Hidden Landscapes of Mediterranean Europe

Cultural and methodological biases in pre- and protohistoric landscape studies

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10 Toward an understanding of archaeological visibility: the case of the Trentino (Southern Alps)

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Abstract

This article deals with the topographic setting of late Upper Palaeolithic and early Mesolithic sites (corresponding to the final Epigravettian and Sauveterrian cultures, respectively) in relation to three environmental characteristics: slopes, modern land use, and the presence of slope, alluvial or glacial deposits. Together with a pair of other papers (see Cavulli & Grimaldi 2007 and 2009), this work is the virtual extension of two other studies that concentrated mainly on the differences in elevation and site typology (Bagolini & Pedrotti 1992; Dalmeri & Pedrotti 1992). Whereas we then considered a large region made up from the mountain areas of Veneto, Alto-Adige/Südtirol and Trentino, we now consider a more restricted area (Trentino) because of the limited availability of basic environmental digital data, but also because we hope to extend our current method of analysis to a larger region in the future.

1. General setting

Northeastern Italy represents one of the archaeologically richest areas in the Alps. Several hundreds of archaeological sites (excavations in well-stratified deposits as well as surface finds), attributed to the late Upper Palaeolithic/early Mesolithic, are known. Field data have been gathered over decades and there is therefore an abundant bibliography (see, for example, references in Leonardi 1963; Broglio 1972, 1973, 1982, 1994a, b, 1995a, b; Broglio & Improta 1995; Broglio & Lanzinger 1990, 1996; Alessio *et al.* 1977, 1984; Bagolini 1980a, b, 1982; Bagolini & Broglio 1985; Bagolini & Pasquali 1984; Bagolini *et al.* 1984; Biagi 1995; Dalmeri & Lanzinger 2001; Dalmeri *et al.* 2001; Lanzinger 1987, 1991).

After the Last Glacial Maximum in the Alps, the first presence of human groups in the Trentino, attributable to the Epigravettian, is dated to about 11,200 uncal. BP (Riparo Dalmeri; Bassetti *et al.* 2002; see also Broglio & Improta 1995). It has been suggested that the entry of human groups into the mountain area took place in the south as a response to the climatic change brought about by the lateglacial (Bagolini & Broglio 1985). This climate change caused a movement towards the northern alpine pastures, the characteristic habitat of gregarious ungulates. Ibex in particular was presumably the staple of subsistence of these prehistoric groups, as testified by the faunal remains from sites such as Riparo Dalmeri (Fiore *et al.* 2002). Epigravettian rock-shelters are mainly situated in the pre-Alps, while most of the Epigravettian open-air sites in mountain environments are situated near small lakes. Moreover, the elevation distribution of the Epigravettian sites suggests a settlement pattern characterized by the occupation of increasingly higher altitudes. It is worth mentioning that this may be due to the morphology of the landscape instead of to conscious decision-making. As already suggested by previous authors, materials for Epigravettian lithic industries were mainly knapped from local flint (Broglio *et al.* 1995) that, eventually, might be hoarded and stored in-site (Peresani 2003); the off-site use of products made from local flint is also evident (Broglio & Improta 1995).

Sauveterrian (early Mesolithic) human groups peopled the alpine environment from the beginning of the Preboreal to the end of the Boreal zones, and seem to have occupied the whole of the Trentino region. The early Mesolithic site distribution seems denser than that of previous Palaeolithic groups, and the elevation distribution of archaeological evidence in the Trentino — taking into account both excavated sites and surface finds of lithic artefacts — is characterized by the presence of sites on the Adige river valley floor, in the foothills, and in many areas situated at around 2000m asl (see review in Bagolini 1980; Bagolini & Pedrotti 1992; Dalmeri & Pedrotti 1992; Dalmeri *et al.* 2001). While the former are mainly rock shelters characterized by thick deposits and frequently showing complete Mesolithic stratigraphic sequences, the latter consist of small concentrations of lithic artefacts, with little or no clear evidence of settlement features. Furthermore, faunal remains have been rarely preserved at high altitude sites. S.G.

2. Methods

Considering the Pleistocene-Holocene transition and our earlier study which explains the distribution of sites by reference to an exploitation strategy, we asked ourselves if other factors could have influenced the archaeological record (fig. 1).

The landscape information available for a study of site location choice is limited to modern geographical data such as land use, slopes, elevation, groups of geological formations, and a few others. Recent soil and geomorphological maps are only available for parts of the region. Land use, slope morphology, and the presence of Holocene surface sediments seem to us to be the features most relevant in relation to post-depositional processes and the (in-) visibility of evidence. These aspects were studied in relation with the three main elevation ranges (0-500m, 500-1500m, above 1500m), which other authors had already found to have a peculiar relation to the distribution of these sites (Bagolini & Pedrotti 1992; Dalmeri & Pedrotti 1992). The following cartography (in Gauss-Boaga projection) was used for the analysis:

- A slope map of the region (raster and vector) created from the Digital Terrain Model 10m, which has a reference scale of 1:10,000. The DTM has been Created by Sistema Informativo Ambiente e Territorio (SIAT) of Provincia Autonoma di Trento.
- The CORINE Land Cover map (reference scale 1:10,000), simplified to seven main land use classes: Agriculture, Forest, Open uncultivated, Urban areas, Water basins, Glaciers and Marshy areas.
- The Lithological formation group map, from which the Quaternary sediments of 'slope, alluvial and glacial deposits' (here after named 'SAG') were selected. Lacking better cartography this is the only map showing the position and extent of recent covering sediments (Bosellini *et al.* 1999). Although shown as a single legend unit, from an archaeological point of view this has to be split up into three different polygon types: Slope, Alluvial and Glacial deposits, respectively. While the former two are relevant to post-depositional processes affecting archaeological visibility, the glacial deposits precede the formation of archaeological sites. Conscious of this limitation,

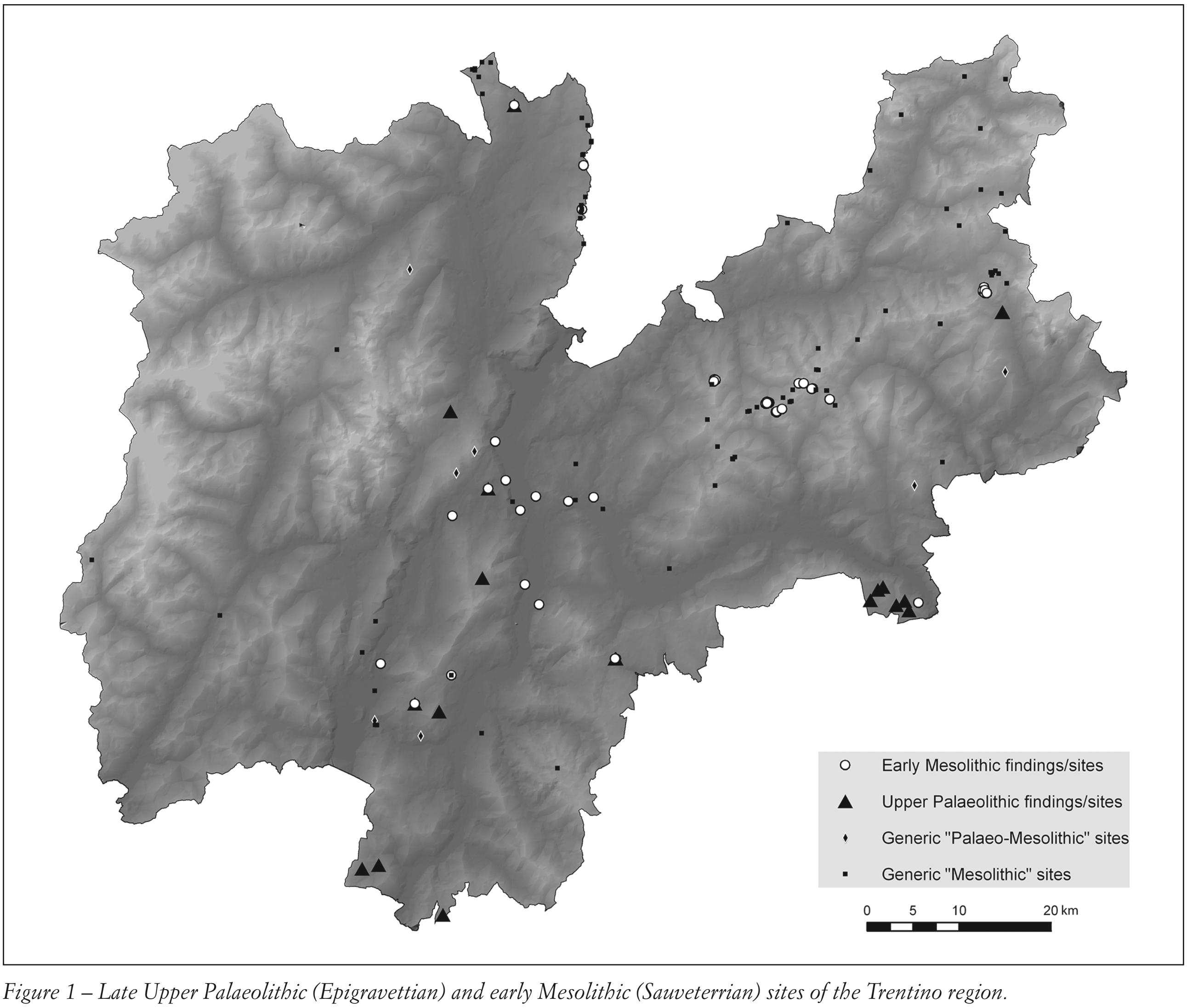


Figure 1 – Late Upper Palaeolithic (Epigravettian) and early Mesolithic (Sauveterrian) sites of the Trentino region.

we tested the relevance of this variable for the distribution of archaeological records.

The area considered in this study is restricted to Trentino province; the results of future studies will be exported to the regions of Alto-Adige/Südtirol and Veneto. Studying a limited area provides the opportunity of testing our exploratory analysis in a homogeneous morphology; at a later stage this can be adapted to a larger area considering only the specific morphologies (i.e. minimum/maximum elevations of valley bottoms and peaks.

In the tables and histograms below, the *relative* site densities of areas (such as forested areas above 1500m asl or slopes with a gradient of between 15° and 35° below 500 m asl, etc.) are considered more important than the absolute densities or frequency. Nonetheless we provide the frequencies and percentages for the interested reader.

In the present analysis, all bibliographical evidence relating to the late Upper Palaeolithic and early Mesolithic periods is considered, irrespective of whether they are made up by a deposit or by a few scattered finds. The flint artefacts attributed generically to the Mesolithic (89 examples) or to the 'Palaeo-Mesolithic' period (7 examples) were considered only towards the end of the work when comparison with chronologically precisely attributed finds was possible. 22 records can be related to the Epigravettian culture (Upper Palaeolithic period), and 48 to the Sauveterrian (early Mesolithic); the late Mesolithic Castelnovian has not been considered in this work. F.C.

3. A brief overview of the geology and geomorphology of the Trentino region

The Trentino region is located in the eastern sector of the southern Alps and mostly coincides, together with South Tirol, with the mountain reaches of the Adige river drainage basin. Trentino's eastern part (e.g., the Sarca valley) drains directly into the Po river further south. The physiography of the region is rather diverse, as a result of its geological complexity and the polygenetic Quaternary landscape evolution. From a geographical point of view, the Adige and Sarca valleys form the 'backbones' of the region. Both valleys are oriented roughly North-South and cross the whole southern Prealpine and Alpine ranges, linking the area to the northern slope of the Alps as well as (through East-West oriented valleys such as Valtellina, Valpusteria, and Valsugana) to other segments of the Alpine chain. Altitude ranges from 200m in the Adige valley bottom to over 3000m, often with abrupt transitions between altitudinal belts.

The geographical setting of the Trentino is closely linked to its rather varied geological and structural layout. Three main geological domains may be recognized (Bosellini *et al.* 1999):

- Southern Alpine terrains extend along the central and eastern sectors of the region and comprise pre-Permian crystalline basement materials (such as the metamorphic rocks outcropping next to the Cima d'Asta granite) and Permian to Tertiary covers. These range from the volcanic rocks of the so-called Adige porphyric platform to the sedimentary ones, mostly Mesozoic carbonates, which form the bulk of Dolomites;
- Austroalpine terrains are mostly metamorphic and outcrop in the NW corner of the region; and
- The Adamello batholith is formed of granitoid lithotypes dating to the Cenozoic and spreads out along the eastern border of the Trentino.

The relief is mainly controlled by geological factors, even if the present landscape strongly depends on dynamics relating to the last glacial – interglacial cycle. Structural and geological factors are responsible for the high relief energy and orientation of the main hydrographic and orographic axes. The two major drainage systems (Sarca and Adige rivers) were formed by the intense erosion triggered by the Miocene Messinian crisis. Nevertheless, the most obvious landscape features today are due to glacial (and periglacial) morphogenesis, which intensely modelled the landscape during the coldest phases of the Pleistocene when glaciers were flowing from the upland through the valleys and into the Po Plain. Interglacial morphogenesis was controlled by fluvial and slope activity, with the formation of relict slopes and terraces often still recognizable along valley flanks.

The last glacial cycle is the best known. The pre-Würmian drainage pattern was significantly different from the present one, with the palaeo-Adige flowing through what is today the Sarca valley. At the Alpine Last Glacial Maximum (ALGM, circa 20,000 BP), Trentino was almost completely subject to glacial and periglacial conditions, with glacial bodies thicker than 1 km occupying the main Adige, Sarca and Brenta valleys. At this time the Alpine margin was experiencing steppe-like conditions, and main reliefs (including prealpine plateaux) were subject to periglacial environments. The pre-ALGM surface inside the Adige valley lies some 200m below the present surface, as detected by coring at Trento (Felber *et al.* 2000). The importance of these ice-related dynamics means that the ALGM, for most of the Trentino territory, has to be regarded as time 'zero' for most of the archaeological record.

The deglaciation was a time-transgressive process that took place between circa 16,000 and 14,500 BP at the Alpine margin, and around 12,000 BP in mountain areas, the mid-altitude belt being nearly deglaciated around 14,000 BP (Casadoro *et al.* 1976; Avigliano *et al.* 2000; Pellegrini *et al.* 2005). At this time, intense discharge from the glacial fronts led to the accumulation of thick sedimentary prisms in the main valleys and in the Po Plain. Other relevant processes of the lateglacial include loess deposition in the Prealps (probably before GI1), soil formation between circa 11,500-11,000 BP (during GI1, former Bølling and Allerød zones), and the shifting of biological communities towards mid-altitude uplands. Human occupation reached the mid-altitude Prealpine plateaux during GI1. The GS1 (i.e. Younger Dryas) cold shift caused an interruption of these trends, another possible phase of wind-blown dust sedimentation, the reduction of Prealpine human occupation to 'refugee' areas, and intense vertical aggradation due to fluvial activity in valley bottoms (Fuganti *et al.* 1998; Angelucci & Bassetti 2009).

The climatic and environmental trends observed during GI1 were renewed at the onset of the Holocene. Following intense slope activity in the early Holocene (recorded at several sites located in footslopes, like Romagnano or Vatte di Zambana), geomorphological surfaces progressively stabilized and the drainage systems re-established equilibrium by infilling of depressions such as those at Trento and Valle dei Laghi ('Valley of the Lakes' in the Sarca drainage). Stability and biostasy up to circa 2000m have been observed during this time span, matching the abundant archaeological evidence from the Mesolithic in mountain areas. Soil formation continued throughout the Atlantic until it was interrupted by the beginning of 'Neoglaciation', the effects of which were often magnified by the first human impact on the landscape (Cavulli *et al.* 2002).

As a result of the complex geological layout and late Quaternary morphodynamics, the Trentino region is composed of a mosaic of juxtaposed and superimposed landscape units. In general, the region presents dramatic landscape contrasts and high relief energy. Floodplains (less than 10% of the total surface of the Trentino) are limited to the main valley bottoms; the latter are often constrained by steep slopes with compound profiles reaching mountain areas. Talus scree and cones are found at the foot of these slopes. Land over 1500m amounts to almost 50% of the surface and abrupt periglacial-related morphologies are common, as well as structural plateaux or depressions derived from the still unattained hydrological equilibrium. The upland areas have been subject, during the Holocene, to erosion or non-sedimentation, explaining the general shallowness and near-surface position of the archaeological evidence. By contrast, the lower-lying areas were subject to intense sedimentation through the lateglacial and early Holocene, with consequent accumulation of thick successions that may embed significant archaeological sequences but, at the same time, have buried and hidden them from view. D.E.A.

slope °	SAG	Soil Use Type	Upper Palaeo. Early Meso. sites	<500	500-1500	>1500
0-5	present	agriculture	1	1		
0-5	present	open uncultivated	1			1
0-5	absent	forest	2		2	
0-5	absent	open uncultivated	4		2	2
5-15	absent	agriculture	3	1	2	
5-15	absent	forest	13	2	7	4
5-15	absent	open uncultivated	11	2	4	5
15-35	present	forest	5		2	3
15-35	present	urban area	1	1		
15-35	absent	agriculture	1	1		
15-35	absent	forest	8	1	5	2
15-35	absent	open uncultivated	17			17
35-90	absent	forest	1	1		
35-90	absent	open uncultivated	1	1		
35-90	absent	urban area	1	1		

Table 1 – Summary characteristics of Upper Palaeolithic and early Mesolithic sites of the Trentino region.

4. Palaeolithic and Mesolithic finds and the environment (table 1)

How can we explain the observed distribution of finds/deposits: as a direct reflection of exploitation strategies, or as the result of a combination of research limitations and such exploitation strategies? It is possible that the landscape itself, its transformation through time and post-depositional processes, has affected the archaeological record. It is probable that vegetation and slope and alluvial sediments now cover archaeological deposits and evidence; in other words, the possibility of finding traces of them today may be severely limited. Therefore, we would like to verify to what extent the spatial distribution of the archaeological record corresponds to a valid picture of the past. We will first describe the general elevation, slope, SAG and land-use properties of our site sample, then go into more detail regarding Late Upper Palaeolithic and early Mesolithic sites in sections 4.1 and 4.2.

Elevation (fig. 2)

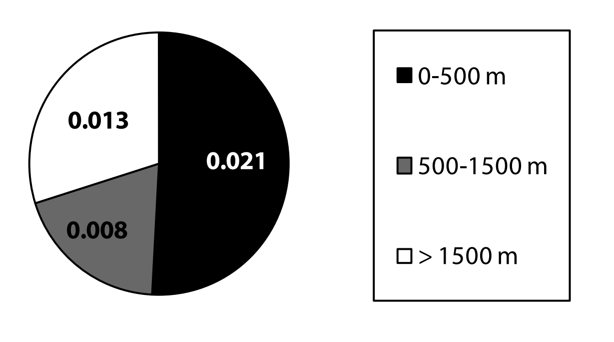
Taking the whole sample of Epigravettian and Sauveterrian sites together, the site count increases with higher altitudes (almost 50% of sites are found above 1500 m), but the highest density is located between 90 and 500 m asl.

Slope (fig. 3)

With regard to the variability of slope inclination in the region and the classification of site frequency into three main categories (0-15, 15-35, and 35-90 degrees), it comes as no surprise to find a higher site density in flat areas. What is more surprising is to find three sites above the angle of repose (35 degrees): the early Mesolithic sites of Vatte, Pradestel and Bus de la Vecia are shelters placed on vertical rock walls a few metres above the Adige Valley, and linked to it by means of steep talus cones. Today, because of extraction activities, they are on vertical walls.

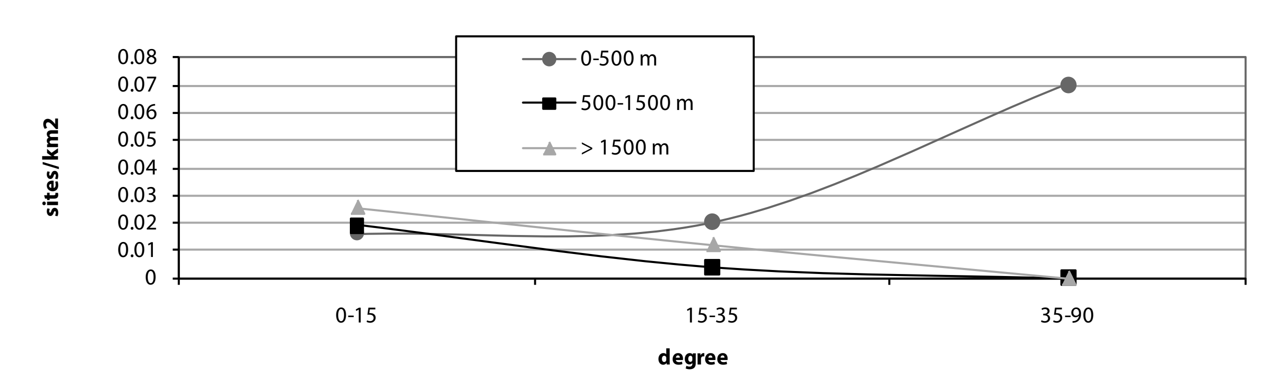
Slope, alluvial and glacial (SAG) deposits (fig. 4)

The few sites that are located on SAG deposits are located on cone and scree deposits above the main valley floor such as La Vela, Romagnano Loch; on high elevation saddles such as Passo S. Barbara, Malga delle Buse del Sasso; or close to ancient elevated lakes such as Viotte. Combining the data on slopes and those on the presence of SAG deposits,



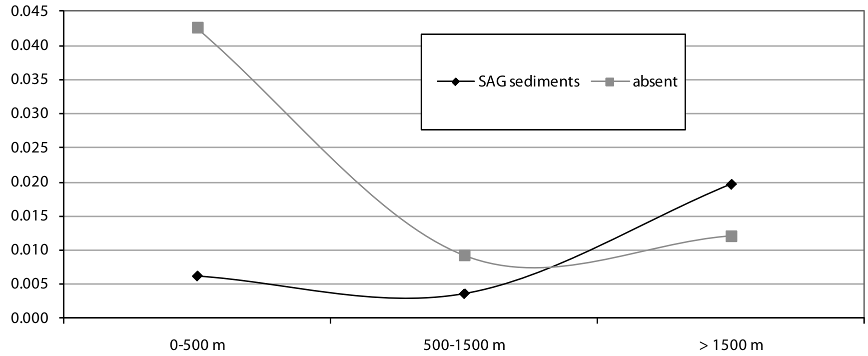
Elevation m	Area km²	Area %	Freq. of sites	Sites %	Density (Sites/km²)
0-500	559.3	9.0	12	17.143	0.021
500-1500	2955.3	47.6	24	34.286	0.008
> 1500	2693.8	43.4	34	48.571	0.013

Figure 2 – Site density (per km²) per elevation zone.



Elevation m	Slope °	Area km²	Area %	# Sites	Sites %	Sites/km²
0-500	0-15	369.5	6.0	6	8.571	0.016
0-500	15-35	147.0	2.4	3	4.286	0.020
0-500	35-90	42.8	0.7	3	4.286	0.070
500-1500	0-15	891.8	14.4	17	24.286	0.019
500-1500	15-35	1741.3	28.0	7	10.000	0.004
500-1500	35-90	322.0	5.2	0	0.000	0.000
> 1500	0-15	469.1	7.6	12	17.143	0.026
> 1500	15-35	1810.1	29.2	22	31.429	0.012
> 1500	35-90	414.0	6.7	0	0.000	0.000

Figure 3 – Site density (per km²) per elevation zone for each slope class.



Elevation m	SAG deposits	Area km²	Area %	# Sites	Sites %	Sites/km²
0-500	present	324.6	5.2	2	2.899	0.006
500-1500	present	561.3	9.0	2	2.899	0.004
> 1500	present	203.1	3.3	4	5.797	0.020
0-500	absent	234.7	3.8	10	14.493	0.043
500-1500	absent	2394.0	38.6	21	30.435	0.009
> 1500	absent	2490.7	40.1	30	43.478	0.012

Figure 4 – Site density (per km²) per elevation zone for areas with/without SAG (slope, alluvial and glacial) deposits.

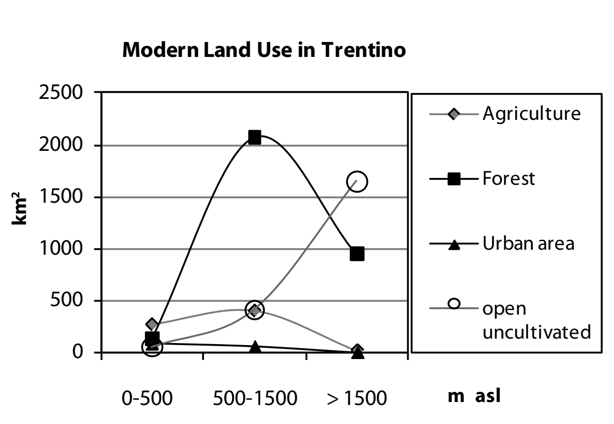
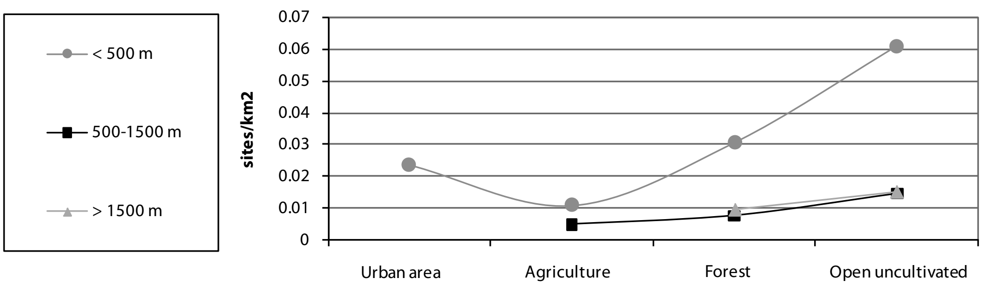


Figure 5 – Area (in km²) of modern landuse per elevation zone in the Trentino region.

Slope (°)	SAG deposits	Land use	Upper Palaeo. sites	<500 m	500-1500 m	>1500 m
0-5	present	open uncultivated	1			1
0-5	absent	forest	2		2	
0-5	absent	open uncultivated	2		2	
5-15	absent	agriculture	1		1	
5-15	absent	forest	6		5	1
5-15	absent	open uncultivated	5	1	4	
15-35	present	forest	1		1	
15-35	absent	forest	4		3	1

Table 2 – Summary features of late Upper Palaeolithic sites in Trentino.



Land use	Area km²	Area %	# Sites	Sites %	Sites/km²
Agriculture	696.3	11.2	5	7	0.007
Forest	3159.4	50.9	29	42	0.009
Open uncultivated	1876.9	30.2	34	48	0.018
Urban area	152.3	2.5	2	3	0.013
Water basins	38.8	0.6	0	0	0.000
Glaciers	55.4	0.9	0	0	0.000
Marshy area	0.3	0.0	0	0	0.000

Figure 6 – Site density (per km²) per elevation zone for each land use type.

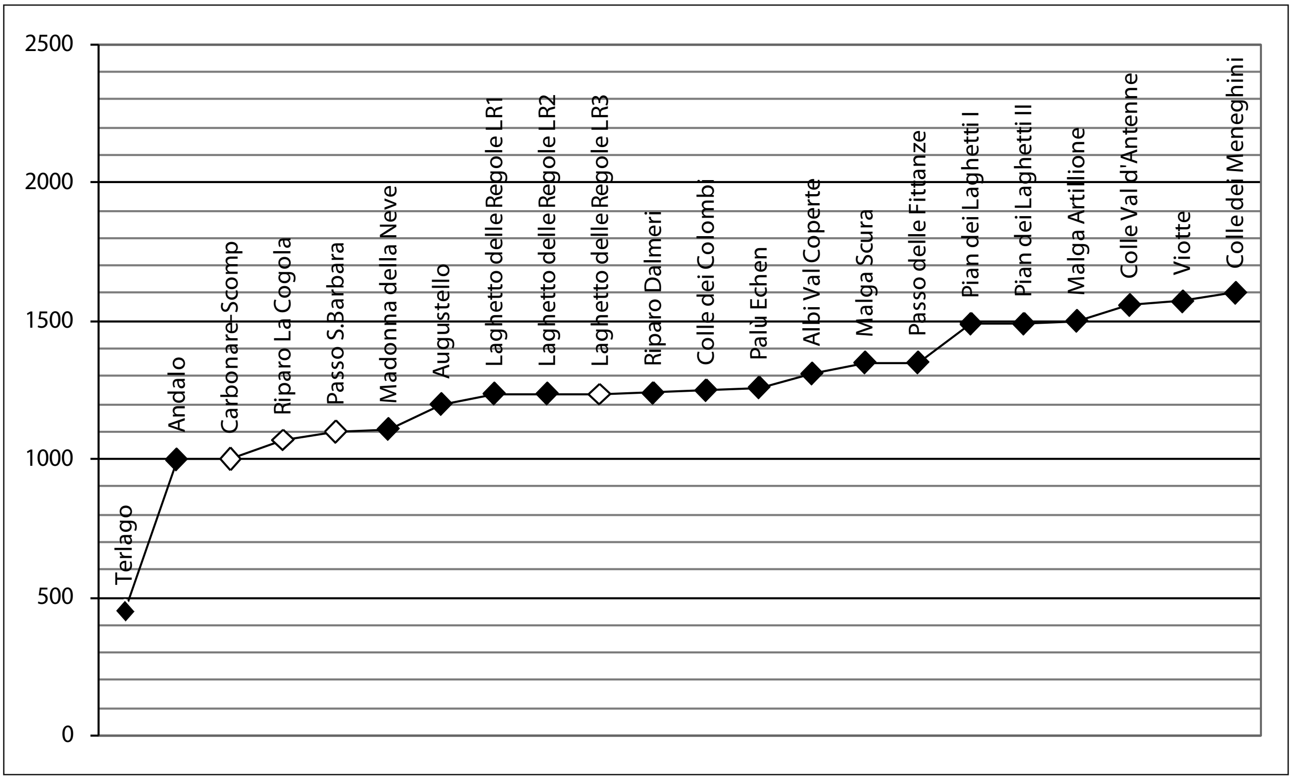


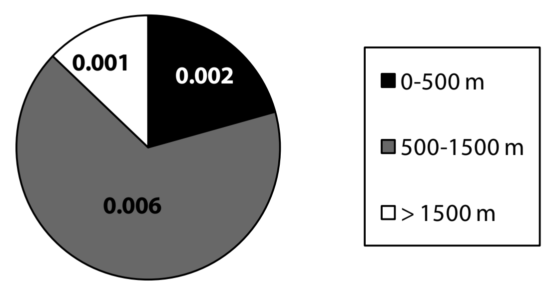
Figure 7 – Elevations of late Upper Palaeolithic sites. White symbols indicate sites that continue into the Sauveterrian.

the sites turn out to be generally located on sub-flat surfaces without SAG sediment.

Land use (figs 5, 6)

A large part (more than 50%) of the study region is covered by forest, but the main sites density is recorded in open uncultivated areas (30% by area) and urban areas (town, villages, industrial and extraction areas, roads, etc., altogether 2.5% of the area). However, the number of sites in forested land is still quite high, demonstrating the possibility of recovering finds/sites even in difficult visual conditions.

Considering the differences in elevation, it is clear that sites above 1500m asl are in pastures or in forests; areas occupied by agriculture or villages are scarce at this altitude. Sites between 500 and 1500m asl are mainly in forested areas – forest being the most common type of land use at these elevations – and secondarily in cultivated or uncultivated open areas. Below 500m asl the sites seem to have no 'preference' for a particular land use.



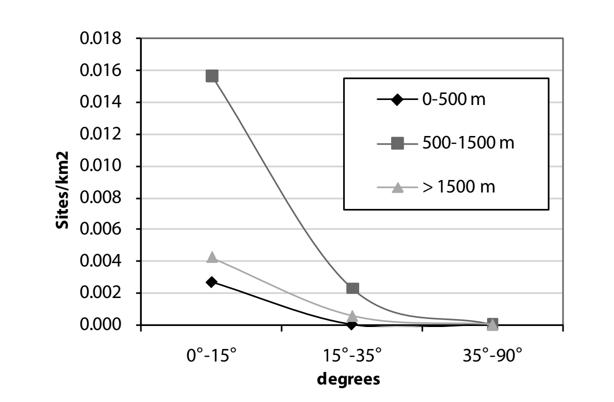
Elevation m	Area km²	Area %	# Sites	Sites %	Sites/ km²
0-500	559.3	9.0	1	5	0.002
500-1500	2955.3	47.6	18	82	0.006
> 1500	2693.8	43.4	3	14	0.001

Figure 8 – Density of late Upper Palaeolithic sites (per km²) per elevation zone.

4.1 Late Upper Palaeolithic sites (table 2)

Once the whole sample is analysed it is worth having a look at how sites divided by chronology act. As mentioned above, the Epigravettian sites are located at middle elevations, between 1000 and 1600m asl (fig. 7). The site of Terlago is exceptional, probably because of the strategic position between two mountains without a high altitude passage: Monte Bondone, where the site of Viotte is located, and Monte Paganella with the site of Andalo. Indeed, this south-north line appears to mark a significant route into the Southern Alps, from Monte Baldo to the end of the Non Valley (Le Regole site).

Evidently, Palaeolithic sites preferred to be located in flat areas at elevations between 1000 and 1600m asl (figs 8, 9). The case of Terlago at 450m asl shows that it is possible to find Epigravettian evidence even below 1000m. In spite of two cases of sites in SAG sediments (Passo S. Barbara and Viotte), the most commonly selected locations are SAG-free and are often in forested or pasture areas (figs 10, 11).



Elevation m	Slope °	Area km²	Area %	# Sites	Sites %	Sites / km²
0-500	0-15	369.5	6.0	1	5	0.003
0-500	15-35	147.0	2.4	0	0	0.000
0-500	35-90	42.8	0.7	0	0	0.000
500-1500	0-15	891.8	14.4	14	64	0.016
500-1500	15-35	1741.3	28.0	4	19	0.002
500-1500	35-90	322.0	5.2	0	0	0.000
> 1500	0-15	469.1	7.6	2	10	0.004
> 1500	15-35	1810.1	29.2	1	5	0.001
> 1500	35-90	414.0	6.7	0	0	0.000

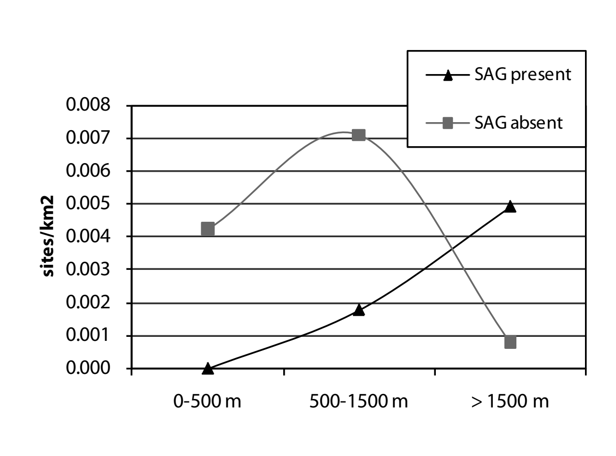
Figure 9 – Density of late Upper Palaeolithic sites (per km²) per elevation zone for each slope class.

Slope (°)	SAG deposits	Land use	Early Meso. sites	<500 m	500-1500 m	>1500 m
0-5	present	agriculture	1	1		
0-5	absent	open uncultivated	2			2
5-15	absent	agriculture	2	1	1	
5-15	absent	forest	7	2	2	3
5-15	absent	open uncultivated	6	1		5
15-35	present	forest	4		1	3
15-35	present	urban area	1	1		
15-35	absent	agriculture	1	1		
15-35	absent	forest	4	1	2	1
15-35	absent	open uncultivated	17			17
35-90	absent	forest	1	1		
35-90	absent	open uncultivated	1	1		
35-90	absent	urban area	1	1		

Table 3 – Summary characteristics of early Mesolithic sites in the Trentino region.

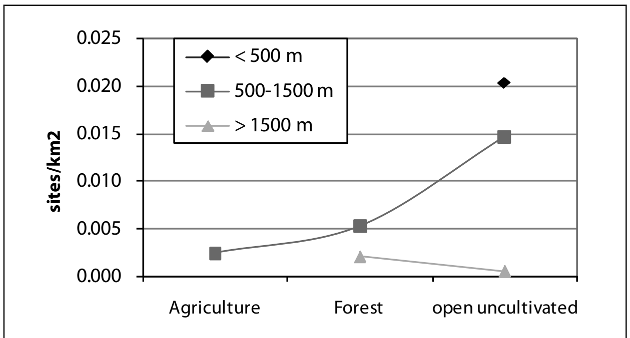
4.2 Early Mesolithic sites (table 3)

Five early Mesolithic finds are located between 1000 and 1238m asl. This group is important because it has not been studied previously and because there appear to be clear 'gaps' in between the finds be-



Elevation m	SAG deposits	Area km²	Area %	# Sites	Sites %	Sites/ km²
0-500	present	324.6	5.2	0	0	0.000
500-1500	present	561.3	9.0	1	5	0.002
> 1500	present	203.1	3.3	1	5	0.005
0-500	absent	234.7	3.8	1	5	0.004
500-1500	absent	2394.0	38.6	17	77	0.007
> 1500	absent	2490.7	40.1	2	10	0.001

Figure 10 – Density of late Upper Palaeolithic sites (per km²) per elevation zone for areas with/without SAG (slope, alluvial and glacial) deposits.



Land use	Area km²	Area %	# Sites	Sites %	Sites/ km²
Agriculture	696.3	11.2	1	5	0.001
Forest	3159.4	50.9	13	62	0.004
Open uncultivated	1876.9	30.2	8	36	0.004
Urban area	152.3	2.5	0	0	0.000
Water basins	38.8	0.6	0	0	0.000
Glaciers	55.4	0.9	0	0	0.000
Marshy areas	0.3	0.0	0	0	0.000

Figure 11 – Density of late Upper Palaeolithic sites (per km²) per elevation zone for each land use type. Only the site of Terlago is under 500 m, and only three sites are around 1600 m asl (Colle Val d'Antenne, Viotte, and Colle dei Meneghini).

longing in the three classes (low, mid and high elevations; see figures 12 and 13).

Finding even a few sites at this elevation range indicates a high site potential for an area characterized by low archaeological visibility: the area covered by forest, SAG deposits and with frequent steep slopes (see above). Of this group, only Grotta d'Ernesto has no previous Epigravettian occupation. This may be due to the specific character of these middle elevations areas, which may have been suitable for base camps, rich in raw material (flint) and vegetal resources, and along 'forced' passageways to higher hunting areas.

Much like Palaeolithic finds, Mesolithic ones too are located in flat or slightly inclined areas (fig. 14). The

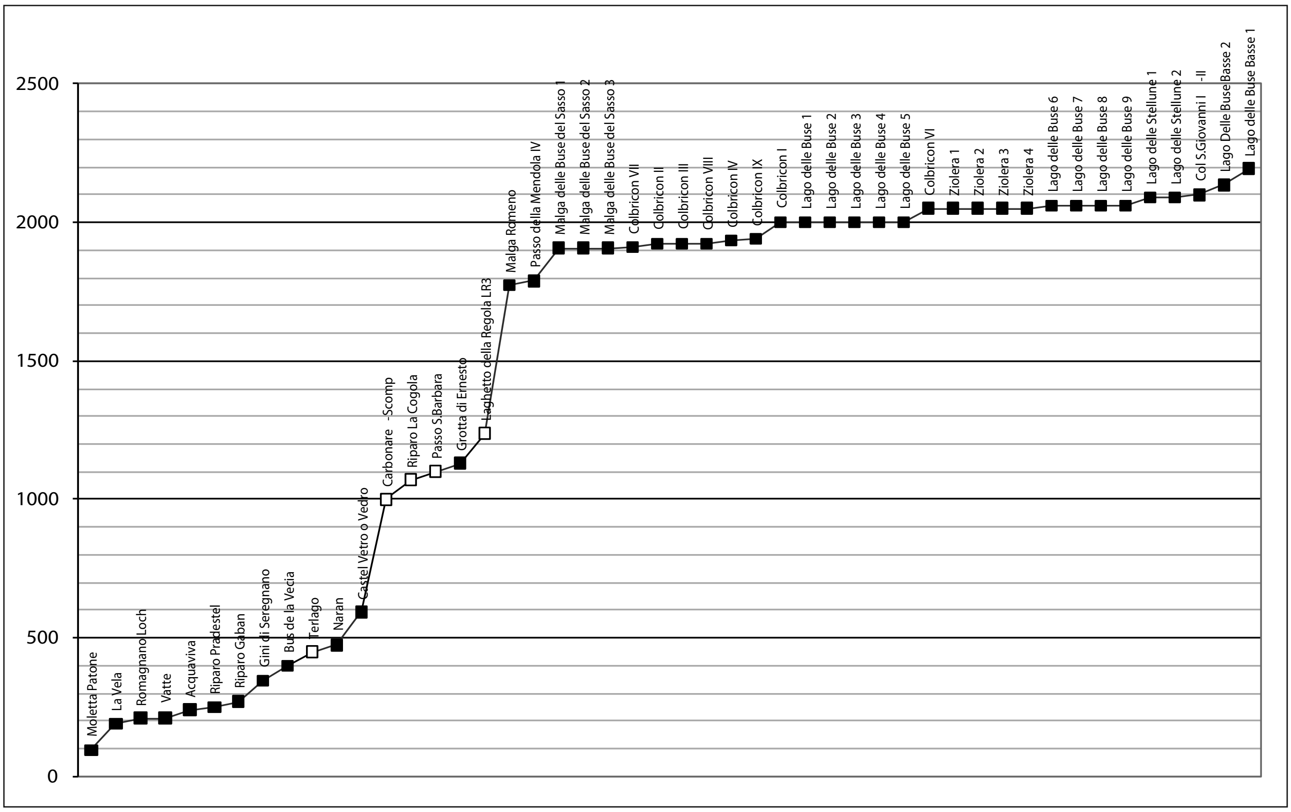
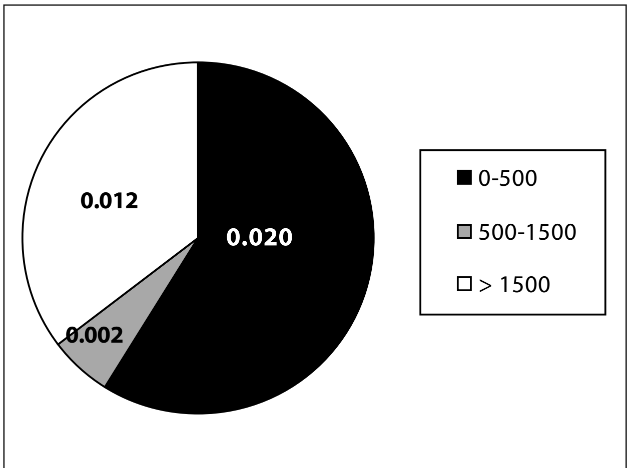
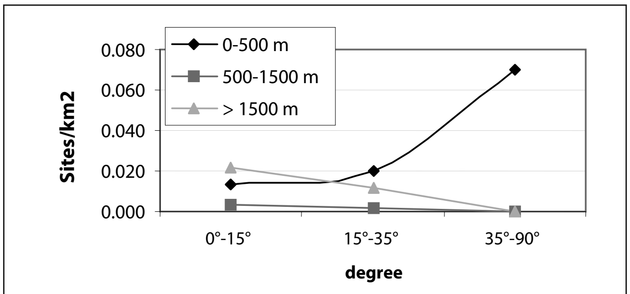


Figure 12 – Elevations of early Mesolithic sites. White symbols indicate a previous Epigravettian occupation.



Elevation m	Area km²	Area %	# Sites	Sites %	Sites/ km²
0-500	559.3	9.0	11	23	0.020
500-1500	2955.3	47.6	6	13	0.002
> 1500	2693.8	43.4	31	65	0.012

Figure 13 – Density of early Mesolithic sites (per km²) per elevation zone.



Elevation m	Slope °	Area km²	Area %	# Sites	Sites %	Sites/ km²
0-500	0-15	369.5	6.0	5	10	0.014
0-500	15-35	147.0	2.4	3	6	0.020
0-500	35-90	42.8	0.7	3	6	0.070
500-1500	0-15	891.8	14.4	3	6	0.003
500-1500	15-35	1741.3	28.0	3	6	0.002
500-1500	35-90	322.0	5.2	0	0	0.000
> 1500	0-15	469.1	7.6	10	21	0.021
> 1500	15-35	1810.1	29.2	21	44	0.012
> 1500	35-90	414.0	6.7	0	0	0.000

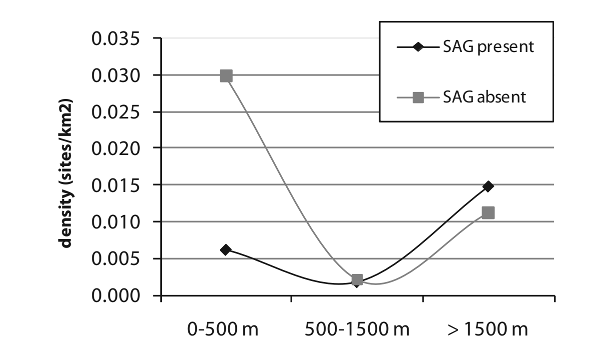
Figure 14 – Density of Mesolithic sites (per km²) per elevation zone for each slope class.

high density between 35 and 90 degrees is due to the low altitude shelters already discussed above. There is a high density of Mesolithic finds at low elevations without SAG sediments, but there is another group at altitudes over 1500m asl where these sediments are present — probably because many of these are located about 2000m where erosion and scree are abundant (fig. 15). The high density of sites in low-lying urban areas is of course due to modern construction and extraction activities during the 1970s and 1980s, which led to the discovery of many sites (fig. 16).

The largest group of finds generically attributed to the Mesolithic or Palaeo-Mesolithic period are from above 1500m asl (fig. 17). These scattered flints, usually bladelets, without any diagnostic characteristics (formal tools) are interpreted as Mesolithic finds only because they were found on high altitude mountains. Even if in this zone it is not easy to collect finds from other periods, there is still no proof that this attribution is correct. The difference between the high site frequency in the eastern part of the region and the lower frequency to the west (fig. 18) appears to be due only partially to morphology (except for the Non valley in the north-east, the rest of east Trentino presents steep and high slopes) and mainly to a lack of research. F.C.

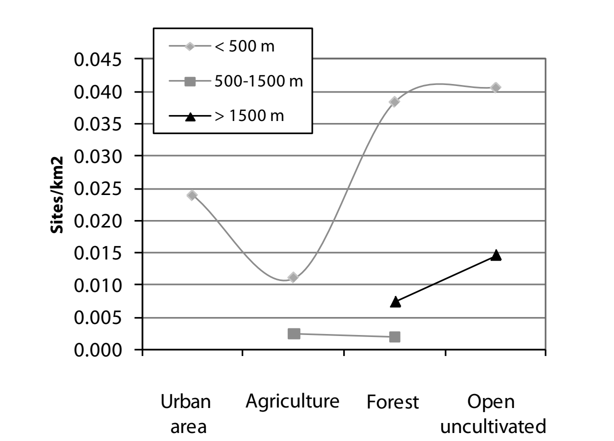
5. Conclusions

Late Upper Palaeolithic and early Mesolithic sites in the Trentino are usually found in flat or sub-flat



Elevation m	SAG deposits	Area km²	Area %	# Sites	Sites %	Sites/ km²
0-500	present	324.6	5.2	2	4	0.006
500-1500	present	561.3	9.0	1	2	0.002
> 1500	present	203.1	3.3	3	6	0.002
0-500	absent	234.7	3.8	7	15	0.030
500-1500	absent	2394.0	38.6	5	10	0.002
> 1500	absent	2490.7	40.1	28	58	0.011

Figure 15 – Density of Mesolithic sites (per km²) per elevation zone for areas with/without SAG (slope, alluvial and glacial) deposits.



Land use	Area km²	Area %	# Sites	Sites %	Sites/ km²
Open uncultivated	1876.9	30.2	26	54	0.014
Forest	3159.4	50.9	16	33	0.005
Agriculture	696.3	11.2	4	8	0.006
Urban area	152.3	2.5	2	4	0.013
Water basins	38.8	0.6	0	0	0.000
Glaciers	55.4	0.9	0	0	0.000
Marshy areas	0.3	0.0	0	0	0.000

Figure 16 – Density of early Mesolithic sites (per km²) per elevation zone for each land use type.

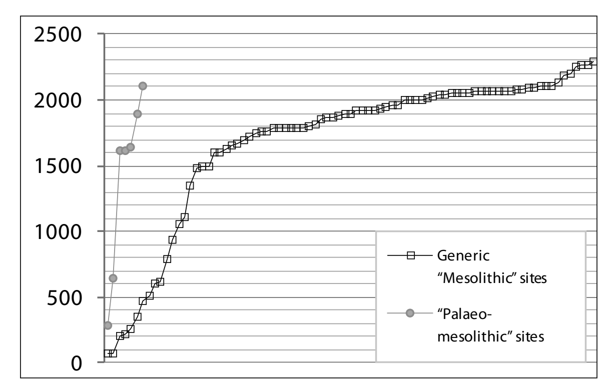
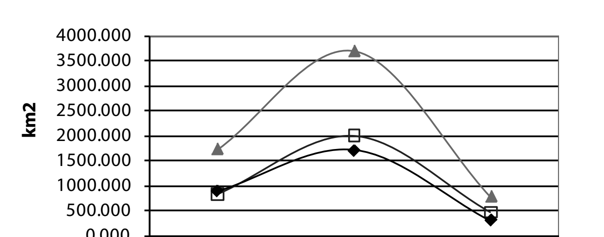


Figure 17 – Altitude distribution of sites generically attributed to the Mesolithic and to the Palaeolithic or Mesolithic.



	0°-15°	15°-35°	35°-90°
WEST TN	836.227	1995.645	468.397
tot	1731.782	3698.823	778.903
EAST TN	895.555	1703.178	310.506

Figure 18 – Comparison of areas (km²) of each slope class between East and West Trentino.

areas (fig. 3), free of a significant overburden of alluvial or glacial slope deposits (fig. 4). Elevation is a very important variable (fig. 2): while Palaeolithic sites (fig. 7) are located with one exception at middle elevations (1000-1600m asl), the Mesolithic ones are located at three different elevation ranges (fig. 12): low (between 95 and 594m asl), mid (1000-1238m) and high (1773-2000m). Currently, there are no finds attributed to these chronological phases in the 'gaps' between these ranges.

Because of the wet, marshy conditions of the valley floor of the Adige River during the early Holocene (Fuganti *et al.* 1998), the shelters are located above the valley bottom on footslopes of talus cones (fig. 15). That they are currently found on vertical walls is due to the well-known and intensive exploitation of these talus on footslopes for gravel extraction from the 1970s onwards.

More is known today about the middle elevation range because of important new research (La Cogola, Dalmeri *et al.* 2000; Dalmeri 2005; and Laghetto della Regola, Dalmeri *et al.* 2005). These Sauveterrian sites, excepting Grotta d'Ernesto, have a previous Epigravettian occupation (fig. 7). Finds from the middle elevations (both Mesolithic and Palaeolithic) are located in specific places such as rock shelters/caves (Riparo La Cogola, Riparo Dalmeri and Grotta d'Ernesto), smooth morphologies such as flat open areas or plateaus (Passo S. Barbara, Madonna della Neve, Colle dei Colombi, Albi Val Coperte, Malga Scura, Malga Artillione, Colle Val d'Antenne, Colle dei Meneghini, Augustello), and close to small lakes (Viotte, Andalo, Terlago, Carbonare, Laghetto della Regola LR1-3, Pian dei Laghetti I–II, Palù Echen).

The middle altitudes in this region are mostly unstable (almost 60% has an inclination between 15 and 35 degrees, and more than 10% is steeper than 35 degrees) and of low archaeological visibility. More than 50% of the SAG deposits are found at this elevation range, and dense coniferous forests hide the potential finds (more than 50% of the region and more than 70% of the middle elevations are forested). Although we must take the presence of 24 finds of the two periods in this elevation range seriously, they occupy only those morphologies that have a high survey visibility and are preserved by surface dynamics. All these considerations must be taken into account when promoting the exploration of the site gaps in western Trentino and at middle elevations.

The success of this analysis means that we can extend the method to neighbouring regions, using an approach based on multivariate analysis and hydrographical basins, because the differences of valley bottoms, slopes and top areas are very similar between the regions of Trentino-Alto Adige, Veneto, and Friuli. Taking into account our earlier remarks about archaeological visibility and post-depositional processes, we are now better placed to investigate the exploitation strategies of the last hunter-gatherer groups of the southern Alps. A.P., F.C., S.G., D.E.A.

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