALS	**13**	**193**	**218**	**158**	**348**	**361**	**228**	**64**
Unidentifiable bones	173	655	262	357	690	631	524	12
Teeth	5	44	22	2	30	28	18	3
Total faunal assemblage	191	892	502	517	1060	1020	770	79
Rank Order of Sample Sizes (and Number of Species)	L8-6	L4-L1	H2-H	G3-G1	F3-F1	EF-E	D3-D1	D-A
Identifiable Bones (Ranking)	1	4	5	3	7	8	6	2
All Fragments (Ranking)	2	6	3	4	8	7	5	1
Number of Species	4	12	10	14	13	10	9	4

Table A6.1: Pradestel - Summary of animal bone types showing rank order of sample sizes for each group of layers and number of species present

1:ANIMAL BONES	AF-AE	AC8-4	AC3-1	AB3	AB2-1	AA2-1
Red deer	3	107	59	29	29	48
Roe deer	3	47	40	17	15	38
Ibex	9	68	24	-	2	-
Chamois	-	28	7	9	13	15
Pig	2	18	3	2	3	9
Bear	1	7	1	-	-	5
Beaver	15	6	3	3	4	3
Pine marten	-	8	1	5	10	8
Fox	-	1	-	-	-	4
TOTALS	**33**	**290**	**138**	**65**	**76**	**130**
Unidentifiable bones	-	133	66	40	44	30
Teeth	-	265	79	12	49	32
Antler fragments	-	9	-	7	2	3
Total faunal assemblage	33	697	283	124	171	195
2: Rank Order of Sample Sizes (and Number of Species)	AF-AE	AC8-4	AC3-1	AB3	AB2-1	AA2-1
Identifiable Bones (Ranking)	1	6	5	2	3	4
All Fragments (Ranking)	1	6	5	2	3	4
Number of Species	6	9	8	6	7	8

Table A6.2: Romagnano III - Summary of animal bone types showing rank order of sample sizes for each group of layers and number of species present

A6.2). The absence of one animal type between a 697 bone assemblage and a 283 assemblage is that fox is not recorded in Layers AC3 - AC1. The 'missing animal' in Layers AA2 - AA1 is ibex. The loss of this animal can be explained in terms of subsistence change and not sample size, as it is absent from all the sites in the later Mesolithic period. The smallest group of Layers (AF-AE) contains 33 bones and produced six animal species. Sample size therefore does not appear to be such a significant factor in terms of species diversity at Romagnano III. This pattern is perhaps not quite so evident in the faunal material from Pradestel due to the presence of smaller mammals in small quantities scewing the broad trends in the data.

At Vatte di Zambana, the layers with the largest bone assemblages also contain a greater number of animal types (Layers 8-6) (Table A6.3).

At Riparo Gaban the situation is very different (Table A8.4). The group of layers comprising the early Castelnovian period, contains 885 identifiable bones and a further 10011 unidentifiable bones. Compared to Pradestel and Romagnano, there is a higher proportion of fragmented bone, and many were small midshaft pieces. Although this is both the largest grouping of bones at Riparo Gaban and the biggest analytical unit in this study, it contains only six identifiable species of animals, including the biggest grouping of wolf or large dog (15 bones). Species diversity is low and red and roe deer are the main animals recorded. There may be some significance in this limited range of animals as the site is located away from the Adige river, and smaller mammals such as beaver may not have been exploited to the same extent.

Sample Size and Diversity : Lithics and Fauna

Romagnano III has the largest lithic assemblage, and has been used by Broglio and Kozlowski (1983) as the type site for Mesolithic lithic analysis (Bagolini pers comm.). In terms of sample size and its relation to the faunal material, there are several observations.

ANIMAL BONES	11-9	8-6	5-4	3-1
Red deer	50	41	5	21
Roe deer	-	-	-	-
Ibex	3	7	-	-
Chamois	4	10	5	9
Pig	-	-	-	-
Brown bear	-	-	2*	-
Wild Cat	-	7	-	-
Beaver	-	-	-	-
Pine marten	-	-	-	-
Bird	-	-	1	1
TOTALS	**57**	**65**	**13**	**31**
Unident bones	133	55	48	44
Teeth*	-	-	-	-
Antler fragments	-	-	-	-
Total faunal assemblage	190	120	61	75
Rank Order of Quantities (and Species Diversity)	11-9	8-6	5-4	3-1
Identifiable Bones	3	4	1	2
All Fragments	4	3	1	2
Species Diversity	3	4	3	3

Table A6.3: Vatte di Zambana. Summary of animal bone types showing rank order of sample sizes for each group of layers and number of species present

1: ANIMAL BONES	1	2	3	4	5
Red deer	31	36	438	131	42
Roe deer	24	10	299	85	12
Ibex	8	-	-	-	-
Chamois	5	-	-	-	-
Pig	13	8	117	31	2
Sheep/goat	-	-	-	-	4
Bear	2	1	-	-	-
Wolf/ dog	6	2	15	3	2
Beaver	2	2	6	9	-
Pine marten	16	8	6	2	-
Hare	-	1	-	-	1
Fox	-	-	-	1	-
Human	2	-	-	1	-
TOTALS	**109**	**68**	**885**	**263**	**64**
Unidentifiable bones	1528	107	10011	6052	224
Teeth	-	-	-	-	-
Antler fragments	-	-	-	-	-
Total faunal assemblage	1637	175	10896	6315	288
2: Rank Order of Quantities (and Species Diversity)	1	2	3	4	5
Identifiable Bones (Ranking)	3	2	5	4	1
All Fragments (Ranking)	3	1	5	4	2
Number of Species	10	8	6	8	6

Table A6.4: Riparo Gaban . Summary of animal bone types showing rank order of sample sizes for each group of layers and number of species present

The character of the lithic material shows similar attributes to the faunal remains from Romagnano III. Sample size does not affect the range of lithic material recorded. Layers AC8 - AC4 contain the highest quantities of tools and microlithic material, and together with the succeeding layers (AC3 - AC1) contain the greatest range of tool types (see Table A6.5). In terms of range or variation in microliths there is very little difference between large lithic assemblages and small ones, except that the Castelnovian levels contain trapezes. An assemblage of 143 microliths contains the same range of material as an assemblage of 826. This indicates that the larger assemblages do not show a greater range of activities, but simply represent a more intensive pursuit of these activities: projectile points for hunting large mammals.

Tools show a similar lack of diversity between large and small assemblages. An assemblage of 622 tools contains ten types of tool (AC8-AC4) and AB3 with 94 fragments has nine tool types. It is argued that this lack of both tool and microlithic range of diversity is also reflected in the range of animals recorded throughout the Romagnano sequence. Apart from ibex disappearing from the Castelnovian levels, the range of animals is steady throughout the history of the site.

Section C of Table A6.5 confirms that assemblage diversity of both tools and microliths does not seem to be significantly affected by sample size at Romagnano III. A 205 sample of lithics has only three fewer tool / microlith types than a sample of 1448.

The lithic material from each group of layers at Pradestel confirms the broad pattern seen in the faunal material: the larger the assemblage, the greater the range of tools and microliths (Table A6.6). Although Pradestel has a smaller lithic assemblage, it has a much larger bone assemblage and the lithics appear to show a pattern that reflects this greater range of animal species, particularly with regard to small mammals.

Although Layers H2-H contain the largest tool assemblage (171 tools), Layers G3-G1 and F3-F1 contain smaller tool assemblages (64 and 39 tools respectively), but similar ranges of tool types. The range of scrapers are of particular significance. Short end scrapers and nosed

A: Microlithic Material	AF-AE	AC8-4	AC3-1	AB3	AB2-1	AA2-1
Total Microliths Microlith Fragments	106 37	702 124	463 115	119 24	144 18	153 -
Total inc. Fragments	143	826	578	143	162	153
Rank Order of Microlithic Fragments	1	6	5	2	4	3
B: Tools	AF-AE	AC8-4	AC3-1	AB3	AB2-1	AA2-1
Complete Tools Fragments of Tools Total Tools	32 30 62	483 139 622	196 64 260	71 23 94	118 12 130	122 4 126
Rank Order of Tool Fragments	1	6	5	2	3	4
Complete Lithic Assemblage	205	1448	838	237	292	279
Rank Order of All Lithics	1	6	5	2	4	3
C: Tool / Microlith Diversity	AF-AE	AC8-4	AC3-1	AB3	AB2-1	AA2-1
Diversity of Tool Types	8	10	10	9	8	8
Diversity of Microlith Types	8	9	8	9	9	6
Diversity of Complete Assemblage	16	19	18	18	17	14

Table A6.5: Romagnano - Lithics and diversity of tools and microlithic (see Tables 7.1 and 2 for full details)

A: Microlithic Material	L8 - 6	L4 - L1	H2 - H	G3- G1	F3-F1	EF-E	D3-D1
Total Microliths (Microburins	17 38	17 9	30 197	9 8	9 7	2 6	13 27)
Rank Order of Microliths	6	5	7	3	2	1	4
B: Tools:	L8-6	L4 - L1	H2-H	G3- G1	F3-F1	EF-E	D3-D1
Total Tools (excluding*)	10	17	67	36	26	13	19
* Fragments of backed retouched tools	22	17	104	28	13	6	2
Total Tool Fragments	32	34	171	64	39	19	21
Rank Order of Tools (Total sample including fragments)	1 3	3 4	7 7	6 6	5 5	2 1	4 2)
Total Lithic Sample Including Fragments Rank Order	130 2	138 3	414 7	160 4	193 6	51 1	178 5
C: Tool / Microlith Diversity	L8-6	L4 - L1	H2-H	G3- G1	F3-F1	EF-E	D3-D1
Diversity of Tool Types excluding fragments*	7	9	13	12	11	8	6
Diversity of Microlith Types	3	4	5	4	3	2	5
Diversity of Complete Lithic Assemblage	10	13	18	16	14	10	11

Table A6.6: Pradestel - Lithics and diversity of tools and microlithic (see Table 7.11 and 7.12 for full details) end scrapers dominate Layers G3-G1 and F3-F1. These Layers G3-G also contains awls or borers. These tools may be indicative of fur processing. It is considered significant that the animal bones from these same layers show an increase in the range of smaller mammals such as wild cat, beaver, pine marten and fox, as well as lynx and bird. It is argued that additional archaeological activity is visible within the H - F Layers. Trapping, skinning and other processing activities related to these animals resulted in the use of a greater range of tools being present in the assemblage.

APPENDIX 7

GROTTA D'ERNESTO ANIMAL BONES

This Appendix provides an example of the database used to record the animal bones from all the faunal assemblages presented in this study. Grotta d'Ernesto was chosen because it is relatively well preserved.

The computer database is based on the field recording sheets first developed in Clark (1985). A full archive of the bone data-sheets with butchery codes is held by the writer.

The coding is as follows:

URN, TRI, NO and LAYER refer to contextual information relating to phasing, layers and my reference number for each bone. BONE type, FUSION, CONDition, FRAGmentation and SIDE are self evident features of each bone. BUTCH1 and BUTCH2 are a computer coding system developed from Binford 1981 (Clark 1985).

The butchery coding is divided into three elements of a four digit numbering system (e.g. **1024**) suitable for computer database processing. The first digit is either **1** for cutmark or **2** for chopmark. The second and third digit (in the above example **02**) is the reference number of the cut / chop mark on a particular bone (in this example marks around the glenoid cavity of a scapula), and the fourth digit (**4**) refers to the number of cut or chopmarks in this area of the bone. Unlike a Bronze Age faunal assemblage, where it can be relatively easy to distinguish between a cut and chop mark, the evidence from the Mesolithic material is less clear - a heavy cutmark and a light chopmark may be visually the same. This problem is further compounded by the lack of evidence within the lithic assemblages for heavy duty tools such as axes. DETAILS refers to further information relevant to each bone. This may include contextual information as well a data specifically relating to the bones.

APPENDIX 7: GROTTA D'ERNESTO ANIMAL BONES

GROTTA D'ERNESTO: IBEX BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	BUTCH2	SIDE	DETAILS
4	239	79R	-	ASTRAG	F	G	100	0	0	L	-
6	0	17AR	R	ASTRAG	F	G	100	0	0	R	-
52	0	-	1-2	ASTRAG	F	G	100	0	0	L	-
66	48	48R	-	CALC	F	G	100	0	0	L	-
72	38	49R	-	CALC	F	G	100	0	0	R	-
26	0	53B3	6	CARPEL	F	G	100	0	0	R	-
38	0	A50	2	FEMUR	PUF	F	P05	0	0	N	BALL
43	6	04R	1-2	FEMUR	DF	F	D95	0	0	L	MALE 4R, GNAW TROCHAN
48	0	5AR	-	FEMUR	DF	G	D40	2621	1591	L	NO BALL TOOTH MKS MED DIST
73	123	-	3	FEMUR	F	G	100	1612	0	L	GRAW TROCHAN
76	115	28AR	3	FEMUR	DUF	F	D40	2612	0	R	FITS 93,94 TRAMP?
93	0	A53i	3	FEMUR	PUF	F	P20	2562	1563	a	ssist76,94 TRAMP?
94	222		3	FEMUR	UF	F	005			R	FITS 76,93 TRAMP?
27	200	-AR	-	HORN	F	G	060	0	0	L	195mm L 200CIRC LECK A R
28	0	C51	2	HORN	F	P	XXX	0	0	N	MANY FRAGS LECK B R
32	0		1-2	HORN	F	F	020	0	0	N	NEAR HEARTH
33	0		1-2	HORN	F	G	100	2000	0	N	370 H
34	0	-	1-2	HORN	F	G	005	0	0	N	-
	116	56AR		HUMER	DF	F	D80	0	0	L	-
25	13	-	-	HUMER	PUF	F	P05	0	0	L	-
41	0	52A2	3	HUMER	DF	F	D80	0	0	R	-
47	0	5AR	-	HUMER	DF	G	D80	0	0	L	SLIGHT BURNING
79	0	A54	2	HUMER	N	F	020	0	0	L	-
24	0	49A	3	INCISR	F	G	100	0	0	N	-
9	0	A53i	-	MAND	FG	G	D60	0	0	L	M3 ERRUPTING
10	0	*	1-2	MAND	MAT	G	090	0	0	L	ZONZ INGRESSO
12	0	53B	3	MAND	FG	G	010	0	0	R	CRENULATED

IBEX BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	BUTCH2	SIDE	DETAILS
14	282	75R	-	MAND	FG	G	020	0	0	L	TEETH V POINTED CUSPS
16	0	02AR	-	MAND	FG	G	080	0	0	R	-
17	247	78R	-	MAND	F	G	080	0	0	R	TOOTHMARKS
19	228	65R	-	MAND	F	F	040	0	0	R	-
21	0	06AR	3-9	MAND	F	F	060	0	0	L	MAT ADULT
23	152	57R	-	MAND H	F	F	005	0	0	L	-
22	0	49Ai	3	MANDF	F	P	020	0	0	R	82R
11	264	74R	-	MAXILA	FD	G	020	0	0	L	-
13	127	29R	-	MAXILA	F	F	005	0	0	R	-
15	0	07R	-	MAXILA	F	F	050	0	0	*	COMPLETE MOUTH 85mm wide
18	2	30R	-	MAXILA	F	F	010	0	0	R	-
20	52	39BR	3	MAXILA	MAT	F	010	0	0	R	-
80	68	-	-	MAXILA	F	F	005	0	0	R	M1 TOOTH
49	0	-	1-2	MCAR	F	G	100	0	0	R	138mm
50	0	-	1-2	MCAR	F	G	100	0	0	L	138 mm
51	0	0	1-2	MCAR	F	G	100	0	0	R	141 mm
91	0	06R	-	MCAR	PF	F	P60	2411	0	R	FEMALE LG THAN G.PARADISO
1	267	68R	-	MTAR	F	G	100	0	0	R	-
5	0	T12	US 3	MTAR	F	B	100	1418	0	L	CUT MARKS AT DIST.
65	23	-	-	MTAR	F	G	100	0	0	R	155mm
8	0	A53i	3	P1	F	G	100	0	0	R	-
44	0	4R	1-2	P1	F	G	100	0	0	R	-
45	25	66R	-	P1	F	G	100	0	0	R	-
53	0	-	1-2	P1	F	G	100	0	0	R	-
61	49	-	-	P1	F	G	100	0	0	L	-
69	199	-	-	P1	F	G	100	0	0	R	-
85	0	48AA	3	P1	F	G	100	0	0	R	-
36	0	A50	2	P2	F	G	100	0	0	L	-

IBEX BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	BUTCH2	SIDE	DETAILS
46	221	-	-	P2	F	G	100	0	0	R	-
54	0	-	1-2	P2	F	G	100	0	0	L	-
55	0	-	1-2	P2	F	G	100	0	0	L	-
56	0	-	1-2	P2	F	G	100	0	0	R	-
57	0	-	1-2	P2	F	G	100	0	0	R	-
62	93	55AR	-	P2	F	G	100	0	0	L	-
83	0	52C2	3	P2	F	G	100	0	0	R	-
88	50	-	3	P2	F	G	100	0	0	L	-
37	0	A50	2	P3	F	G	100	0	0	L	-
42	0	52A2	3	P3	F	G	100	0	0	L	-
60	85	45R	-	P3	F	G	100	0	0	L	-
63	124	44	-	P3	F	G	100	0	0	R	-
68	171	47R	-	P3	F	G	100	0	0	L	-
70	85	-	-	P3	F	G	100	0	0	L	-
81	91	-	2	P3	F	G	100	0	0	R	-
82	63	-	2	P3	F	G	100	0	0	R	-
84	0	91R	3	P3	F	G	100	0	0	R	-
86	0	4-AA	3	P3	F	G	100	0	0	L	-
87	0	4-AA	3	P3	F	G	100	0	0	R	-
39	0	52A2	3	PELVIS	F	G	060	0	0	R	ACETAB/ILIUM
40	0	52A2	3	PELVIS	F	G	050	0	0	L	ACETAB
77	59	20AR	3	PELVIS	F	F	040	2451	0	L	ACET/IL GNAWED
78	38	-	3	PELVIS	F	F	040	2451	0	R	PAIR W 77 TOOTH MARKS ON
71	4	52AR	-	RAD/UL	F	F	095	0	0	R	RODENT GNAWING
2	0	5R	-	SCAP	PF	G	P80	2081	0	R	-
3	249	76R	-	SCAP	PF	G	P60	0	0	R	-
7	0	5 T2		SCAP	PF	F	P20	0	0	L	CORRID INTERNO SPORAH
35	0	A49	1-2	SCAP	PF	G	P40	0	0	R	-

IBEX BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	BUTCH2	SIDE	DETAILS
58	245	86R	-	SCAP	PF	F	P60	0	0	L	COVERED IN CALCRETE
59	92	-	-	SCAP	N	F	010	0	0	N	-
74	39	-	3	SCAP	PF	G	P80	0	0	L	-
75	73	-	3	SCAP	PF	F	P20	0	0	R	-
89	0	A49	1-2	SCAP	PF	F	P40	0	0	L	-
29	0	F01	-	SKULL	MAT	G	100	0	0	M	2 HORNS 225 H 210 CIR COM SKU
30	0	III	-	SKULL	MAT	G	095	0	0	M	265 H 225CIR 1.2HORNS COMSKU
31	0	III	-	SKULL	G	G	100	0	0	M	270H 225C COMPLETE
64	11	55R	-	TIBIA	PUF	G	P10	0	0	R	-
67	89	54R	-	TIBIA	PUF	B	090	1671	0	L	ASSOC. ASH MATERIAL
90	0	A53	2	TIBIA	PUF	F	P10	0	0	R	-
92	0	03R	-	TIBIA	DUF	F	D20	0	0	L	-

GROTTA D'ERNESTRO: IBEX VERTEBRAE

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH	DETAILS
10	235			ATLAS	F	F	80	0	-
26	132			VERT C	MAT	G	100	0	-
27	49aIV	US3		VERT C	MAT	G	60	0	-
28		US2/3		VERT C	MAT	F	60	0	-
29		US2/3		VERT C	F	F	60	0	-
15	281	3		VERT C	MAT	F	60	0	-
19	184			VERT C	MAT	F	100	0	-
30	48AA	3		VERT L	F	F	60	0	-
22	A53	US2		VERT L	F	G	100	0	-
21	274			VERT L	F	F	100	0	-
18	191			VERT L	M	F	40	0	-
4	142			VERT L	MAT	F	60	0	-

IBEX VERTEBRAE

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH	DETAILS
3	288			VERT L	MAT	F	60	0	-
6		B53III		VERT L	FG	G	100	0	-
7		52AIII		VERT L	F	G	100	0	-
12	1--2	C48		VERT L	F	G	100	0	-
16	192	3		VERT L	F	G	100	0	-
23	A53	US2		VERT L	MAT	F	60	0	-
24	A53	US2		VERT L	MAT	F	100	0	-
1	196			VERT T	F	F	60	0	-
2	28			VERT T	F	G	60	1000	cutmark on spine
5	192			VERT T	MAT	F	60	0	-
8		52AIII		VERT T	F	F	60	0	-
9	9			VERT T	MAT	F	40	0	-
11	35	96		VERT T	MAT	F	60	0	-
13	285	3		VERT T	N	F	5	0	-
14	286	3		VERT T	F	G	80	0	-
17	112	3		VERT T	F	G	80	0	-
20	139			VERT T	MAT	F	60	0	-
25	A53	US2		VERT T	MAT	F	60	0	-
31	94			VERT T	F	G	10	0	-

GROTTA D'ERNESTO: RED DEER BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	BUTCH2	SIDE	DETAILS
9	0	019	3	ACETAB	F	F	080	0	0	L	-
49	0	43AA	2	ASTRAG	F	G	100	0	0	L	-
11	0	-	-	ATLAS	F	G	100	0	0	M	INT CORIDOR
50	0	43AA	2	CALC	F	G	100	0	0	R	-
74	235			EPIPH	MAT	F	060	0	0	-	-
35	0	49AA	-	FEMUR	F	F	005	0	0	N	15 AR
5	0	05R	-	FEMUR	PUFDF	G	D80	0	0	R	-
56	192	34AR	-	FEMUR	DUF	F	D10	2591	0	R	-
48	2R	43AA	2	HUMER	PFGDF	G	D90	1240	0	L	19 CUT MARKS
1	263	69R	-	HUMER	PUFDF	G	D80	0	0	R	-
54	116	56AR	-	HUMER	PUF	F	P05	0	0	R	-
19	0	1AR	-	MAND	F	G	100	0	0	R	P O 18 MATURE
20	189	67AR	-	MAND	FG	G	010	0	0	R	YOUNG ADULT
28	87	-	-	MAND	F	F	005	0	0	N	-
23	0	48AA	3	MAND	F	G	005	0	0	N	-
64	278	-	-	MAND	DF	F	D05	0	0	N	-
22	0	07R	-	MAND	F	G	005	0	0	N	-
18	0	1AR		MAND	F	G	100	0	0	L	P O 19 MATURE
67	0	49AA	1-2	MAND H	F	F	060	0	0	R	-
10	0	018	3	MAND H	F	G	020	0	0	R	-
65	0	52C	3	MAND H	UF	F	005	0	0	L	-
29	0	49AA	1-2	MAND H	F	F	010	0	0	R	-
21	0	63R	-	MAXILA	F	F	005	0	0	N	MATURE
17	156	31R		MAXILA	F	G	005	0	0	L	-
57	111	24R	-	MCAR	DF	F	D40	0	0	N	MOD BREAK
38	0	43AA	2	MCAR	F	G	100	0	0	R	iv
45	0	43AA	2	MTAR	F	G	100	0	0	L	PAIR W 46

RED DEER BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	BUTCH2	SIDE	DETAILS
46	0	43AA	2	MTAR	F	G	100	0	0	R	PAIR W 45
40	0	43AA	2	P1	F	G	100	0	0	R	iv
36	0	B50	2	P1	F	G	100	0	0	L	-
55	95	35AR	-	P1	F	G	100	0	0	R	-
66	0	48A	3	P1	F	G	100	0	0	R	-
53	0	43AA	2	P1	F	G	100	0	0	R	-
51	0	43AA	2	P1	F	G	100	0	0	L	-
26	0	49AA	3	P2	PUF	F	040	2831	0	N	-
43	0	43AA	2	RADIUS	F	G	100	0	0	R	-
60	197	32R	-	RADIUS	PF	G	100	0	0	R	P OF ULNA FU
47	0	43AA	2	RADIUS	F	G	100	0	0	L	V BIG
41	0	43AA	2	RADIUS	F	G	100	0	0	L	P O 42 iv
2	268	72R	-	SCAP	PF	G	P60	0	0	L	-
59	202	33AR	-	SCAP	PF	G	P60	2081	0	L	-
8	250	77R	-	SCAP	PF	G	P60	2081	0	R	-
70	245		3	SCAP	M	F	010	0	0	R	FITS URN3
25	34		-	SCAP	PF	F	P10	2021	0	L	-
6	0	05R	-	SCAP	F	G	005	0	0	N	-
3	266	71R	-	SCAP	PF	G	P40	0	0	R	TOOTH MARKS
37	0	B50	2	SCAP	PF	G	P60	0	0	R	-
34	0	49AA	1-2	SCAP	PF	G	P60	0	0	R	2 AR
69		1	3	SKULL	M	F	050	FEMALE		TOOTH PUNCS	
62	169	-	3	TIBIA	PUFDF	F	D90	0	0	L	-
63	155	-	-	TIBIA	DF	F	D60	2671	0	L	-
68	0	48A	1-2	TIBIA	PF	F	P40	2661	0	R	-
61	178	32R	-	ULNA	PF	G	P40	0	0	R	P O 60?
58	175	30AR	3	ULNA	PF	G	100	0	0	L	GNAW OLEC

RED DEER BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	DETAILS
42	0	43AA	2	ULNA	F	G	100	0	P O 41
44	0	43AA	2	ULNA	F	G	100	0	P O 43

GROTTA D'ERNESTO: RED DEER VERTEBRAE

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	DETAILS
32	135	-	-	VERT	F	F	080	0	-
80	270			VERT C	MAT	F	060	0	-
13	0	020	3	VERT C	F	G	100	0	-
78	191			VERT C		F	100	0	-
79	184			VERT C	MAT	F	100	0	-
68		T10		VERT C	M	F		0	TOOTH PUNC
72			2-3	VERT C	MAT	F	060	0	-
71			2-3	VERT C	MAT	F	060	0	-
39	0	43AA	2	VERT L	FG	G	100	0	-
33	0	48C	1-2	VERT L	F	G	100	0	9A
4	280	70R	-	VERT L	F	G	100	0	-
52	0	43AA	2	VERT L	F	G	100	0	-
76	C48		1-2	VERT L	MAT	F	060	0	-
31	180	-	-	VERT T	F	F	060	0	-
16	0	A53i	-	VERT T	F	G	060	2000	CH RIBS OFF
73	9			VERT T	MAT	F	060	0	-
30	0	49AA	1-2	VERT T	F	F	060	0	-
75		49AA	1-2	VERT T	MAT	F	040	0	-
77	112			VERT T	MAT	F	060	0	-
24	0	52C	3	VERT T	N	F	005	0	-
12	0	022	3	VERT T	F	G	080	0	-
14	0	021	3	VERT T	F	G	080	0	-
81	139			VERT T	MAT	F	060	0	-

RED DEER VERTEBRAE

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	DETAILS
82	229			VERT T	MAT	F	060	0	-
27	0	49AA	3	VERT T	F	G	010	0	-

GROTTA D'ERNESTO: BROWN BEAR BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH	SIDE	DETAILS
19	16		US7	ASTRAG	F	F	100	0	R	-
20	16		US7	CALC	F	F	100	0	R	-
1	0	SET1	US-3	CRANIU	F	G	080	0	-	LOWER PT NOT PRESENT 17/1
10	16	-	US 7	FEMUR	PUF	F	P05	0	N	BALL
14	6	09AA	US 7	FEMUR	PUF	G	080	1000	R	TOOTH MK DIST
13	9	08AR	-	HUMER	DF	F	D60	2193	L	-
4	12	SET2	-	MAND	F	G	D80	0	R	MATURE
12	13		US 7	MAND	F	P	010	0	N	-
11	13	-	-	MAND H	F	F	P05	0	R	-
22			US7	MCAR	PFDF	F	100	0	R	-
2	0	5(2)	US-7	MTAR 3	MAT	F	080	2000	N	TOOTH MK ON PROX DIST CH 12/3/
22		16	US7	PELVIS	MAT	G	60	0	R	-
6	16	-	US 7	P1	F	F	D20	0	N	-
16			US7	P1	F	F	100	0	L	-
17			US7	P1	F	F	100	0	R	-
7	0	-	US 7	P2	F	F	D10	2801	L	NATURALLY BROKEN?
8	16	-	US 7	P2	F	F	D20	2801	N	NATURALLY BROKEN?
18			US7	P3	F	F	100	0	L	-
9	16	-	US7	P3	F	G	100	0	L	-
3	5	-	-	RADIUS	PF	F	P80	2000	R	CH DIST/GNAW/TOOTH MK ON PROX
5	14	-	-	SCAP	F	G	P80	0	R	IN RIDGE ON HOLE
21	16		US7	TIBIA	PDFD	G	200	0	L	-
15	8	-	US 7	ULNA	F	G	P90	1000	L	SCORING= DEEP NOTCHES

BROWN BEAR BONES

URN	TRI	NO	LAYER	BONE	FUSION	COND	FRAG	BUTCH1	SIDE
23			US7	VERT T	MAT	F	100	0	-
24			US7	VERT C	MAT	F	100	0	-
225			US7	VERT L	MAT	F	800	0	-

GROTTA D'ERNESTO: IBEX AND RED DEER RIB BONES

URN	TRI	NO	LAYER	MEASURMENTS	FUSION	COND	BUTCH1	SIDE
1	1			150 X 14MM			0	
2	16			160 X 12MM			0	
3	0	-	-	20 X 11 MM	F	F	0	
4	0	915A	US 7	150 X 12MM	F	G	0	N
5	0	915A	US 7	200 X 10MM		G	0	N
6	3			120 X 9MM			0	N
7	20			65 X 10MM	F		0	
8	0	C4.8	US 1-2	87 X 12MM			0	N
9	170	-	-	114 X 10MM	F		0	N
10	179	-	-	130 X 11MM			0	N
11	82			142 X 6MM			0	N
12	0	B533	US 3	185 X 7 MM	F	F	0	
13	0	B533	US 3	80 X 13 MM	F	F	0	
14	0	B533	US 3	120 X 12MM		F	0	
15	164			11 X 6MM			0	
16	164			100 X 6MM			0	N
17	168			90 X 12 MM		F	0	N
18	126			116 X 15MM	F	G	0	
19	47			210 X 10MM			0	N
20	0	49AA	US 3	235 X 10MM			0	N
21	0	49AA	US 3	10 X 10 MM	F	F	0	N
22	0	49AA	US 3	30 X 10 MM			0	N

IBEX AND RED DEER RIB BONES

URN	TRI	NO	LAYER	MEASURMENTS	FUSION	COND	BUTCH1	SIDE
23	0	49AA	US 3	30 X 9MM	F	F	0	
24	0	49AA	US 3	40 X 9 MM	F	G	0	N
25	167			60 X 9 MM	F	G	0	N
26	176	0	0	250 X 10MM	F	G	0	N
27	134			250 X 10MM	F	F	0	
28	84	0	0	160 X 9MM	F	G	0	N
29	277	-	-	120 X 15MM	F	G	0	N
30	194	-	-	80 X 10 MM	F	G	0	N
31	136			128 X 15MM	F	G	0	N
32	135	-	-	141 X 13MM	F	G	0	N
33	74	-	-	60 X 6 MM	F	G	0	N
34	74	-	-	80 X 6 MM	F	G	0	N
35	151	-	-	120 X 8 MM	F	G	0	N
36	75	-	-	60 X 12 MM	F	G	0	N
37	0	48Ai	US 3	100 X 10MM	F	G	0	N
38	0	43AA	US 1-2	250 X 15MM	F	G	0	N
39	72			10 X 5 MM	F	F	0	
40	166	-	-	100 X 16MM	F	G	0	N
41	237	-	-	210 X 17MM	F	G	0	N
42	100	-	-	10 X 16 MM	F	G	0	N
43	271	-	-	14 X 12 MM	F	G	0	N
44	56	-	-	230 X 13MM	F	G	0	N
45	22	-	-	130 X 9MM	F	G	0	N
46	43	-	-	14 X 8 MM	F	N	0	N
47	96	-	-	60 X 10 MM	F	G	0	
48	158	-	-	13 X 11MM	F	G	0	
49	226	-	-	200 X 14MM	F	G	0	N
50	25	-	-	120 X 11MM	F	G	0	N

IBEX AND RED DEER RIB BONES

URN	TRI	NO	LAYER	MEASURMENTS	FUSION	COND	BUTCH1	SIDE
51	183	-	-	200 X 6 MM	F	G	0	N
52	238	-	-	280 X 10MM	F	G	0	N
53	217	-	-	40 X 10 MM	F	G	0	N
54	79	-	-	190 X 12MM	F	G	0	N
55	19	-	-	160 X 14MM	F	G	2222	N
56	57	-	-	12 X 11 MM	F	G	0	N
57	45	-	-	140 X 13MM	F	G	0	N
58	273	-	-	190 X 12MM	F	G	0	N
59	54	-	-	18 X 3MM	F	G	0	N
60	30	-	-	60 X 9 MM	F	G	0	N
61	231	-	-	50 X 9 MM	F	G	0	N
62	0	C51	US 2	270 X 20MM	F	G	0	N
63	135	-	-	160 x 12MM	F	G	0	N
64	75	-	-	80 X 10 MM	F	G	0	N
65	82	-	-	120 X 6 MM	FUSING	G	0	N
66	0	C48	US 1-2	40 X 10 MM	F	G	0	N
67	126	-	-	170 X 10MM	F	G	0	N
68	136	-	-	120 X 24MM	F	G	0	N
69	134	-	-	150 X 9 MM	F	G	0	N
70	74	-	-	110 X 5 MM	F	G	0	N
71	47	-	-	21 X 8 MM	F	G	0	N
72	277	-	-	10O X 21MM	F	G	0	N
73	194	-	-	110 X 9 MM	F	G	0	N
74	76	-	-	250 X 8 MM	F	G	0	N
75	84	-	-	100 X 6 MM	F	G	0	N
76	179	-	-	140 X 11MM	F	G	0	N
77	164	-	-	120 X 6MM	F	G	0	N
78	151	-	-	112 X 5 MM	F	G	0	N

IBEX AND RED DEER RIB BONES

URN	TRI	NO	LAYER	MEASURMENTS	FUSION	COND	BUTCH1	SIDE
79	168	-	-	75 X 9 MM	F	G	0	N
80	170	-	-	111 X 9 MM	F	G	0	N
81	0	52B2	US 3	210 X 10MM	F	G	0	N
82	0	52B2	US 3	132 X 15MM	F	G	0	N
83	0	52B2	US 3	100X 10 MM	F	G	0	N
84	0	52A2	US 3	211 X 21MM	F	G	0	N
85	0	52A2	US 3	180 X 18MM	F	G	0	N
86	0	52A2	US 3	190 X 6 MM	F	G	0	N
87	0	C51	US 3	230 X 21	F	G	0	R
88	236	-	-	40 X 10 MM	F	G	0	N
89	129	-	-	140 X 12MM	F	G	0	N
90	81	-	-	231 X 6MM	F	G	0	N
91	165	-	-	180 X 10MM	F	G	0	N
92	40	-	-	380 X 15MM (100%)	F	G	0	L
93	259	-	-	120 X 6 MM	F	G	0	N
94	23	-	-	41 X 8 MM	F	G	0	N
95	24	-	-	80 X 10 MM	F	G	0	N
96	58	-	-	40 X 10 MM	F	G	0	N
97	204	-	-	240 X 10MM	F	G	0	N
98	157	-	-	153 X 8 MM	F	G	0	N
99	0	A54	US 2	60 X 12 MM	F	G	0	N
100	0	A54	US 2	60 X 12 MM	F	G	0	N
101	46	-	-	230 X 12MM	F	G	0	N
102	161	-	-	111 X 11MM	F	G	0	N
103	286	-	-	194 X 12MM	F	G	0	N
104	27	-	-	111 X 12MM	F	G	0	N
105	113	-	-	123 X 11MM	PF	G	0	R
106	42	-	-	76 X 8 MM	PF	G	0	L

IBEX AND RED DEER RIB BONES

URN	TRI	NO	LAYER	MEASURMENTS	FUSION	COND	BUTCH1	SIDE
107	55	-	-	221 X 10MM	PF	G	0	R
108	0	48AA	US 1-2	200 X 11MM	F	F	0	N
109	0	48AA	US 1-2	155 X 15MM	F	G	0	N
110	0	48AA	US 1-2	200 X 11MM	F	G	0	N
111	28	-	-	100 X 10MM	F	G	0	N
112	179	-	-	120 X 6 MM	F	G	0	N
113	147	-	-	70 X 8 MM	F	G	0	N

BIBLIOGRAPHY

Aimar A., Alciati G., Broglio A., Castelletti L., Cattani L., D'Amico C., Giacobini G., Maspero A. and Peresani M. 1994. Les Abris Villabruna dans la Vallée du Cismòn *Preistoria Alpina* 28: 227-254.

Alciati G., Cattani L., Fontana F., Gerhardinger E., Guerreschi A., Milliken S, Mozzi P. and Rowley-Conwy P. 1994. Mondeval de Sora: a high altitude Mesolithic campsite in the Italian Dolomites *Preistoria Alpina* 28: 351-366.

Alessio M., Allegri L., Bella F., Broglio A., Calderon G., Cortesi C., Improta S., Preite Martinez M., Petrone V. and Turi B. 1983. 14C datings of three Mesolithic sites in the Trento Basin in the Adige Valley (Vatte di Zambana, Pradestel and Romagnano) and comparisions with mesolithic series of other regions. *Preistoria Alpina* 19: 245-254.

Ammerman A.J. and Cavalli-Sforza L.L. 1973. A population model for the diffusion of early farming in Europe. In Colin Renfrew (ed.) *The Explanation of Culture Change: Models in Prehistory*, 343-357. London, Duckworth.

Anderson S.H. 1987 Tybrind Vig: A submerged Ertbolle settlement in Denmark. In J.M. Coles and A.J. Lawson (eds.) *European Wetlands in Prehistory*, 253-280. Oxford, Clarendon Press.

Andresen J.M., Byrd B.F., Elson M.D., McGuire R.H., Mendoza R.G., Staski E. and White J.P. 1981. The deer hunters: Star Carr reconsidered *World Archaeology* 13: 31-46.

Awsiuk R., Bartolomei G., Cattani L., Cavallo C., Dalmeri G., d'Errico F., Giacobini G., Girod A., Hercman H., Jardon-Giner P., Nisbet R., Pazdur M.F., Peresani M. and Riedel A. 1994. La Grotta d'Ernesto (Trento): frequentazione umana e paleoambiente *Preistoria Alpina* 27: 7-160.

Bagolini B. 1968. Richerche sulle dimensioni del manufatti litici preistorici non ritoccati in Ann Univ Ferrara, *Sez XV* Vol, N10.

Bagolini B. 1971. Richerche sulla tipometria litica dei complessi epipaleolitici della Valle dell'Adige. *Preistoria Alpina* 7.

Bagolini B. 1972. Primi risulti delle ricerche sugli insediamenti epipaleolitici del Colbricon. *Preistoria Alpina* 8:107-149.

Bagolini B. 1980. *Il Trentino nella Preistoria del Mondo Alpino*. Editrice Temi

Bagolini B. and Broglio A. 1975. Pradestel (Trento). *Preistoria Alpina* 11: 331.

Bagolini B., Carli R., Ferrari A.and Pasquali T. 1985. Dos de la Forca (Mezzocorona) Trento. *Preistoria Alpina* 21: 212-215.

Bagolini B., Carli R., Ferrari A., Messori A., Pasquali T., and Pessia A. 1991. Il sepolcreto eneolitico del Dos de la Forca (Mezzocorona - Trento) *Preistoria Alpina* 25: 121-164.

Bagolini B. and Dalmeri G. 1987. I siti mesolithici di Colbricon (Trentino) Analisi spaziale e fruizione del territorio. *Preistoria Alpina* 23: 7-188.

Barfield L.H. 1971. *Northern Italy Before Rome* London: Thames and Hudson.

Barfield L.H. 1987 . Recent work on sources of Italian flint. In G. De G. Sieveking and M.H. Newcomer (eds.) *The Human Uses of Flint and Chert*, 231- 239. Cambridge: Cambridge University Press.

Baroni C., Biagi P., Nisbet R. and Scaife R.G. 1990. Laghetti del Crestoso: a high altitude Castelnovian camp in its environmental setting. In P Biagi (ed) *The Neolithisation of the Alpine Region: Monografie di Natura Bresciana* 13 1990: 43-51.

Bartolomei G. 1974. I talus detritici e la stabilizzazoine del destro della Valle dell'Adige nella zone di Trento In *Studi Trentini di Science Naturali* 51, 2A: 213-228.

Bartolomei G., Broglio A., Camitanio M.A., Perini R. 1972. Loc di Romagnano In Guida all'escursione nel Veronese e nel Trentino *XV Riun.Sc. Inst. It Preistoria e Protostoria*: 80-90.

Bay Petersen J.L. 1978. Animal exploitation in Mesolithic Denmark. In P Mellars (ed) *The Early Post Glacial Settlement of Northern Europe*, 115-146 London, Duckworth.

Behrensmeyer A.K. and Hill A.P. 1980. *Fossils in the Making* Chicago, University of Chicago Press.

Bender B. 1978. Hunter-gatherer to farmer: a social perspective. *World Archaeology* 10: 204-222.

Benedetti R., Campana R., D'Amico C. and Nannetti M.C. 1994. Petroarchaeometry of epigravettian amd mesolithic flints in the Val Cismon - Lagoari (NE Italy): The flint supply question. *Preistoria Alpina* 28/1: 33-49.

Bettinger R. 1991. *Hunter-Gatherers: Archaeological and Ecological Theory*. New York: Plenum.

Biagi P. 1981. *The Mesolithic and early Neolithic settlement of northern Italy* Unpublished PhD Institute of Archaeology University of London.

Biagi P. 1994. Mesolithic exploitation of the highland Zone: a case study for the southern Alps. *Preistoria Alpina* 28/1: 367-372.

Bietti A. 1990. The late Upper Palaeolithic in Italy: An overview. *Journal of World Prehistory* Vol 4 No1: 95-155.

Binford L.R .1962. Archaeology as anthropology. *American Antiquity* 28 (No 2): 217-225.

Binford L.R. 1968. Post-Pleistocene adaptations In S.R. Binford and L.R. Binford (eds) *New Perspectives in Archaeology*, 313-341. Chicago, Aldine.

Binford L.R. 1976. Forty-seven trips: a case study in the character of some formation processes of the archaeological record. In E Hall (ed) *Contributions to Anthropology: The Interior People of Northern Alaska* National Museum of Man. Ottawa 299-351.

Binford L.R. 1978a. *Nunamiut Ethnoarchaeology*. Academic Press, New York.

Binford L R .1978b. Dimensional analysis of behaviour and site structure: learning from an Eskimo hunting stand. *American Antiquity* 43: 330- 361.

Binford L.R. 1979. Organisation and formation processes: looking at curated technologies *Journal of Anthropological Research* 35: 255-73.

Binford L.R. 1980. Willow smoke and dogs tails: hunter-gatherer settlement systems and site formation processes. *American Antiquity* 45: 4-20.

Binford L.R. 1981. *Bones Ancient Men and Modern Myths.* New York, Academic Press.

Binford L.R. 1983. *In Pursuit of the Past: Decoding the Archaeological Record.* London, Thames and Hudson.

Binford L.R. 1984. *Faunal Remains from Klasies River Mouth* New York, Academic Press.

Binford L.R. 1989. Mobility, housing and environment: a comparative study. In B Herman (ed.) *Models in Environmental History.* Institut für Anthropologie, Universität Göttingen, Germany.

Binford L.R. 1991. When the going gets tough, the tough get going: Nunamiut local groups, camping patterns and economic organisation. In C.S. Gamble and W. Boismier (eds.) *Ethnoarchaeological Approaches to Mobile Campsites: Hunter-Gatherer and Pastoralist Case Studies,* 77-156.International Monographs in Prehistory: Ann Arbor, Michigan.

Binford L.R. and Bertram J.B. 1977. Bone frequencies - and attritional processes In L.R. Binford (ed.) *For Theory Building in Archaeology,* 77-153. New York, Academic Press.

Bleed P. 1986. The optimal design of hunting weapons: maintainability or reliability. *American Antiquity* 51:737- 47.

Boscato P. and Sala B. 1980. Dati paleontologici, paleoeologici e cronologici di 3 depositi epipaleolitici in Valle dell'Adige (Trento). *Preistoria Alpina* 16: 45-61.

Brain C.K. 1981. *The Hunters or the Hunted: An Introduction to African Cave Taphonomy* Chicago, The University of Chicago Press.

Broglio A. 1964. Il Riparo Raffaello Battaglia presso Asiago *Rivista di Scienze Preistoriche* Vol XIX Firenze. 129-174.

Broglio A. 1971. Risultati preliminari dell ricerche sui complessi epipaleolitici della Valle dell'Adige *Preistoria Alpina* 7:135-241.

Broglio A. 1972. I più antichi abitatori dell Valle de l'Adige *Preistoria Alpina* 8:157-176.

Broglio A. 1976. L'epipaléolithique de la Vallée du Pô. *UISPP Coll XIX "Les civilisation du 8e au 5e millénaire avant notre ére en Europe: paléoenvironment, structure d'habitat, outillanges, économie,*9-31.

Broglio A. 1980. Culture e ambienti della fie del Paleolitico e del Mesolitico nell'Italia nord-orientale. *Preistoria Alpina* 16: 7-29.

Broglio A. 1994. Mountain sites in the context of the north-east Italian Upper Palaeolithic and Mesolithic In *Preistoria Alpina* 28/1: 293-310.

Broglio A., Castelletti L., Frigo G., Martello G., Maspero A. and Perasani M. 1994. Le site epigravettian de Val Lastari sur l'Haut Plateau d'Asiago (Prealpes de la Venetie) *Preistoria Alpina* 28/1:207-225.

Broglio A. and Kozlowski SK. 1983. Tipologia ed evoluzione delle industrie mesolithiche di Romagnano III *Preistoria Alpina* 19: 93-148.

Bunn H. 1983. Comparative analysis of modern bone assemblages from a San hunter-gatherer camp in the Kalahari desert, Botswana, and from a spotted hyena den near Nairobi, Kenya In J Clutton-Brock and C Grigson (editors) *Animals and Archaeology: 1 - Hunters and their Prey* Oxford: British Archaeological Reports International Series 496:3-22.

Castelletti L. and Maspero A. 1994. Dati antracologici relativi all'ultima fase della glaciazione nelle Alpi Orientali italiane. *Preistoria Alpina* 28:105-114.

Castiglioni G.B., Cremaschi M., Guerreschi A., Meneghel M., Sauro U. and Van Vliet Lanoe B. 1990. The loess deposits in the Lessini plateau In M. Cremaschi (ed.) *The Loess in Northern and Central Italy*: Milan Quaderni di Geodinamica Alpina e Quaternaria, 41-59.

Cattani L. 1977. Dati palinologici inerenti ai depositi di Pradestel e di Vatte di Zambana nella Valle dell'Adige (TN). *Preistoria Alpina* 13: 21-29.

Cattani L. 1983. Il paesaggio postglaciale del Colbricon (Passo Rolle, Trento) in base alle analisi polliniche dell'insediamento mesolithico. *Preistoria Alpina* 19: 255-257.

Cattani L. 1985. Ricerche palinologiche nell'insediamento preistorico del riparo di Biarzo (S.Pietro l Natisone, Udine). *Gortania*, No 7. Udine.

Cattani L. 1990. Steppe environments at the margin of the Venetian Pre-Alps during the Pleniglacial and late Glacial periods In M. Cremaschi (ed.) *The Loess in Northern and Central Italy* : Milan Quaderni di Geodinamica Alpina e Quaternaria, 133-137.

Cattani L. 1994. Prehistoric environments and sites in the Eastern Alps during the Late Glacial and Postglacial. *Preistoria Alpina* 28/1: 61-71.

Cavallo C., d'Errico F. and Giacobini G. 1994. A taphonomic approach to the Grotta d'Ernesto Mesolithic site. In Awsiuk R. *et al* (eds.). *Preistoria Alpina* 27: 121-150.

Champion T., Gamble C., Shennan S. and Whittle A. 1984. *Prehistoric Europe* London, Academic Press.

Cherry J.F., Gamble C.S., Shennan S. 1978. (eds.) *Sampling in Contemporary British Archaeology.* Oxford, British Archaeological Reports British Series 50.

Clark G.A. 1983 . The Asturian of Cantabria: Early Holocene Hunter-Gatherers in Northern Spain *Anthropological Papers of the University of Arizona 41*. Tucson, University of Arizona Press.

Clark G.A. and Straus L. 1983. Late Pleistocene hunter-gatherer adaptations in Cantabrian Spain. In G. Bailey (ed.) *Hunter-Gatherer Economy in Prehistory,* 131-149. Cambridge, Cambridge University Press.

Clark J.G.D. 1952. *Prehistoric Europe: The Economic Basis.* London, Methuen & Co.

Clark J.G.D. 1954. *Excavations at Star Carr.* Cambridge, Cambridge University Press.

Clark J.G.D. 1972. Star Carr: *A Case Study in Bio-Archaeology.* Reading, Addiston Wesley.

Clark R.H. 1985. *The Fiavé 1974 Faunal Sample: A Study of the Butchery Traces* Unpublished MSc dissertation, University of Southampton.

Clark R.H. 1989. Towards the integration of social and ecological approaches to the study of early agriculture. In A Milles, D Williams and N Gardiner (eds) *The Beginnings of Agriculture*, 3-22. Symposia of the Association for Environmental Archaeology No 8 British Archaeological Reports International Series 496.

Clark R.H. 1990. The beginnings of agriculture in sub-Alpine Italy: some theoretical considerations. In P. Biagi (ed) *The Neolithisation of the Alpine Region: (Monografie di Natura Bresciana)* 13: 123-137.

Clark R.H. and Schofield A.J. 1991. By experiment and calibration: an integrated approach to archaeology of the ploughsoil. In A.J. Schofield (ed.) *Interpreting Artefact Scatters: contribution of Ploughzone Archaeology*, 93-105. Oxford, Oxbow Monograph

Clark R.H. forthcoming Stenico: Animal bone report (Paper submitted for publication R Perini editor: Trento).

Clark R.H., Dalmeri G., Finlayson W. and Mithen S. 1992. Excavations at Pre Alta, Trentino, Northern Italy. *Cambridge Archaeological Journal* Vol 2 No2. 254-261.

Clarke D.L. 1968. *Analytical Archaeology.* London, Methuen & Son.

Clarke D.L. 1973. Archaeology: the loss of innocence. *Antiquity* XLVII: 6-18.

Clarke D.L. 1976. Mesolithic Europe: the economic basis. In G. Sieveking, I.H. Longworth and K.E. Wilson (eds) *Problems in Economic and Social Archaeology,* 449-82. London, Duckworth.

Cohen M.N. 1977. *The Food Crisis in Prehistory.* Yale, Yale University Press.

Corrain C., Graziati G. and Leonardi P. 1976. La sepoltura epipaleolitica del Riparo di Vatte di Zambana *Preistoria Alpina* 12: 175-212.

Cremaschi M. 1990. The loess in northern and central Italy: a loess basin between the Alps and the Mediterranean regions. In M.Cremaschi (ed.) *The Loess in Northern and Central Italy*: Milan Quaderni di Geodinamica Alpina e Quaternaria, 15-19.

Dalmeri G. 1985. La Grotta d'Ernesto: un insediamento preistorico di grande interesse per la conoscenza del Paleolitico finale nell'area trentino-vereta (Colle dei Meneghini - Val d'Antenne, Trentino sud-orientale) *Natura Alpina* (No2-3) Trento.

Dalmeri G. 1991. Gli insediamenti paleolitici della Grotta d'Ernesto e della Marcésina (Grigno) *Natura Alpina* 42. No1: 1-48.

Dalmeri G. 1994. L'industria. In R. Awsiuk *et al.* (eds.) *Preistoria Alpina* 27: 67-71.

Dalmeri G. and Lanzinger M. 1994. Risulti preliminari delle ricerche nei siti mesolitici del Lago delle Buse, nel Lagori chain (Trentino) In *Preistoria Alpina* 28/1: 317-349.

Dalmeri G. and Pasquali T. 1980. Colbricon - Passo Rolle (Trento) In *Preistoria Alpina* 16 Notiziario Regionale.

Dalmeri G. and Pedrotti A. 1994. Distribuzione topografica dei siti del Paleolitico Superiore finale e Mesolitico in Trentino Alto-Adige e nelle Dolomiti Venete (Italia) In *Preistoria Alpina* 28: 247-267.

David A. 1986. A possible later Mesolithic arrow from Seamer Carr, N Yorks. Paper presented at the Palaeolithic/Mesolithic conference, January 31, Sheffield.

Dennell R. 1983. *European Economic Prehistory: A New Approach.* New York, Academic Press.

Doran J. and Hodson F. 1975. *Mathematics and Computers in Archaeology* Edinburgh, Edinburgh University Press.

Flannery K.V. 1968. Archaeological systems theory and early Mesoamerica. In B. Meggars (ed.) *Anthropological Archaeology in the Americas*, 67-87. Washington.

Gamble C.S. 1986a. *The Palaeolithic Settlement of Europe.* Cambridge, Cambridge University Press.

Gamble C.S. 1986b. The Mesolithic sandwich: ecological approaches and the archaeological record of the early post-glacial. In Marek Zvelebil (ed.) *Hunters in Transition: Mesolithic Societies of Temperate Eurasia and Their Transition to Farming*, 33-42. Cambridge, Cambridge University Press.

Gamble C.S. 1996 . Hominid behaviour in the Middle Pleistocene: an English perspective. In Clive Gamble and Andrew Lawson. (eds.)*The English Palaeolithic Reviewed,* 63-71.

Gamble C.S. 1997. The animal bones from Klithi In G. Bailey (ed.) *Klithi: Palaeolithic settlement and Quaternary landscapes in northwest Greece - Vol.1 Excavation and intra-site analysis at Klithi,* 207-244. Cambridge, McDonald Institute Monographs.

Gamble C.S. and Clark R.H .1987. The faunal remains from Fiave: pastoralism, nutrition and butchery. In R. Perini (ed.) *Scavi Archeologici Nella Zona Palafitticola di Fiave-Carera*, 423 - 445. Trento.

Gifford D.P. 1981. Taphonomy and paleoecology: a critical review of archaeology's sister disciplines. *Advances in Archaeological Method and Theory Volume 4*, 365-438. Academic Press, New York.

Gifford D.P. and Behrensmeyer A.K. 1977. Observed depositional events at a modern human occupation site in Kenya. *Quaternary Research* 8: 245-266.

Gorecki P. 1991. Horticulturalists as hunter-gatherers: rock shelter usage in Papua New Guinea. In C.S. Gamble and W. Boismier (eds.) *Ethnoarchaeological Approaches to Mobile Campsites: Hunter-Gatherer and Pastoralist Case Studies*, 237-262. International Monographs in Prehistory: Ann Arbor, Michigan.

Gould S.J. 1994. So near and yet so far *New York Review Books* October 20: 24-28.

Grayson D.K. 1984. *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Faunas.* New York, Academic Press.

Habermehl K.H. 1985. Altersbestimmung bei Wild- und Pelztieren. *Paul Parey Verlag,* 1-223. Hamburg.

Hahn J. 1983. Die Frühe Mittelsteinzeit. In H Müller-Beck (ed) *Urgeschichte in Baden-Württemberg*, 365-438. Stuttgart, Konrad Theiss Verlag.

Higgs E.S. (ed.) 1972. *Papers in Economic Prehistory.* Cambridge, Cambridge University Press.

Higgs E.S. (ed.) 1975. *Palaeoeconomy* Cambridge, Cambridge University Press.

Ingold T. 1980. *Hunters, Pastoralists and Ranchers.* Cambridge, Cambridge University Press.

Jacobi R.M. 1973. Aspects of the 'Mesolithic Age' in Great Britain, In S. Kozlowski (ed.) *The Mesolithic in Europe,* 237-66. Warsaw: Warsaw University Press.

Jacobi R.M. 1980. The early Holocene settlement of Wales. In J.A. Taylor and R. Bowen (eds.) *Culture and Environment in Prehistoric Wales British Archaeological Reports* 76: 237-262. Oxford, British Archaeological Reports.

Jacobi R.M. 1987. Misanthropic miscellany: musings on British early Flandrian archaeology and other flights of fantasy. In P A Rowley-Conwy *et al* (eds) *Mesolithic of Northwest Europe: Recent Trends,* 163-168. Sheffield.

Jarman M.R. 1972. European deer economies and the advent of the Neolithic. In E.S. Higgs (ed.) *Papers in Economic Prehistory,* 125-147. Cambridge, Cambridge University Press.

Jarman M.R., G.N. Bailey and H.N. Jarman 1982 . *Early European Agriculture.* Cambridge, Cambridge University Press.

Jochim M.A. 1976. *Hunter-Gatherer Subsistence and Settlement: A Predictive Model.* Academic Press, New York.

Jochim M.A. 1981. *Strategies for Survival: Cultural Behaviour in an Ecological Context.* New York, Academic Press.

Jochim M.A. 1989. Optimization and stone tool studies: problems and potentials. In R.Torrence (ed.) *Time, Energy and Stone Tools*, 106-111. Cambridge, Cambridge University Press.

Jochim M.A. 1998. *A Hunter-Gatherer Landscape: Southwest Germany in the Late Paleolithic and Mesolithic* Plenum Press, New York.

Johnson S.J., Clausen H.B., Dansgaard W., Fuhrer K., Gundestrup N., Hammer C.U., Iverson P., Jouzel J., Stauffer B. and Steffensen J.P. 1992. Irregular Glacial interstadials recorded in the New Greenland ice core *Nature* 359: 274-275.

Keene A.S. 1981. Optimal foraging in a non-marginal environment: A model of prehistoric subsistence strategies in Michigan . In B. Winterhalder and E.A. Smith (eds.) *Hunter Gatherer Foraging Societies: Ethnographic and Archaeological Analysis,* 171-193. Chicago, University of Chicago Press.

Keene A.S. 1983. Biology, behaviour and borrowing: A critical examination of optimal foraging theory in archaeology. In J A Moore and A S Keene (eds.) *Archaeological Hammers and Theories*, 137-155. New York, Academic Press.

Kelly R.L. 1983. Hunter-gatherer mobility strategies *Journal of Anthropological Research* 39: 277-306.

Kelly R.L. 1988. The three sides of a biface. *American Antiquity* 53: 717-734.

Kelly R.L. 1995. *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways.* Washington, Smithsonian Institution Press.

Kofler W. 1994. Die vegetationsentwicklung im Späolithikum und Mesolithikum im Raume Trient, *Preistoria Alpina* 28/1: 83-103.

Kuhn S.L. 1993. Mousterian technology as adaptive response: a case study. In G. Larsen Peterkin, H. Brinker and P. Mellars (eds.) *Hunting and Animal Exploitation in the later Palaeolithic and Mesolithic of Eurasia*, 25-32. Archaeological Papers of the American Anthropological Association Vol 4.

Kuhn S.L. 1995. *Mousterian Lithic Technology: An Ecological Perspective.* Princeton, Princeton University Press.

Lanzinger M. 1990. Lithic industries and the peopling of the eastern Italian Alps during the end of the Upper Pleistocene. In M. Cremaschi (ed.) *The Loess in Northern and Central Italy*: Milan Quaderni di Geodinamica Alpina e Quaternaria, 151-165.

Lanzinger M. and Cremaschi M. 1987. Flint exploitation and Production at Monte Avena in the Dolomitic region Italian eastern Alps. In Dibble and Montet-White (eds.) *The Upper Pleistocene Prehistory of Western Eurasia.* Philidelphia, University Museum.

Laplace G. 1964. *Essai de Typologie Systématique* Ann Univ Ferrara, Sez *XV* Vol 1

Law C. 1998. The uses of fire ecology of reedswamp vegetation In P. Mellars and P. Dark (eds.) *Star Carr in Context: New Archaeological and Palaeoecological Investigations at the Early Mesolithic Site of Star Carr, North Yorkshire,* 197-206. Cambridge: McDonald Institute of Archaeological Research.

Lee R.B. 1968. What hunters do for a living, or, how to make out on scarce resources. In R.B. Lee and I. DeVore (eds.) *Man the Hunter.* Chicago, Aldine.

Lee R.B. 1969. !Kung bushmen of Botswana: an input -output analysis. *National Museum of Canada Bulletin* 230.

Legge A.J. 1972. Cave Climates. In E.S. Higgs (ed.) *Papers in Economic Prehistory,* 97-103. Cambridge, Cambridge University Press.

Legge A.J. and Rowley Conwy P.1988. *Star Carr Revisited: A Re-Analysis of the Large Mammals.* London, University of London, Birkbeck College, Centre for Extra-Mural Studies.

Lovari S. (ed.) 1985. *The Biology and Management of Mountain Ungulate.* London, Croom Helm.

Lowe J.J. 1992. Late glacial and early Holocene lake sediments from the northern Apennines, Italy - pollen stratigraphy and radiocarbon dating. *BOREAS 21 An International Journal of Quaternary Research,* 193-208. Sweden.

Mason 1946. Notes on the Indians of the Great Slave Lake area. *Yale University Publications in Anthropology* 34.

Mellars P.A. 1976. Fire ecology, animal populations and man: a study of some ecological relationships in prehistory *Proceedings of the Prehistoric Society* 42: 15-45.

Mellars P.A. 1998. Star Carr in context In P. Mellars and P. Dark (eds.) *Star Carr in Context: New Archaeological and Palaeoecological Investigations at the Early Mesolithic Site of Star Carr, North Yorkshire,* 215-24. Cambridge:, McDonald Institute of Archaeological Research.

Mellars P. and Dark P. (eds.) 1998. *Star Carr in Context: New Archaeological and Palaeoecological Investigations at the Early Mesolithic Site of Star Carr, North Yorkshire.* Cambridge, McDonald Institute of Archaeological Research.

Milliken S. 1998 . The role of raw material availability in technological organisation. A case study from the south-east Italian late Palaeolithic. In S Milleken (ed.) *The Organisation of Lithic Technology in Late Glacial and Early Post-Glacial Europe*, 63-82. Oxford, British Archaeological Reports International Series 700.

Minnis P.E. 1985. *Social Adaptation to Food Stress: A Prehistoric Southwestern Example.* Chicago, Chicago University Press.

Miracle P, T. 1997, Early Holocene foragers in the Karst of northern Istria. *Porocilo o raziskovanju paleolitika, neolitika in eneolitica Sloveniji* XXIV, Ljubljana 1997.

Miracle P, T. and O'Brien C.J. 1998. Seasonality of resource use and site occupation at Badanj, Bosnia-Herzegovina: Subsistence stress in an increasingly seasonal environment? In T.R. Rocek and O. Bar-Yosef (eds.) *Seasonality and Sedentism: Archaeological Perspectives from Old and New World Sites,* 41-74. Peabody Museum Bull, Peabody Museum of Archaeology and Ethnology, Harvard University.

Mitchell B., Staines BW. and Welch D. 1977. *Ecology of Red Deer: A Research Review Relevant to Their Management in Scotland* Banchory, Institute of Terrestrial Ecology.

Mithen S.J. 1987. Prehistoric red deer hunting : a cost-risk-benefit analysis with reference to Upper Palaeolithic Spain and Mesolithic Denmark. In P.A. Rowley-Conwy *et al* (eds) *Mesolithic Northwest Europe: Recent Trends*, 93-108. Sheffield.

Mithen S.J. 1990. *Thoughtful Foragers: A Study of Prehistoric Decision Making.* Cambridge, Cambridge University Press.

Moore P.D. and Webb J.A. 1978. *An Illustrated Guide to Pollen Analysis.* London, Hodder and Stoughton.

Morrison A. 1980. *Early Man in Britain and Ireland.* London, Croom Helm.

Müller-Beck H, 1983, Die späte Mittelsteinzeit In H, Müller-Beck (ed)_*Urgeschiche in Baden-Württemberg*, 393-404. Stuttgart, Konrad Theiss Verlag.

Myers A.M. 1986. *The Organisational and Structural Dimension of Lithic Technology: Theoretical Perspectives from Ethnography and Ethnoarchaeology Applied to the Mesolithic of Mainland Britain with a Case Study from Northern England.* Unpublished PhD dissertation, Sheffield University

Myers A.M. 1989. Reliable and maintainable technological strategies in the mainland of Britain In R. Torrence *Time, Energy and Stone Tools*, 78 - 91. Cambridge, Cambridge University Press.

Noe-Nygaard N. 1974. Mesolithic hunting in Denmark illustrated by bone injuries caused by hunting weapons, *Journal of Archaeological Science* 1: 217-48.

O'Connell and Hawkes 1981. Alyawara plant use and optimal foraging theory. In B. Winterhalder and E.A. Smith (eds.) *Hunter Gatherer Foraging Societies: Ethnographic and Archaeological Analysis*, 99-125. Chicago, University of Chicago Press.

Oeggl K. and Wahlmüller N. 1994. Vegetation and climate history of a high alpine mesolithic camp site in the Eastern Alps. *Preistoria Alpina* 28/1-1992 : 71-81.

Oswalt W.H. 1973. *Habitat and technology.* New York, Holt, Reinhart and Winston

Oswalt W.H. 1976. *An anthropological analysis of food-getting technology.* New York, Wiley and Sons.

Peresani M. 1994. Flint exploitation at epigravettian sites in the Asiago Plateau (Venetian Prealps. *Preistoria Alpina* 28/1:193-205.

Perini R. 1971. I depositi preistorici di Romagnano Loc (Trento) *Preistoria Alpina* 7.

Pianka E. R. 1983. *Evolutionary Ecology.* New York, Harper and Row 3rd edition.

Pitts M.W. 1978. On the shape of waste flakes as an index of technological change in lithic industries *Journal of Archaeological Science* 5:17-37.

Polanyi K. 1959. Anthropology and economic theory. In M H Fried (ed.) *Readings in Anthropology.* New York, Crowell.

Price T.D. 1985. Affluent foragers of Mesolithic southern Scandinavia In T.D. Price and J.A. Brown (eds) *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity*, 341-363. New York, Academic Press.

Price T.D. and Brown J.A.(eds) 1985. *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity.* Academic Press, New York.

Putman R.J. and Wratten S.D. 1984. *Principles of Ecology.* London, Croom Helm.

Rapoport A. 1960. *Fights, Games and Debates.* Ann Arbor, University of Michigan Press.

Riedel A. 1994 . The animal bones from Grotta d'Ernesto. In R. Awsiuk *et al* (eds.) *Preistoria Alpina* 27: 79-120.

Rio Declaration on Environment and Development 1992.

Rogers E.S. 1972. The Mistasini Cree. In M G Bicchieri *Hunters and Gatherers Today*, 90-137. New York, Holt, Reinhart and Winston.

Rosingnol-Strick M. Planchais N., Paterne M. and Duzer D. 1992. Vegetation dynamics and climate during the deglaciation in the south Adriatic basin from a maritime record *Quaternary Science Review* 11: 415-423.

Rowley-Conwy P. 1983. Sedentary hunters: The Ertbølle example. In G.N. Bailey (ed.) *Hunter Gatherer Economy in Prehistory: A European Perspective,* 111-126. Cambridge, Cambridge University Press.

Rowley-Conwy P. 1986. Between cave painters and crop planters: aspects of the temperate European Mesolithic In Marek Zvelebil (ed.) *Hunters in Transition: Mesolithic Societies of Temperate Eurasia and Their Transition to Farming,* 17-32. Cambridge, Cambridge University Press.

Rowley-Conwy P. and Zvelebil M.1989. Saving it for later: storage by prehistoric hunter-gatherers in Europe. In P. Halstead and J. O'Shea (eds) *Bad year Economics: Cultural Responses to Risk and Uncertainty*, 40-56. Cambridge, Cambridge University Press.

Rozoy J.-G. 1989. The revolution of the bowmen in Europe. In C. Bonsall (ed.) *The Mesolithic in Europe*, 13-28. Edinburgh, John Donald.

Sahlins M. 1968. Notes on the original affluent society. In R.B. Lee and I. DeVore (eds.) *Man the Hunter.* Chicago, Aldine.

Sahlins M. 1972. *Stone Age Economics.* Chicago, Aldine.

Schiffer M.B. 1987. *Formation Processes in the Archaeological Record.* Albuquerque: University of New Mexico Press.

Schmid E. 1976. *Atlas of Animal Bones* Knochenatlas für Prähistoriker, Archälogen und Quartärbiologen. Amsterdam, London and New York.

Seiwald A 1980 Beiträge zur Vegetationsgeschichte Tirols IV: Natzer Plateau - Villanderer Alm *Berichte des naturwissenschaftlich-medizinischen Verins Innsbruck,* 67:31-72

Simmons I.. G. 1996. *The Environmental Impact of Later Mesolithic Culture: The Creation of Moorland Landscape in England and Wales*. Edinburgh, Edinburgh University Press.

Simmons I. G., Dimbleby G.W. and Grigson C. 1981. The Mesolithic. In I.G. Simmons and M. Tooley (eds.) *The Environment in British Prehistory*, 82-124. London: Duckworth.

Smith C. 1992. *Late Stone Age Hunters of the British Isles*. London, Routledge.

Smith E.A. 1981. The application of optimal foraging theory to the analysis of hunter-gatherer group size. In Winterhalder B and EA Smith (eds) 1981 *Hunter Gatherer Foraging Societies: Ethnographic and Archaeological Analysis,* 36-65. Chicago, University of Chicago Press.

Speth J.D. 1983. *Bison Kills and Bone Counts: Decision Making by Ancient Hunters.* Chicago, University of Chicago Press.

Speth J.D. 1991. Nutritional constraints and late Glacial adaptive transformations: the importance of non-protein energy sources. In N. Barton *et al* (eds.)*The Late Glacial in North-West Europe.* CBA Research Report No 77: 169-178.

Speth J.D. and K.A. Spielmann 1983. Energy source, protein metabolism and hunter-gatherer subsistence strategies. *Journal of Anthropological Archaeology* 5: 279-312.

Stefansson V. 1944. *Arctic Manual.* New York, MacMillan.

Stern N. 1993. The structure of the Lower Pleistocene archaeological record: a case study from the Koobi Fora Formation. *Current Anthropology* 34: 201-25.

Stiner M.C. 1994. *Honor Among Thieves: A Zooarchaeological Study of Neandertal Ecology.* Princeton, Princeton University Press.

Straus L.G. 1993. Upper Palaeolithic hunting tactics and weapons in western Europe. In G. Larsen Peterkin, H. Brinker and P. Mellars *Hunting and Animal Exploitation in the later Palaeolithic and Mesolithic of Eurasia* Archaeological Papers of the American Anthropological Association Vol 4: 83-93.

Taute W. 1974. Neolithische Mikrolithen und andere Neolithische Silexartifakte aus Süddeutschland und Österreich. In *Archaeologische Information* 2-3.

Taylor J.A. 1975. The role of climatic factors in environmental and cultural changes in prehistoric times. In J.G. Evan, S. Limbrey and H. Cleere (eds.) *The Effects of Man in the Landscape: The Highland Zone,* 6-19. CBA Research Report 11 London, CBA.

Thomas D. H. 1978. The awful truth about statistics in archaeology. *American Antiquity* 43: 231-244.

Thomas J. 1991. *Rethinking the Neolithic.* Cambridge, Cambridge University Press.

Tilley C. 1994. *A Phenomenology of Landscape: Places, Paths and Monuments.* Oxford, Berg Publishers.

Torrence R. 1983. Time budgeting and hunter-gatherer technology. In G. Bailey (ed.) *Hunter-Gatherer Economy in Europe,* 11-22. Cambridge: Cambridge University Press.

Torrence R. 1989. Re-tooling. towards a behavioural theory of stone tools. In R. Torrence (ed.) *Time, Energy and Stone Tools,* 57 - 66.Cambridge: Cambridge University Press.

Van Andel T.H. 1989. Late quaternary sea level changes and archaeology. *Antiquity* 63: 733-745.

Van Noten. F. 1978. Les Chasseurs de Meer *Dissertationes Archaeologicae Gandanes* 18.

Villa P. 1982. conjoinable pieces and site formation processes. *American Antiquity* 47: 276-290.

Villa P. and Courtin J. 1983. The Interpretation of stratified sites: a view from underground. In *Journal of Archaeological Science* 10: 267-281.

Voorhies M.R. 1969. Taphonomy and population dynamics of an early Pliocene vertebrate fauna, Knox County, Nebraska. *University of Wyoming Contributions to Geology Special Papers* 1:1-69.

White R. 1985. *Upper Palaeolithic Land Use in the Perigord: A Topographic Approach to Subsistence and Settlement* Oxford: British Archaeological Reports S253.

Whitelaw 1983. People and space in hunter-gatherer camps: a generalising approach to ethnoarchaeology. *Archaeological Review from Cambridge* 2: 48-66.

Wiessner P. 1982. Beyond willow smoke and dogs' tails: a comment on Binford's analysis of hunter-gatherer settlement systems. *American Antiquity* 47: 253-76.

Willis K. J. 1994. The vegetational history of the Balkans *Quaternary Science Review* 13: 769-788.

Willis K. J. 1997. Vegetational history of the Klithi environment: a palaeoecological viewpoint In G. Bailey (ed.) *Klithi: Palaeolithic settlement and Quaternary landscapes in northwest Greece - Vol.2 Klithi in its local and regional setting*, 395-413. Cambridge, McDonald Institute Monographs.

Winterhalder B. 1986. Diet choice, risk and food sharing in a stochastic environment *Journal of Anthropological Archaeology* 5: 369-92.

Winterhalder B. and Smith E.A. (eds) 1981. *Hunter Gatherer Foraging Societies: Ethnographic and Archaeological Analysis.* Chicago, University of Chicago Press.

Worsley P. 1961. The utilization of natural food sources by an Australian Aboriginal tribe *Acta Ethnographica* X Budapest.

Zvelebil M. 1984. Clues to recent human evolution from specialised technologies? *Nature* 307: 314-5.

Zvelebil M. (ed) 1986. *Hunters in Transition: Mesolithic Societies of Temperate Eurasia and Their Transition to Farming*. Cambridge, Cambridge University Press.