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EVALUATING MESOLITHIC SETTLEMENT PATTERNS IN MOUNTAIN ENVIRONMENTS (DOLOMITES, EASTERN ITALIAN ALPS): THE ROLE OF RESEARCH BIASES AND LOCATIONAL STRATEGIES

1. Introduction

Among the European mountainous zones, the Alps – and in particular the eastern Alps – are one of the best archaeologically investigated. During the Early Holocene the recolonisation of the Alps after the Ice Age reached its climax as attested by the hundreds of sites and findspots identified over the last 50 years (Bagolini 1972; Bagolini *et al.* 1983; Broglio 1994; Cesco Frare, Mondini 2005; Fontana, Govoni *et al.* 2009; Fontana, Pasi *et al.* 2009; Fontana *et al.* 2011; Fontana, Visentin 2016; Visentin, Carrer *et al.* 2016). Research focused mainly on highland evidence, identifying recurrent locational patterns (on passes, ridges, lake shores or close to water sources) and defining hierarchic relationships between sites, divided into seasonal residential camps (Fig. 1) and satellite stands (Bagolini, Dalmeri 1987; Broglio, Lanzinger 1990; Dalmeri, Pedrotti 1994; Fontana *et al.* 2011).

By re-evaluating the distribution of known sites in the uplands, some authors tried to understand whether it reflected actual settlement strategies adopted by the last hunter-gatherer groups or it was purely the result of research biases. Fontana and colleagues adopted a descriptive and qualitative approach in order to analyse the main factors affecting visibility and preservation of archaeological evidence at mid-high altitude (Fontana *et al.* 2011). On the other hand Cavulli and colleagues tried to quantify the impact of archaeological visibility using a GIS-based methodology (Cavulli, Grimaldi 2007; Cavulli *et al.* 2011). Both these approaches highlighted the limits connected to the reconstruction of Palaeo-Mesolithic settlement strategies at high-altitudes but did not quantify the relative weight of each factor.

The aim of this paper is to compare a selection of territorial parameters connected to archaeological visibility with others potentially reflecting settlement strategies, in order to identify which set of parameters had the strongest impact on the distribution of known Mesolithic sites in the eastern Alps. To tackle this issue, a dataset of Mesolithic sites recorded in the Venetian Dolomites will be investigated using GIS and spatial statistics.

2. The study area

This study is based on the Mesolithic evidence of a Dolomitic district located in the south-eastern Italian Alps (Belluno province, Veneto region, Italy) (Fig. 2,

Fig. 1 – Panoramic view on the site of Mondeval de Sora, the most important archaeological context in the investigated area (photo D. Visentin).

a). Only the mountain sector (above 1600 m a.s.l.) included between the Boite and Cordevole valleys has been considered. In this area – that covers 346 km^2 and encompasses the municipalities of San Vito di Cadore, Cortina d'Ampezzo, Livinallongo del Col di Lana, Colle Santa Lucia, Selva di Cadore, Alleghe, Zoldo Alto, Vodo di Cadore and Borca di Cadore – 76 Mesolithic sites or find-spots (both Sauveterrian and Castelnovian) were identified (Fig. 2, b) (Fontana, Pasi 2002; Cesco Frare, Mondini 2005; Visentin, Carrer *et al.* 2016).

The Boite and Cordevole streams are the two largest right tributaries of the Piave river. They flow respectively to the NE and SW of the investigated territory, in a NS direction, through a typical Dolomitic landscape (Fig. 3) characterised by sub-vertical cliffs, steep ridges and peaks (up to more than 3200 m a.s.l.) standing out with respect to the gentler and woody slopes of the lowlands and midlands. From a geological point of view this territory is characterised by the alternation of limestones (both carbonates and dolomite, generally associated to rougher morphologies) and sandstones, marls and pelitic rocks (gentler morphologies).

The reconstruction of the environmental evolution of the area since the Early Holocene indicated the presence of pioneer plants (*Salix, Betula, Pinus mugo*) in the first part of the Holocene, later replaced by dense woodlands

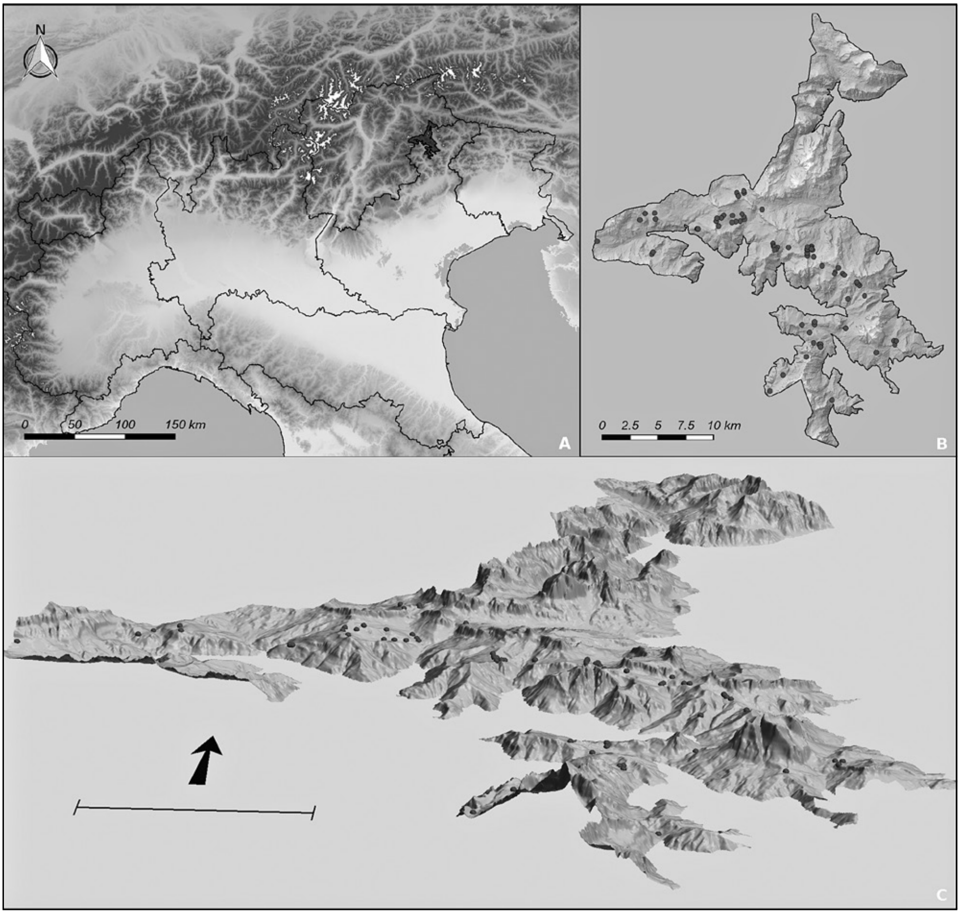

Fig. 2 – Location of the project area within the Venetian Dolomites (South-Eastern Italian Alps). Inset (b) location of the analysed sites within the study area and (c) visualisation of their altitudinal distribution.

dominated by *Picea*, *Larix* and *Pinus cembra* (Soldati *et al.* 1997). These data confirm the general trends attested in the south-eastern Alps, where a rapid rising of the timberline has been assumed (2100 m a.s.l. around 8850 cal BC) (Oeggl, Wahlmüller 1994; Drescher-Schneider 2009).

The study area corresponds to a contiguous highland zone (1600 m a.s.l. upwards) where archaeological surveys were undertaken since the 1970s (Fig. 2, c) (Cesco Frare, Mondini 2005). A recent survey project enabled the positioning and mapping of published evidence as well as the identification of new find-spots. Moreover the techno-typological revision of the lithic

Fig. 3 – A typical Dolomitic landscape characterized by calcareous cliffs standing out on gentler slopes, with some archaeologists surveying natural erosions around a dirt path (photo D. Visentin).

industries enabled a more precise chrono-cultural attribution. These data have been described in dedicated papers (Visentin, Carrer *et al.* 2016; Visentin, Fontana *et al.* 2016) and will not be discussed here. Valley bottoms and mid-altitude areas (up to 1600 m a.s.l.) were not surveyed and have thus been excluded from the analysis. Sauveterrian, Castelnovian and generic Mesolithic sites have not been separately considered, since the resulting sample would have been too meagre to be statistically relevant.

3. Methods

In order to tackle the research question of this paper, site distribution was correlated with two different sets of covariates: 1) environmental and geomorphological characteristics of the territory, used as proxies for the locational choices of the Mesolithic hunter-gatherers; 2) landscape features and other environmental and geomorphological characteristics of the territory that might have constrained field-walking and archaeological visibility. The set of covariates that fitted better the location of sites was expected to show whether the archaeological reconstruction of Mesolithic settlement patterns was reliable or not.

Different statistical methods are commonly used to evaluate the correlation between spatial covariates and archaeological sites locations (Kwamme 1999; Finke *et al.* 2008; Jarosław, Hildebrandt-Radke 2009; Löwenborg 2010; Carrer 2013). Point pattern analysis (PPA, see Orton 2004), in particular, has been widely used in archaeology during the last decade for investigating spatial patterns at landscape scale (Bevan, Conolly 2006; Bevan *et al.* 2013; Palmisano 2013). Eve and Crema (2014) applied PPA to create alternative locational models based on combinations of topographic and visibility variables, and compared the models using Bayesian Information Criterion (BIC). Their research goal matches the objective of this study: inferring the rationale behind the settlement pattern of the studied context. For this reason an analytical protocol based on Eve and Crema's methodology was applied here. The density of Mesolithic sites (spatial point process intensity), calculated on a quadrature scheme, was assumed to depend on the spatial variability (spatially varying intensity) of alternative sets of spatial covariates. Three inhomogeneous Poisson process models were fitted to the point pattern dataset (site locations): Model 1 integrating covariates affecting research bias, Model 2 integrating covariates hypothetically related to the Mesolithic settlement pattern, and Model 3 integrating all the covariates of the previous two models. The significance of alternative covariates was explored with Model 4.

In order to test the performance of the models, we created a homogeneous Poisson model to act as a null model (Model 0). Multi-model selection was performed using both BIC and Akaike Information Criterion (AIC). BIC tends to favour smaller (or more parsimonious) models than the more common AIC (Zimmerman 2010). AIC was applied in this study to assess the outcomes of BIC. AIC/BIC scores were used to select the most significant covariates for each model, whereas AIC/BIC weights were used to compare the different models to each other. Preliminary statistical assessment (correlation between covariates at site locations) enabled significant collinearity between the selected variables to be excluded.

All the digital maps used for the creation of the models were provided by the Regione Veneto (http://idt.regione.veneto.it/app/metacatalog/) and the Italian national geoportal (http://www.pcn.minambiente.it/): Digital Elevation Model (DEM), resolution 5 m; thematic vector maps (landuse, lithology), rasterized according to the DEM resolution; topographic maps. All these maps were managed and modified in GRASS GIS 6.4 using *r.drain*, *r.slope.aspect*, *r.sun* and *r.cost* modules (Neteler, Mitasova 2013). A Region of Interest (ROI) was defined (Vanzetti *et al.* 2010), excluding all the areas below 1600 m of elevation and those portions of territory that were out of the surveyed territory (see above).

Model creation and model analysis were conducted in R 3.0 (http://www.r-project.org) (Crawley 2012). Raster and shape files were imported in R using the *spgrass6* package (Bivand 2010) and managed using *maptool* package (Bivand, Lewin-Koh 2013). PPA was performed using *spatstat* package (Baddeley, Turner 2013) and AIC/BIC were estimated using *MASS* package (Venables, Ripley 2002).

3.1 *Model 1*

For the creation of the first model three proxies of archaeological visibility were selected. Here visibility is intended as the probability of identifying archaeological evidence during field-survey, and it is correlated to the occurrence of anthropic and natural processes that contribute to expose archaeological deposits without causing their complete obliteration (Cavulli *et al.* 2011). Three covariates have been selected according to the fieldwork experience of the authors in the study area and to the availability and quality of geomorphological thematic maps (Fig. 4).

The first variable refers to the presence or absence of local erosive phenomena, to be intended as the presence of anthropic or geomorphological features creating small erosion surfaces that favour the visibility and identification of archaeological finds without destroying the evidence itself. For the creation of this map, three main layers were superposed: paths, ridges and streams. A buffer of 5 m was applied to modern paths (manually digitalised from a topographic map), with the exception of paved roads in which the visibility is null. Streams were extracted by tracing flows through the elevation model, and ridges were mapped by applying the same analysis to the inverse-elevation map. A 10 m buffer was then applied to all the streams and ridges. For the streams the central pixel was excluded as the visibility in the stream bed was judged to be lower than in the lateral erosive surfaces. All the aforementioned layers were merged and the resulting map re-classed to values 1 (eroded areas) and 0 (non-eroded areas). Environmental, hydrographic and geomorphological transformations occurred during the Holocene led to exclude the possibility that current paths, streams and ridges might also be proxies of Mesolithic settlement strategies.

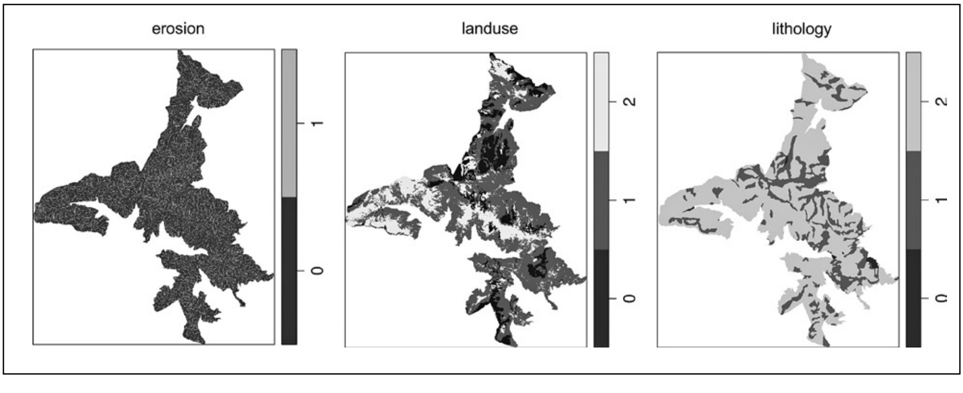

Fig. 4 – Maps of the territorial parameters used as proxies for investigating research biases (Model 1).

Model	Selected covariates	Discarded covariates	AIC	df	Weights Model 1-2	Weights Model 1-3	Weights Model 1-4
0	-	-	2484.30	1	0	0	0
1	Landuse, Erosion	Lithology	2434.78	3	0	0	0
2	Elevation, Slope	Insolation, Aspect	2392.44	3	1	0.0001	0
3	Landuse, Lithology, Slope	Erosion, Insolation, Aspect, Elevation	2373.97	4	-	0.9999	0
4	Landuse, Lithology, Elevation, Slope, Dist. from Paths	Erosion, Insolation, Aspect	2338.51	6	-	-	1

Tab. 1 – Result of the AIC stepwise covariates selection and model selection based on AIC weights.

Model	Selected covariates	Discarded covariates	BIC	df	Weights Model 1-2	Weights Model 1-3	Weights Model 1-4
0	-	-	2486.63	1	0	0	0
1	Landuse, Erosion	Lithology	2441.77	3	0	0	0
2	Elevation, Slope	Insolation, Aspect	2399.43	3	1	0.0002	0
3	Landuse, Slope	Erosion, Lithology, Elevation, Insolation, Aspect	2382.21	3	-	0.9998	<0.0001
4	Landuse, Lithology, Slope, Dist. from Paths	Erosion, Elevation, Insolation, Aspect	2350.77	5	-	-	0.9999

Tab. 2 – Result of the BIC stepwise covariates selection and model selection based on BIC weights.

The selection of land-use parameters depended on the impact that vegetational (or anthropic) surface cover was supposed to have on the archaeological survey. Highland pastures were considered very favourable in term of visibility, and woodlands were considered low visibility areas, with no distinction between the different plant associations. Bare rocks and altered areas (e.g. isolated buildings, parking lots, ski runs) were considered null visibility zones. The thematic vector map (1:10,000) provided by Regione Veneto was re-classified as follows: 2 for high visibility, 1 for low visibility, 0 for null visibility.

The third variable, lithology, was introduced in order to distinguish areas where Holocene geomorphological processes could have destroyed or covered the archaeological evidence. The low resolution of the available cartography (1:100,000) prevented an accurate estimation of local lithology and pedology, and only the largest events, such as valley bottoms filling by water-laid deposits or landslides, could be discriminated. As for the previous variable, different categories were reclassified using map-algebra: pre-Quaternary deposits were attributed a high probability value (2) and Holocenic deposits a null probability value (0), as they postdate or are contemporary (geomorphologically unstable areas) to the Mesolithic occupation of the territory. Late Pleistocene or Early Holocene deposits that cannot be dated with more precision were assigned an intermediate value (1).

An inhomogeneous point pattern model was created using the previous variables. Stepwise selection of the most significant covariates was performed using AIC and BIC, and both the methods excluded lithology and kept land-use and erosion as significant proxies for archaeological visibility in the studied area (Tables 1, 2).

3.2 *Model 2*

The selected variables for Model 2 are based on a preliminary evaluation of those environmental factors that could have been considered by hunter-gatherer groups in their locational strategy. Although the functional variability of Mesolithic settlements (hunting stand, base-camp, etc.) is supposed to have influenced their spatial organisation (Bagolini, Dalmeri 1987; Kompatscher, Hrozny-Kompatscher 2006; Fontana *et al.* 2011), all the sites were analysed as a single dataset. The rationale was that most of these sites correspond to find-spots where only few artefacts were recovered, and this prevented a reliable functional attribution. Four variables were selected: elevation, aspect, insolation and slope (Fig. 5).

Elevation, calculated on the DEM provided by the Regione Veneto, was selected because previous studies suggested that sites are preferentially distributed along specific altitude belts (Dalmeri, Pedrotti 1994; Cavulli *et al.* 2011; Fontana *et al.* 2011; Visentin, Carrer *et al.* 2016; Visentin, Fontana *et al.* 2016). This parameter can be considered as a proxy to evaluate the position of sites with respect to the ancient timber-line (an attractive area in relation to hunting practices) supposedly located at around 2100 m a.s.l. in the Early Holocene (Oeggl, Wahlmüller 1994). Although elevation might seem similar to the land-use covariate used in Model 1, Early- and Late-Holocene environmental conditions in the study area are too dissimilar to take current land-use as a reliable reference for prehistoric high-altitude ecosystem.

Slope is directly derived from the elevation map (using first-derivative function), calculated on a 3×3 neighbourhood around the cell and expressed in degrees of inclination from the horizontal. The general assumption motivating the choice of this parameter is that flat or gently sloping areas are generally more suitable for settling. It needs to point out that extreme slope might be also associated to erosive phenomena, and then pertain to the set of covariates affecting archaeological visibility. Nevertheless the moderate average steepness of the surface where the investigated sites are located (mean=14 degrees; median=12 degrees) led to underestimate this possibility.

Considering the highland climate and daily temperature range, an insolation map was created to figure out whether light was a conditioning parameter in settlement strategies. A longer exposition to the sunlight, in fact, could have played an important role both from a microclimatic point of view and in relation to specific activities carried out at hunting-sites, such as the

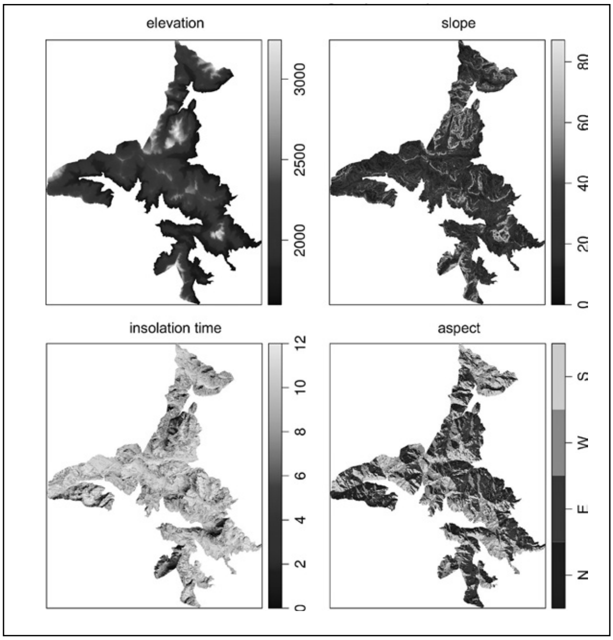

Fig. 5 – Maps of the territorial parameters used as proxies for investigating settlement strategies (Model 2).

drying of hides before their transportation. The value of each cell corresponds to the hours of direct sunlight on a mid-summer day.

Aspect corresponds to the orientation of slopes (first-derivative of slope), and represents a proxy to estimate wind direction (Eve, Crema 2014). A raster map with aspect degrees of East, counterclockwise reported, was categorized according to the cardinal points: East (E) = 315-0 degrees, 0-45 degrees; North (N) = 45-135 degrees, West (W) = 135-225 degrees, South (S) = 225-315 degrees.

Proximity to water sources, traditionally considered a crucial locational parameter, was not taken into account here. This choice is motivated by the abundance of water in the investigated mountain range, by the incompleteness of the water sources in the available cartography, and by the geomorphological evolution of the area, which substantially altered the surface-water distribution over time.

As for Model 1, stepwise AIC and BIC were applied to select the set of covariates that best explained the varying density of Mesolithic sites within the study-area (Tables 1, 2). Both the methods suggested that elevation and slope were the most significant proxies to explain the settlement preferences of Early Holocene hunter-gatherers in this territory.

3.3 *Model 3*

Previous models were created to evaluate whether research bias or Mesolithic settlement strategies could explain the pattern of sites considered in this study. These two explanations are not mutually exclusive: the available dataset, although depending on the ancient locational choices, could have been partially affected by archaeological visibility and fieldwork strategies. In order to test this hypothesis, Model 3 was created incorporating all the covariates used for Model 1 and Model 2. Using AIC and BIC the most significant covariates were selected.

AIC identified as best combination of parameters (Table 1) land-use, lithology and slope. BIC selected land-use and slope. As expected, BIC dropped one covariate that was instead considered by AIC: lithology (Table 2).

4. MODEL COMPARISON

The three models described above were compared using AIC and BIC weights. The lower AIC and BIC weights clearly privileged the inhomogeneous models over the Null Model, and suggested that Model 2 was more performant than Model 1 (Tables 1, 2). It can be argued that locational choices have a stronger impact on the position of known sites than archaeological bias. However, the higher AIC and BIC weights showed that the best model to explain the location of Mesolithic sites is Model 3 (see Tables 1, 2).

As pointed out before, AIC and BIC selected different combinations of parameters for Model 3. The statistical estimation of the regression coefficients (z-test) showed that the two covariates selected by BIC had a significant relationship with the spatial distribution of sites (Table 4), while one of the covariates selected by AIC (lithology) yielded a non-significant z-value (Table 3). The higher consistency of the BIC-selected parameters showed that the BIC-suggested Model 3 was the most reliable and accurate.

The comparison of the model weights and in particular of the BIC ones indicated that the two most significant variables (land-use and slope) belong to the sets of parameters representing respectively proxies of research biases and locational choices. The selection of parameters belonging to two different models indicated that it was actually the interplay between archaeological bias and locational choices that had the most significant impact on the spatial organisation of the dataset.

4.1 *Additional covariates*

The low number of significant covariates selected by BIC in Model 3 suggests the existence of spatial parameters that influence site distribution and that have not been considered in Model 1 and Model 2. An ideal starting

Covariate	Estimate	S.E.	CI 95% lo	CI 95% hi	Z-test
Intercept	-15.4179	0.6213	-16.6357	-14.2002	<0.001
Landuse	0.9035	0.2081	0.4419	1.3114	<0.001
Lithology	0.4744	0.2749	-0.0643	1.0131	1
Slope	-0.1007	0.0145	-0.1292	-0.0723	<0.001

Tab. 3 – Covariates of the AIC-selected Model 3.

Covariate	Estimate	S.E.	CI 95% lo	CI 95% hi	Z-test
Intercept	-14.6703	0.4303	-15.5136	-13.8270	<0.001
Landuse	0.9321	0.2099	0.5207	1.3435	<0.001
Slope	-0.0987	0.0145	-0.1271	-0.0704	<0.001

Tab. 4 – Covariates of the BIC-selected Model 3.

point for the identification of the missing covariates affecting the distribution of Mesolithic sites is the interpretative settlement model proposed by Kompatscher and Hrozny-Kompatscher (2006). They suggested that the position of Mesolithic sites was strongly connected to highland mobility patterns. Sites were located at specific altitudes corresponding to the belt immediately above the timberline, along routes that favoured mobility with minimal vertical shifts and with multidirectional accessibility to wide open areas.

This led to assume that modern pathways could be considered reliable proxies for prehistoric upland mobility routes (Fontana, Pasi 2002; Visentin, Carrer *et al.* 2016; Visentin, Fontana *et al.* 2016). On the other hand, though, surface finds are more likely to be identified near modern paths or roads than in less accessible sectors of the territory. According to this observation, modern hiking dirt-paths and paved roads could be part of the set of variables selected for Model 1 (archaeological visibility) or Model 2 (settlement patterns), or rather a parameter that is equally related to modern research strategies and past seasonal mobility.

To evaluate the role of this ambiguous proxy for the spatial distribution of the analysed sites, a map of the proximity to modern paths was created (Fig. 6). Cumulative cost of movement from modern paths, with slope as friction value, was estimated (using immediate neighbours – queen's move – to calculate cost values). Model 4 (Tables 1, 2) was created incorporating all the covariates of Model 1 and 2 and adding distance from path as an additional explanatory variable. AIC- and BIC-selected models shared four variables: land-use, lithology, slope and distance from paths. AIC also kept a fifth variable: elevation (Tables 1, 2). The z-score for the BIC model (Table 5) shows that land-use, slope and distance from paths are the most significant covariates, and they correspond to the two covariates selected

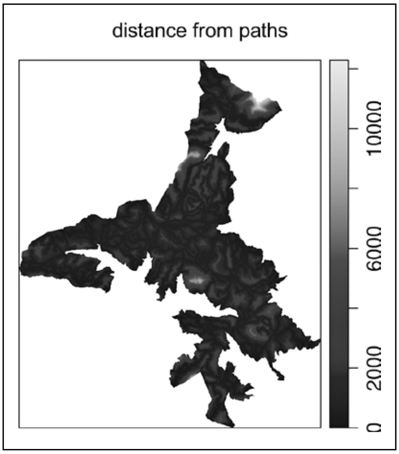

Fig. 6 – Map of the additional covariate used in Model 4.

Covariate	Estimate	S.E.	CI 95% lo	CI 95% hi	Z-test
Intercept	-15.1640	0.6333	-16.4051	-13.9228	<0.001
Landuse	0.7419	0.2074	0.3353	1.1485	<0.001
Lithology	0.5765	0.2754	0.0368	1.1162	<0.05
Slope	-0.0682	0.0166	-0.1008	-0.0356	<0.001
Dist. from Paths	-0.0022	0.0005	-0.0032	-0.0012	<0.001

Tab. 5 – Covariates of the BIC-selected Model 4.

by the BIC-selected Model 3 complemented by distance from paths. AIC and BIC weights show that Model 4 is more performant than all the previously created models (Tables 1, 2), thus suggesting that paths have a key role in influencing the spatial distribution of the analysed sites. As pointed out before, though, it is not clear whether this is related to a research bias, to the similarity between Mesolithic and modern mobility routes or to the interplay between the two.

5. Discussion and conclusions

The research bias proxy that plays the main role in the spatial distribution of Mesolithic sites is land-use. Surface cover influences archaeological visibility by facilitating or hindering survey activities and is quite stable in time (in the same season and during the years). Local erosive phenomena were only selected in Model 1 while dropped in Model 3 and 4. According to the fieldwork experience of the authors, this was expected to be one of the strongest biasing parameters, and the relatively poor significance can be attributed to the multiplicity of factors influencing erosion, as well as to their extreme variability in time and space. Lithology, on the other hand, was considered by the AIC-selected Model 3 and 4 and BIC-selected Model 4, while dropped in Model 1. Its overall low influence in the general result could be motivated by the low resolution of the available geomorphological maps.

The variables selected by AIC and BIC as significant proxies of locational strategies were elevation and slope, while insolation and aspect were systematically dropped. Slope is the variable that was deemed to be the most significant; elevation, on the other hand, only played a minor role as it was kept (with a non statistically significant z-score) only in AIC-selected Model 4. Gently sloping surfaces were evidently preferred to steeper areas, while slope orientation and insolation time were not relevant. The marginal role of elevation, intuitively regarded as an important conditioning factor for hunter-gatherers settlement patterns, can be attributed to the exclusion of the lowlands from the region of interest.

The higher performance of the mixed model (Model 3) indicates that current site distribution is the result of the combination of research bias and settlement strategies. The inclusion of the distance from paths covariate (Model 4) led to the selection of a higher number of significant variables, with land-use, slope and distance from paths yielding the highest z-scores (<0.001). Although model performance is clearly affected by the resolution of the maps used for estimating the covariates (e.g. lithology), the importance of distance from paths variable provides two interesting insights: that the variables initially considered for approximating research biases and locational choices are far from being fully exhaustive, and that highland mobility routes are crucial parameters for the analysis of Mesolithic site distribution. For what concerns the first point, more accurate palaeoecological and geomorphological reconstructions of the study area would be necessary for providing reliable proxies. On the other hand, the role of modern paths in the spatial structure of sites is difficult to decipher. A valid method to address this issue would be the simulation of least-cost paths using GIS tools (Gietl *et al.* 2008). This approach would enable the similarity between prehistoric mobility and modern trails to be quantitatively assessed and the factors that constrain highland mobility to be investigated. The application of GIS methods should be complemented by a more detailed analysis of site function and chronology. New archaeological projects in this and neighbouring areas have recently started tackling this specific issue (Fontana *et al.* 2014; Visentin, Carrer *et al.* 2016).

It is worth pointing out that aggregation of findspots in specific areas might not be exclusively related to the spatial distribution of covariates, but also to the presence of second order effects, i.e. processes of attraction and inhibition between the sites (Bevan *et al.* 2013). The main limitation in the identification of second order effects is temporal uncertainty. Inhibition or attraction processes can occur only between contemporaneous sites, and unverified assumption of contemporaneity might lead to the identification of misleading spatial patterns (Crema *et al.* 2010). The implication of this temporal uncertainty for the reconstruction of Mesolithic settlement patterns has recently been studied in a neighbouring area of the eastern Alps (Grimaldi 2006). In this study Sauveterrian (second half of the 10th-first half of the 7th Millennium cal BC) and Castelnovian (second half of the 7th-first half of the 6th Millennium cal BC) sites were analysed together, and most of the find-spots recorded could not be reliably attributed to any of these two sub-phases.

This study showed the importance of quantitative spatial analysis for testing the reliability of settlement pattern inference, and it provided important insights for the interpretation and quantification of the variables that were empirically considered to be important factors for Mesolithic locational strategies and research biases. The acknowledgment of the interpretative potential of specific landscape parameters and of the limitation of available data is expected to drive the future archaeological research strategies in the Alps. From a methodological point of view, this case-study confirmed the importance of point pattern analysis for testing alternative archaeological reconstructions (Eve, Crema 2014) and in particular for estimating the importance of research biases and locational choices.

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ABSTRACT

The wealth of Mesolithic evidence in the Alpine environments makes it possible to attempt a reconstruction of highland settlement patterns based on the distribution of known sites. However, just how representative this site distribution is has not yet been fully tested and the impact of research biases on the spatial organisation of Mesolithic findspots is not clear. In order to tackle these issues the locational pattern of Mesolithic sites recorded in an upland area of the Venetian Dolomites (North-Eastern Italy) was analysed. Point pattern analysis was used to correlate site distribution with two sets of covariates mirroring research biases and prehistoric settlement preferences. Point-process models were created and compared using both standard Akaike and Bayesian Information Criteria. Results indicate that both factors equally influence the current site distribution. The low number of statistically significant variables – slope and land-use – suggests the existence of additional variables that were not considered. An additional model helped us explore the importance of alternative variables and provided new perspectives for future investigation of high-altitude Mesolithic landscapes, with particular attention to highland mobility.