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THE LOWER AND MIDDLE PALAEOLITHIC SETTLEMENTS IN THE BALDO-LESSINI MOUNTAINS. RESULTS FROM A GIS INVESTIGATION.

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ABSTRACT: On the Monti Lessini and the Monte Baldo, two mountain areas of the Veneto Pre-Alps, studies grounded on human ecology, landscape use and site catchment analysis are still sparse or standing at a preliminary state. A factor of bias is the limitation of the archaeological record that was subject to many paleoenvironment processes, compromising its conservation, with substantial loss of information in the open-air sites. In order to shed light on the Lower and Middle Palaeolithic settlements in these sectors we apply GIS analysis of location features, as a support provided by the methodological innovation in archaeological research. The analysis is significant for the comprehension of territoriality and also provides tools available for the protection of archaeological and cultural heritage in these areas. Site location preferences are the result of a complex decision-making process. Using a methodology based on territorial and employment parameters, already successfully applied in other contributions, the results obtained are key issues in the understanding of subsistence strategies, territorial occupation and settlement patterns during the Lower and Middle Palaeolithic.

Keywords: Palaeolithic, settlement, landscape, GIS, Venetian Prealps.

1. INTRODUCTION

Since the end of the 19th century, the Monti Lessini and the Monte Baldo, two mountain areas in the central southern Pre-Alps, are successfully surveyed for investigations on the Lower and Middle Palaeolithic sites, supported by excavations and multidisciplinary projects. Especially in the Monti Lessini, where the number of Mousterian sites counts the highest in Veneto, a great bulk of data was produced from deposits in caves, rock shelters and in open air sites; remarkable when compared to other mountain ranges in Italy. Therefore, the study of the settlement system is possible despite the increasing dearth of information as the evidence dates back in time to the oldest record of Palaeolithic archaeology. Aside the encouraging support provided by the methodological innovation in archaeological research, studies grounded on human ecology, landscape use and site catchment analysis are still sparse or standing at a preliminary state. A factor of bias is the limitation of the archaeological record to mountain or hilly sectors that were lapped only by alpine glaciers and non intensively or only partially affected by periglacial processes, or those fluvial terraces spared by destructive post-depositional processes. As the preservation degree varies, not all the finds share the same informative potentiality. As a consequence, many aspects of the settlement system inferred from site exploitation territory, site function and raw material circulation can only be studied on a limited range of evidence, the more detailed of which are provided by the stratified archives. The layout of these contexts allows exploring human behavior in relation to the environmental context. On the other hand, the open-air sites were strongly affected by post-depositional processes which caused the impoverishment of traces of past human activity with substantial loss of information. Anyway, their location features are equally significant for territoriality and site catchment analyses under the focus of the following work.

2. BRIEF PRESENTATION OF THE MONTI LESSINI AND THE MONTE BALDO

The Monti Lessini, also called "Lessinia", is a Pre-Alpine mountain group located north of the town of Verona belonging to the Veneto Pre-Alps. Morphologically identified as carbonate plateau, it bounds with Val d'Adige valley to the west and with Valle di Leogra valley to the east (Fig. 1). The group is limited by the Carega massif, which reaches up to 2260 meters of altitude, and by “Valle dei Ronchi” valley to the north, whereas on the south it gently dips towards the alluvial plain of the Adige River and other tributary rivers. The plateau reaches 1860 meters of elevation and slightly bends southwards; it can be considered a monocline structure with a trapezoidal shape, where the shortest side is the northern one. It is radially dissected by several valleys developed along the tectonic lines of the whole area; some sections take the form of a canyon, locally termed *vai*. The top surface of the plateau could be interpreted as a Late Tertiary erosional surface, dissected by tectonic activity and eroded in correspondence of the NNE fault systems

(Zampieri, 2000). Generally, the plateau top and the summits of the ridges were mainly affected by weathering, karst and slope processes which led to the development of Terra Rossa type paleosols (Castiglioni et al., 1990).

As for Monte Baldo, it is an alpine group in the sub -section of the Gardesane Pre-Alps, in the section of the Bresciane and Gardesane Pre-Alps (Marazzi, 2005). It bounds with the Garda Lake to the west, with the Adige valley to the east, with the Loppio valley to the north and to the south with Garda gulf, Caprino depression and the moraine amphitheater of Rivoli Veronese. It mainly consists in a mountain range, reaching up to 2219 meters, that develops in the north-east/south west direction, and in a series of ridges, small plateaux and terraces in the southern, eastern and northern sides. The group rises asymmetrically: the western side slope varies from 40% to 80% at the top, while the eastern side consists in plateaux and depressions hanging on the steep right slope of the Adige valley.

Geologically, the mountain area is constituted by a stratigraphic succession of carbonate rocks formed in a marine environment, with high presence of chert outcrops (Bosellini et al., 1967; Carraro et al., 1969). Depending on their composition, position and permeability, the various formations exert an influence on the hydrography hydrography - the structural and lithological control on the hydrography is strong - which is divided into a dense network of main valleys, to which other smaller valleys connect from the ridges (Pasa, 1954). These result both by the mechanical erosion and by the chemical erosion caused by water along fault lines and tectonic fractures. Both the mountain and hill areas have few superficial water flows, - are mainly inactive or only temporarily active -, while they are sculptured by a dense karst hydrographic network. The springs are closely linked to rainfall and the flow rate is not constant over time. Most of them are not perennial.

The effects of karst processes are not only visible from the hydrographic network, but also from a series of different superficial and underground morphologies, developed because of the numerous faults and fractures that accelerate and facilitate the path of water through the rocks (Sauro, 1973; Mietto & Sauro, 2000). Therefore, these morphologies are expression of fluvial- and tecto-karstic styles: that is well evident from the superficial forms, from the sinkholes, mostly present along fracture lines or along stratigraphic joints, especially between the Maiolica and the underlying Jurassic limestone.

During the Quaternary the area was partly covered by the Adige glacier or by the local glaciers attested on the upper part of the Monti Lessini, the Carega Massif, the summit of the Monte Baldo chain (Sauro, 1973; Sauro & Zampieri, 1999). Periglacial conditions activated strong erosion of the paleosols, accumulations of slope deposits, especially in the central part of the plateau, loess sedimentation spread all over the relief from the Middle Pleistocene onward (Magaldi & Sauro, 1982; Castiglioni et al., 1990). Deposits in caves and rock shelters along the slopes provide data for estimate that the deepening of gorges and valleys occurred at least from the late Middle Pleistocene (Castiglioni et al., 1990; Cremaschi, 1990). Anthropogenic erosion during the Holocene strongly affected the main slopes especially starting from the Neolithic.

The Lessini valleys are occupied by mainly gravelly, sandy and pelitic floods several meters thick, in addition to the frequent detrital deposits at the foot of the steepest slopes consisting of limestone and dolomitic formations. The Lessini and Baldo foreland include a large alluvial plain that mostly originated during the Middle and Late Pleistocene from the main river, the Adige and its tributaries from the central and eastern Monti Lessini (De Zanche et al., 1977; Ferraro, 2009). Particularly the western sector, is an area situated where the Adige spreads from its long and deeply incised valley which dissects the mountain range up to the alpine watershed.

3. HISTORICAL CONTEXT

The Lessinia region can be undoubtedly considered one of the most prominent areas for the development of prehistoric archaeology in Italy (Aspes, 1984; 2003; Aspes et al., 2002). Some first paleontological observations already began in the first half of the 18th century: for example, in 1739 the priest Gregorio Piccoli described the discovery of faunal bones in a cave locally called "*la Taneséla*" in proximity of *Alfaedo* (Piccoli del Faggiol, 1739; Curi, 2001). Consistent with biblical thinking, which permeated most of the researchers of the time, he interpreted those fossilized remains as "diluvial wild beasts" (Sauro, 2017). Few years later (Fortis, 1786), several fossilized bones of *Elephas meridionalis cromeriensis* (and other coeval large mammals, such as *Rhinos* sp.) (Bon et al., 1991), where discovered at Serbaro di Romagnano and, similarly, classified as "antidiluvian". The first scientific approach to paleontological discoveries in the Lessini mountains was published by the Museum of Natural History of Vienna: the naturalist Abramo Massalongo, observed that carts full of Pleistocene vertebrate bones (mainly of *Ursus Spelaeus*), extracted from the clayey layers of the karstic cave complex Covoli di Velo, were brought downstream and sold as fertilizers (Massalongo, 1851). Associated to lithic artefacts, these findings were brought to the attention of the Academy of Agriculture, Arts and Commerce of Verona, the Royal Venetian Institute of Sciences, Literature and Arts and the "Notiziario degli Scavi" by, for the most part, Stefano de Stefani. However, the rate of discoveries of new Pleistocene sites increased mostly in the first half of the 20th century, thanks to the untiring activity of Raffaello Battaglia, along with an intense scientific production (Battaglia,1957; Latella & Sauro, 2007). His perseverance in publishing the results of his research had positive repercussions in the Verona area, as did the reports from Giorgio Dal Piaz and the excavations and recoveries at the Quinzano quarries (Cave di Quinzano) executed from 1933 to the late '50s by Battaglia himself, Paolo Graziosi and Piero Leonardi (see Aspes, 1984, for a complete bibliography).

During the Second World War and especially in its aftermath the researches were consolidated under the coordination of Angelo Pasa, Francesco Zorzi and P. Leonardi, leading the Natural History Museum of Verona to become a fulcrum for the activities in the fields of Pal-

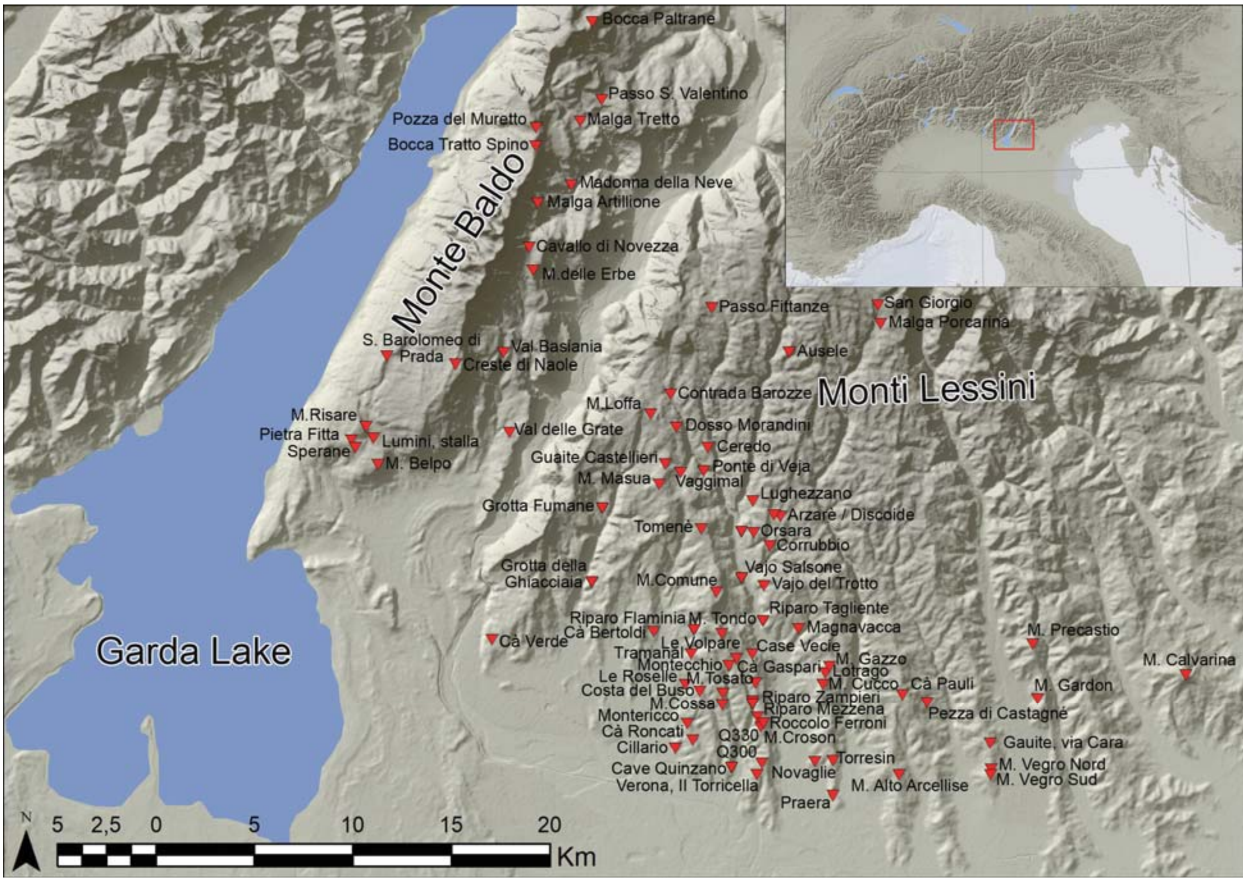

Fig. 1 - Map of Monte Baldo and Lessini Mountains showing the location of Palaeolithic sites analyzed. Technical notes: Coordinate system: Monte Mario/Italy Zone 2 (fuso E) - Datum: Roma 40 - Projection: Gauss-Boaga - Fuso: Est - EPSG: 3004; Digital Elevation Model (base topography - Veneto Region DTM 5 m, http://www.regione.veneto.it/web/ambiente-e-territorio/geoportale), Garda lake (http://www.sinanet.isprambiente.it/it/sia-ispra/download-mais/).

aeontology and Paleoethnology, even beyond the confines of the Lessinia region (Zorzi & Pasa, 1944-45; Zorzi, 1959). The above-mentioned Quinzano excavations were followed by findings of new artefacts from the surface, excavations in the Ponte di Veja caves, the discovery of Grotta del Mondo cave and the interventions at Riparo Mezzena rock shelter by F. Zorzi, A. Pasa and Maria Vittoria Durante Pasa and those at Riparo Zampieri by Arturo Palma di Cesnola. The untimely demise of A. Pasa in 1966 coincided with a quiescence of the scientific activity in the Verona area, compensated by the Institute of Geology of the Ferrara University with the start of decades-long excavations at Riparo Tagliente rock shelter and of new researches in the Ponte di Veja caves (Broglio et al., 1963; Bartolomei & Broglio, 1975). This period of intense investigations was fundamental for the studies on the prehistory of the Verona area in the following years (Leonardi & Broglio, 1962). Extended surface researches were led also by the Centro Studi e Ricerche (Center for Studies and Researches), headed by Giovanni Solinas between 1950 and 1965, with numerous reports of sites and sporadic findings in the Lessinia localities of Ceredo, Lughezzano, Cà Verde and more.

The activity of the Natural History Museum since the '70s and its dense network of collaborators (G. Chelidonio, F. Spadoni, L. Farello, A. Castagna and others) lead to the detection of one of the highest densities of Palaeolithic sites known on the alpine arc, not only on the Monti Lessini, but also on the Monte Baldo (Pasotti, 1970; Chelidonio, 1980; Chelidonio & Rosà, 2011; Chelidonio et al., 2015). The traces distribute through a wide altitude range, between 80 and 1600 meters (Battaglia, 1957; Zorzi, 1959; Leonardi & Broglio, 1962; Peretto, 1980; Chelidonio, 2017; Dalmeri & Duches, 2008), reaching the valley bottoms and the karst surfaces on the plateau.

Cavities are much better represented, with Grotta di Fumane cave, Riparo Mezzena and Riparo Tagliente (for a complete bibliography on this last site until the beginning of the '80s see Bartolomei et al., 1982). Open air sites were reported in the higher Vajo di Squaranto and on the sub-structural terraces at lower altitudes on the ridges between the Mezzane and Illasi valleys. Along with the activities on the field, the Superintendence for Archaeological Heritage of Veneto sustained with constancy projects of collaboration with local amateurs and projects for the revision of Palaeolithic industries, often finalized to the fruition of this rich archaeologic corpus in the museums of the territory.

4. ARCHAEOLOGICAL CONTEXT

The hefty collection of sites and finds ascribable to the Lower and Middle Palaeolithic or to a generic ancient Palaeolithic on the Monti Lessini and the Monte Baldo is associated with variable context conditions (Fig. 1). The Lower Palaeolithic finds are numerous but of extremely uncertain chronological positioning, due to the erosion and the deep post-depositional weathering to which these archaeological contexts have been subjected. Their attribution was therefore assumed essentially on the tecno-typological characteristics of the lithic artefacts, or by the degree of patination of their surfaces. The oldest lithic assemblages are composed of mostly thick flakes, sometimes retouched and in association with some bifaces. Assemblages from the Quinzano quarries, Monte Gazzo and Cà Palui are more recent, characterized by the association of Levallois artefacts and bifaces. The Quinzano quarries remain still the most important site, also because of the association with faunal remains of deer, elephant, fallow deer and roe deer (Zorzi & Pasa 1944-45), and a human occipital. This important pedo-sedimentological sequence was firstly described and interpreted by Zorzi & Pasa (1944-45) and Pasa (1956) and, few decades after, considered by M. Cremaschi as a record of potential reference for the geomorphological evolution of the landscape at the foot of the Lessini. The Lower and Middle Palaeolithic levels are embedded in the lowermost macro-unit (Unit 1, Cremaschi, 1984), an alternance of palaeosols and slope waste deposits, separated by erosional surfaces with stone-lines. Unit 1 is sealed by the fluvial sediments of Unit 2.

The richest sources of information are the contexts preserved in the atrial cavities and under rock shelters, along stratigraphic deposits at times complex and articulated. These are key archives with information about chronology, evolution of natural environments and various expressions of human behavior that have manifested during the last glacial cycle. Among the deposits systematically explored, we mention Riparo Zampieri, Riparo Mezzena, the “cave A” of Veja, Riparo Tagliente, Grotta della Ghiacciaia and Grotta di Fumane. Currently the data of greater detail come from the excavations in progress at Grotta di Fumane and Riparo Tagliente, whose deposits provide useful elements for developing studies on food subsistence, the organization of living spaces, the exploitation of land resources and human mobility in the territorial belt of the Lessini and the upper Po plain. Grotta di Fumane, in addition, is a key site for the Middle Palaeolithic transition with the Upper Palaeolithic, with the oldest cultural attestations ascribable to the Anatomically Modern Humans.

Grotta di Fumane preserves a 12m thick sedimentary sequence composed of four macro-units, S, BR, A and D covering a chronological range extended from MIS 5 to MIS 2 (Bartolomei et al., 1992; Martini et al., 2001) with a cultural record ascribed to the Mousterian, Uluzzian, Aurignacian and Gravettian cultures. Assessments based on sedimentological, pedological and palaeontological analyses have been previously reported by Cassoli & Tagliacozzo (1994), Cremaschi et al. (2005) and López-García et al. (2015). Current investigations are focusing on the late Mousterian levels with their dense scatters of lithic and faunal remains as in units A11, A10, A9 and A6 (Peresani, 2012; Peresani et al., 2011a; 2011b; 2017). Mousterian industries at Riparo Tagliente are associated with amounts of faunal remains recovered all across the stratigraphy and especially in extensively explored uppermost levels (Bartolomei et al., 1982; Arzarello & Peretto, 2005). Grotta della Ghiacciaia preserves a short sedimentary series composed of three macro-units that record environmental evolution in the first part of the Late Pleistocene with evidence of human presence in the two upper macro-units (Bertola et al., 1999). Riparo Zampieri and “Grotta A” di Veia were settled approximately during the Late Pleistocene, despite dating programs are still lacking. A different issue concerns Riparo Mezzena. The Mousterian assemblages recovered in this small shelter dates to the Late Middle Palaeolithic (Bartolomei et al., 1980), although serious uncertainties affect the consistency of the sedimentary sequence and particularly the chronological position of the presumed Neanderthal remains (Condemi et al., 2013), now directly dated to the Late Neolithic (Talamo et al., 2016).

Sites poorer in archaeological data have been identified in open air at various points of the Lessini, mainly in the central-western sector, where vitreous flint and chert deposits abound. The same conditions are also found in the last open-air sites discovered on the Lessini at the highest altitudes (1400-1600 meters), in the high Vajo di Squaranto, and on sub-structural surfaces and terraces at lower altitudes along the ridges between the valleys of Mezzane and d’Illasi.

Similarly, the Monte Baldo chain has also returned some of these evidences, represented by Levallois lithic industries on the surface, with extremely poor information on chronology, environmental context and significance of human presence. Most of the sites located in the Basiana Valley vary between 1050 and 1068 meters a.s.l., an elevation range which was neither unreached by the erosional activity of the local glaciers nor covered by the lateral moraines of the Adige glacier. Basiana valley, along with Tasso valley, are part of a group of plateaux connected to the Monte Baldo syncline (Chelidonio, 2004).

Finally, in 2017 the Vajo Salsone site was discov-

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Tab. 1 - Archaeological sites (multilayered sites as singles cases) and their geographic area (Geog), altitude (H a.s.l.), geological substrate (Geol), context of find (cont), drainage basin (Dr Basin), topography position, slope value, slope range (Sl range), cultural assessment (Cult) and Reference. Note for geological substrate: Eocene limestones (Eoc L), Oolitic limestones (Ool L), Maiolica (M), quaternary deposits (Qu dep), Scaglia Rossa (SR), basalt (bas), Rosso Ammonitico Veronese (RA), Grigi Limestones (Grey L) and Ialoclastite (Ialo); for context of find: surface (surf), depression (dep), Karst grike (kg), dolina (do), plowed field (pf), stratigraphic layer (layer); for position: Alpine pass (Ap), Top of the ridge (Top), medium slope (med sl), bottom valley (bot); for cultural assessment: Mousterian (Mou), Archaic Mousterian (Arch Mou), Acheulean (Acheu).

Site	Geog	H asl	Geol	Cont	Dr Basin	Position	Slope	Sl range	Cult	Reference
Arzarè	Lessini	645	M	do	3	med sl	5	0--10	Mou	Avesani et al. 1986
Arzarè ex scuole	Lessini	637	M	layer	3	med sl	27	20--35	Arch Mou	Avesani et al. 1986
Ausele	Lessini	1379	Ool L	dep	3	med sl	45	>35	Mou	Chelidonio & Sauro 1996
Bocca Paltrane	Baldo	1830	Gray L	surf	\	Ap	41	>35	Mou	Chelidonio & Rosà 2011
Bocca Tratto Spino	Baldo	1816	Ool L	surf	\	Ap	19	10--20	\	Chelidonio & Rosà 2011
Ca' Bertoldi	Lessini	269	Eoc L	pf	2	med sl	14	10--20	Mou	Brunetto & Chelidonio 1988
Cà Gaspari	Lessini	412	Eoc L	\	\	top	22	20--35	Arch Mou	Chelidonio & Costa 2013
Cà Palui	Lessini	561	bas	pf	\	top	14	10--20	Mou	Chelidonio & Farello 1997
Ca' Roncati	Lessini	243	Eoc L	\	\	med sl	7	0--10	Mou	Zorzi 1959
Cà Verde	Lessini	236	Ool L	do	\	med sl	18	10--20	Arch Mou	Zorzi 1960
Case Vecie	Lessini	474	Eoc L	\	3	med sl	55	>35	Mou	Chelidonio et al. 1978
Cavallo di Novezza	Baldo	1428	Eoc L	surf	\	med sl	14	10--20	Mou	Chelidonio & Rosà 2011
Ceredo	Lessini	810	M	layer	\	top	8	0--10	Mou	Bosio et al. 1990
Cillario	Lessini	134	Eoc L	\	\	med sl	15	10--20	\	Zorzi 1960
Contrada Barozze	Lessini	857	Ool L	layer	1	bot	3	0--10	Mou	Chelidonio & Solinas 1983
Corrubbio	Lessini	565	M	\	3	med sl	30	20--35	\	Zorzi 1960
Costa del Buso	Lessini	399	Eoc L	slope	\	top	6	0--10	Mou	Chelidonio et al. 1978
Creste di Naole	Baldo	1574	Ool L	do	\	top	4	0--10	Mou	Chelidonio & Rosà 2011
Dosso Morandini	Lessini	929	M	kc	\	med sl	16	10--20	Mou	Chelidonio 1995
Grotta del Mondo	Lessini	568	Ool L	cave	\	med sl	\	\	\	Zorzi 1960
Grotta di Fumane	Lessini	359	Ool L	cave	2	med sl	97	>35	Mou	Broglio 2002
Grotte Ponte di Veja	Lessini	639	RA	cave	2	med sl	63	>35	Mou	Brunetto & Chelidonio 1988
Guaite, Mezzane	Lessini	352	M	pf	2	med sl	16	10--20	Mou	Chelidonio & Partesotti 1995
Le Roselle	Lessini	242	Eoc L	pf	\	med sl	16	10--20	Mou	Brunetto & Chelidonio 1988
Le Volpare	Lessini	536	Eoc L	slope	\	top	16	10--20	Mou	Chelidonio et al. 1978
Lotrago	Lessini	460	Eoc L	\	\	med sl	8	0--10	Arch Mou	Chelidonio & Farello 1996
Lughezzano	Lessini	589	Ool L	layer	3	med sl	30	20--35	Acheu	Zorzi 1960
Lumini	Baldo	674	Qu dep	layer	\	bot	24	20--35	Mou	Chelidonio & Rosà 2011
Madonna della Neve	Baldo	1072	M	surf	\	med sl	17	10--20	Mou	Peresani & Dalmeri 2000
Magnavacca	Lessini	368	RA	kc	\	top	9	0--10	\	Chelidonio et al. 1978
Malga Artillione	Baldo	1531	Gray L	dep	\	med sl	5	0--10	Mou	Peresani & Dalmeri 2000
Malga Porcarina	Lessini	1.420	Ool L	dep	1	top	3	0--10	Mou	Chelidonio et al. 1992
Malga Tretto	Baldo	1.117	SR	\	\	med sl	15	10--20	Mou	Peresani & Dalmeri 2000
Monte Alto Marcellise	Lessini	352	Eoc L	dep	2	top	7	0--10	Mou	Zorzi 1959
Monte Belpo	Baldo	866	Ool L	\	\	top	9	0--10	Mou	Chelidonio & Rosà 2011
Monte Calvarina	Lessini	656	bas	\	\	top	3	0--10	\	Chelidonio & Solinas 1977
Monte Comune	Lessini	737	Eoc L	do	\	top	29	20--35	Mou	Brunetto & Chelidonio 1988
Monte Cossa	Lessini	387	Eoc L	\	\	top	6	0--10	\	Zorzi 1960
Monte Croson	Lessini	341	Eoc L	surf	\	top	5	0--10	Mou	Chelidonio & Costa 2013
Monte Cucco	Lessini	433	Qu dep	\	\	top	21	20--35	Arch Mou	Chelidonio & FarelLO 1987
Monte delle Erbe	Baldo	1391	Eoc L	slope	\	med sl	13	10--20	Mou	Chelidonio & Rosà 2011
Monte Gardon	Lessini	318	M	slope	\	med sl	44	>35	Mou	Chelidonio 2001a
Monte Gazzo	Lessini	498	Eoc L	pf	\	top	10	0--10	Arch Mou	Chelidonio & Farello 1996
Monte Masua	Lessini	914	Eoc L	surf	\	top	14	10--20	Mou	Brunetto & Chelidonio 1988
Monte Precastio	Lessini	611	M	pf	\	top	4	0--10	Arch Mou	Chelidonio & Stocchiero 1991
Monte Risare	Baldo	781	Ool L	slope	\	med sl	99	>35	Mou	Chelidonio & Rosà 2011
Monte Tondo	Lessini	701	bas	\	\	top	9	0--10	Mou	Chelidonio et al. 1978
Monte Tosato	Lessini	435	Eoc L	\	\	top	12	10--20	\	Zorzi 1960
Monte Vegro N	Lessini	293	SR	do	\	top	5	0--10	Mou	Chelidonio 2000
Monte Vegro S	Lessini	271	Eoc L	slope	\	med sl	13	10--20	Mou	Chelidonio 2000
Montecchio	Lessini	510	Eoc L	pf	\	top	3	0--10	Mou	Chelidonio et al. 1978
Montericco	Lessini	269	Eoc L	do	\	med sl	28	20--35	Mou	Zorzi 1959
Novaglie	Lessini	146	SR	layer	\	med sl	5	0--10	Mou	Chelidonio 2001b
Orsara	Lessini	550	Ool L	do	3	med sl	29	20--35	Mou	Chelidonio & Solinas 1977
Passo Fittanze	Lessini	1.381	M	dep	\	top	17	10--20	Mou	Chelidonio & Solinas 1978
Passo S.Valentino	Baldo	1.322	SR	surf	\	Ap	8	0--10	Mou	Peresani & Dalmeri 2000
Pezza di Castagnè	Lessini	400	Eoc L	pf	\	med sl	22	20--35	Mou	Chelidonio 2003
Pietra Fitta	Baldo	790	Ool L	dep	\	top	2	0--10	Mou	Chelidonio & Rosà 2011
Pozza del Muretto	Baldo	1694	Ool L	dep	\	top	11	10--20	Mou	Chelidonio & Rosà 2012
Preara	Lessini	116	Eoc L	kc	\	med sl	33	20--35	Mou	Chelidonio 1999
Q 300, Torricelle	Lessini	296	Eoc L	kc	\	top	12	10--20	Mou	Chelidonio et al. 1986
Q 330, Torricelle	Lessini	331	Eoc L	pf	\	top	9	0--10	Arch Mou	Chelidonio et al. 1986
Quinzano	Lessini	169	Eoc L	quarry	\	med sl	11	10--20	Acheu	Zorzi 1960
Riparo Flaminia	Lessini	569	Eoc L	cave	\	med sl	39	>35	Mou	Bosio et al. 1990
Riparo Mezzena	Lessini	261	Eoc L	cave	2	bot	75	>35	Mou	Bartolomei et al. 1980
Riparo Tagliente	Lessini	230	Ool L	cave	1	bot	15	10--20	Mou	Arzarello & Peretto 2005
Riparo Zampieri	Lessini	254	Eoc L	cave	2	bot	51	>35	Mou	Bosio et al. 1990
Roccolo Ferroni	Lessini	344	Eoc L	\	\	top	12	10--20	Mou	Zorzi 1959
S. Bartolomeo di Prada	Baldo	933	Qu dep	\	\	med sl	13	10--20	Mou	Chelidonio & Rosà 2011
San Giorgio	Lessini	1.465	Qu dep	dep	\	top	19	10--20	Mou	Chelidonio et al. 1990
Sperane	Baldo	718	Ool L	valley	2	med sl	26	20--35	Mou	Chelidonio & Rosà 2011
Tormenè	Lessini	736	Eoc L	pf	\	med sl	26	20--35	Mou	Brunetto & Chelidonio 1988
Torresin	Lessini	197	Eoc L	pf	\	top	12	10--20	Mou	Chelidonio 2001a
Tramanal	Lessini	360	lalo	pf	\	med sl	48	>35	Mou	Chelidonio et al. 1978
Vaggimal	Lessini	657	RA	valley	2	med sl	59	>35	Mou	Brunetto & Chelidonio 1988
Vajo del Trotto	Lessini	416	Ool L	valley	2	med sl	38	>35	Mou	Chelidonio & Farello 1980
Vajo Salsone	Lessini	376	Ool L	kc	\	med sl	41	>35	Mou	Peresani et al. 2018
Val Basiana	Baldo	1.032	Qu dep	valley	\	med sl	5	0--10	Mou	Chelidonio & Rosà 2011
Val delle Grate	Baldo	659	M	kc	2	med sl	53	>35	Mou	Chelidonio & Rosà 2011
Verona, Il Torricella	Lessini	263	Eoc L	do	3+J58	top	6	0--10	Mou	Zorzi 1959

ered on the right slope of the middle Valpantena. It is represented by huge amount of Levallois lithic artefacts and faunal bones contained in a karst pit developed in oolitic limestones and opened during a road cutting (Peresani et al., 2018). Being the entire archaeological record in secondary deposits and still undated, this makes the location of the original site uncertain.

5. MATERIALS AND METHODS

The territorial and spatial analysis of human occupation during Lower and Middle Palaeolithic in Monte Baldo and Monti Lessini required a geo-localization of sites (caves, rock shelters and open-air sites). Their cultural attribution was based on lithic industry: The Acheulean was defined by the presence of bifacially flaked handaxes; the archaic Mousterian by Levallois or Discoid technologically-based industries associated to bifaces; the Mousterian by Levallois and/or Discoid industries, despite the presence or absence of retouched tools.

5.1. Archaeological data set

The analyses were carried out separately for the two distinct geographic areas: identifying 62 sites for the Lessini Mountains, for a total of 130 frequentations. Of these, 73 frequentations, for a total of 55 sites, are open -air sites. In Monte Baldo area only 18 sites have been identified, none of which is multi-layered (tab. 1).

For both areas, analyses were carried out on all sites, all sites count the multi-layered context a single case, all open-air sites and the open-air sites considering the multi-stratified sites a single case.

The analyses were carried out separately for the two distinct geographic areas: identifying 62 sites for the Lessini Mountains, for a total of 130 frequentations. Of these, 73 frequentations, for a total of 55 sites, are open -air sites. In Monte Baldo area only 18 sites have been identified, none of which is multi-layered.

Based on literature, 11 categories of discovery areas were established:

- "plowed field"
- "quarry";
- "depressions", a landform sunken or mountain seasonal or permanent pools of unknown origin;
- "dolina";
- "caves", excavated deposits in caves and rock shelters;
- "layer", a stratified deposit exposed during construction works;
- "karst grike";
- "surface", collecting during survey;
- "bottom valley";
- "slope".

In several cases, evidence was not enough clear to assign findings to any of these categories.

5.2. Methodology

In order to record the exact position of each site mention by literature two weeks survey were conducted. 38 sites were located using "Garmin 60" GPS model. When the precise finding area was no longer detectable coordinates were extracted by referring to the nearest place name. In other cases, recent buildings and forest made the sites inaccessible. Thus, it was necessary to use the "Capture coordinates" function of QGIS for recording their position and place them on the Regional Technical Map of the Veneto Region, 1:10.000 raster format.

Then a database based on several attributes was developed. Some of them were extrapolated by direct observation during the surveys, whereas others were inferred from terrain parameters generated by the original DTM, which was provided by the geoportal of Veneto and Trentino Alto Adige regions (1:10.000, cell size 5m series). Attributes are listed below:

I Absolute Altitude: the altitude of the site above modern sea level. For the examined area, the difference between modern and Pleistocene sea levels is irrelevant, since all the sites are located far inland and are not subjected to pericoastal factors. Furthermore, the potential magnitude of the still active tectonic dislocations cannot be overlooked in the interpretation of the absolute altitude. Given the Alpine uplifting, that could be estimated to be of one meter every 1000 years (Sternai et al., 2019), the primary elevation of a 100 ky old site could differ by at least 100 meters from the present-day. However, given the isostatic rebound the Alpine chain underwent since the last deglaciation, every attempt to reconstruct the exact dislocation resulting from the combination of tectonic, geomorphic and isostatic processes (Mey et al., 2016) remains problematic.

II Drainage Basin: any area where precipitation collects and drains off into a common outlet. Drainage basins converge into other ones at lower elevations in a hierarchical pattern, with smaller sub-drainage basins, which in turn drain into another common outlet.

III Topography: the position of every site related to the valley floor. Sites positioned at less than 10 m from the valley floor were included in the category "valley floor". Sites positioned within 10 m from the top of a mountain ridge are rated to the "Summit" category. "Pass" has been assigned to sites located near relevant mountain passes.

IV Slope: the magnitude of steepness or the degree of inclination of a feature relative to the horizontal plane expressed in percentage.

V Aspect: the cardinal direction to which the cave mouth/rock shelter and open-air site faces.

VI Geological substrate: the nature of loose sediment or bedrock.

VII Insolation: the estimation in hours of the sunlight-mean time received annually by each site.

VIII Viewshed: the extension of landscape observable from each site, and the dominant direction of visibility, see paragraph 5.2.4.

5.2.1. Hypsometry

Terrain characteristics are important factors for determining settlement location and habitability of an area. Hypsometry specifically deals with categories of elevation that comprise catchments, or drainage basins, and related post-depositional factors in archaeological site assemblages.

For each analysed area the DEM was recalculated

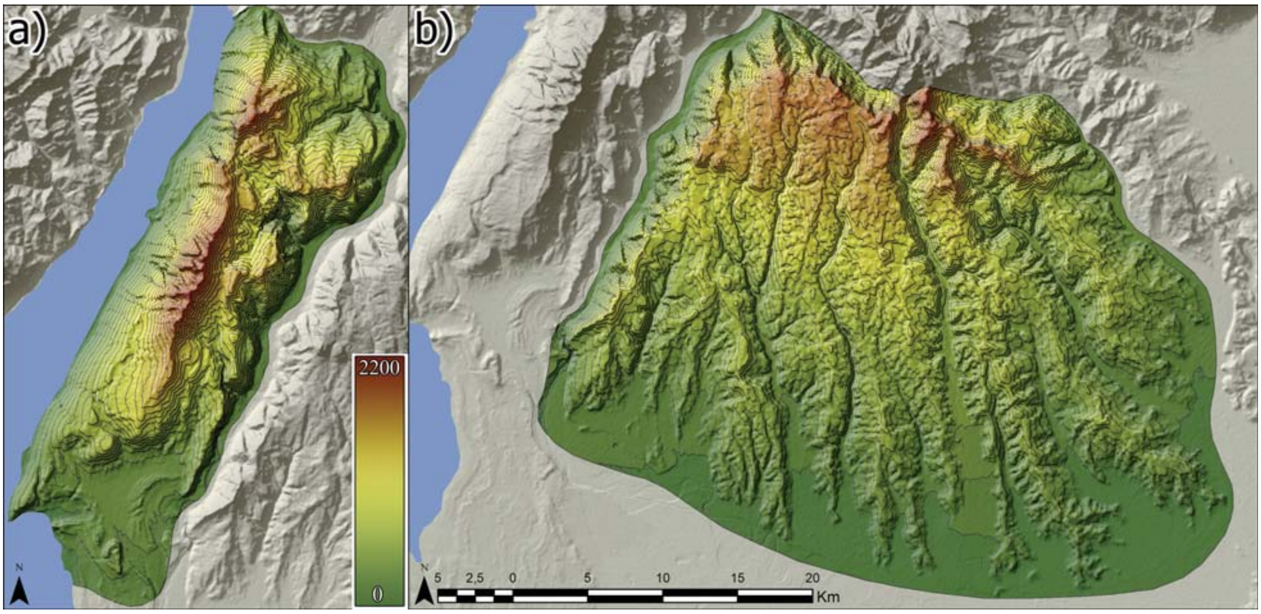

Fig. 2 - a, Map of Monte Baldo area hypsometry based on altitudinal intervals of 100 m; b, Map of Monti Lessini area hypsometry based on altitudinal intervals of 100 m. Technical notes: Coordinate system: Monte Mario/Italy Zone 2 (fuso E) - Datum: Roma 40 - Projection: Gauss-Boaga - Fuso: Est - EPSG: 3004; Digital Elevation Model (base topography - Veneto Region DTM 5 m, http://www.regione.veneto.it/web/ambiente-e-territorio/geoportale), Garda lake (http://www.sinanet.isprambiente.it/it/sia-ispra/download-mais/).

based on altitudinal intervals of 100 m (Fig. 2). For each interval both the surface <(km²) and its covered percentage in relation to the entire area was calculated. Thank to this it was possible to observe whether the sites location related to specific altitudinal ranges are attributable to cultural choices or, more simply, influenced by the area morphology, in which a certain altitudinal range is dominant.

5.2.2. Slope

The surface topography influences several factors, such as habitability conditions and mobility and accessibility patterns. Regarding open air sites it might be also an indicator of the potential of the conservation. In order to calculate the slope, it was necessary to develop a slope model through the DEM. A classification into four categories of terrain slopes for the whole area was performed. The categories are divided into ranges between defined percentages (0-10%, 10-20%, 20-35% and 35-100%). The slope value for each site was obtained by a query function.

5.2.3. Insolation

Sunlight and sun heating are generally considered as important factors for a favourable habitability condition, especially during severe environmental conditions. In order to calculate the potential amount of sunlight hours received by each site, the insolation map was prepared using Bartorelli's tables (1967), which define the annual sunlight hours based of data derived from, latitude, the angle of exposure of the slopes and the percentage of steepness (Bartorelli, 1967). The exposure map was reclassified in order to obtain 72 classes (i.e., values from 1 to 72) corresponding to a 5° range each. A reclassification of the slope map was made, obtaining values from 1 to 4, corresponding to the following slope ranges 0-10%, 10-20%, 20-35%, >35%. Subsequently, the parameters were recalculated based on a specific formula (slope values multiplied by 100, added to the exposure values) to obtain the values (from 101 to 472) to be reclassified with the rules of the Bartorelli tables.

5.2.4. Viewshed

Visibility is other important factor that might influence the choice of stationing sites and/or places to carry out specific activities. We proceeded by setting the observer's height to 1.75 m and an observation radius of 5 km was applied. The operation was carried out for all 75 sites present. For each site the returned area was divided by circular definition, into sixteen equal parts, each corresponding to an interval of 22.5°. In this way, it was possible to establish which cardinal direction corresponds to the portion of territory visible in relation to the observation point.

6. RESULTS

The examination of the Lower and Middle Palaeolithic sites based on specific parameters reveals some evidence useful to comprehend criteria that mostly influenced the human occupation in the analysed area.

6.1. Monti Lessini

Caves and rock shelters are the prevailing archaeological contexts (57 cases) in the Monti Lessini area (Fig. 3a), whereas finds in plowed fields (16) and dolinas (10) are less represented. Other discoveries took place on the soil exposed during construction works (7), in sediments within karst fissures (7) and in depressions (7), although the latter were not exhaustingly described in literature. Five archaeological sites have been report-

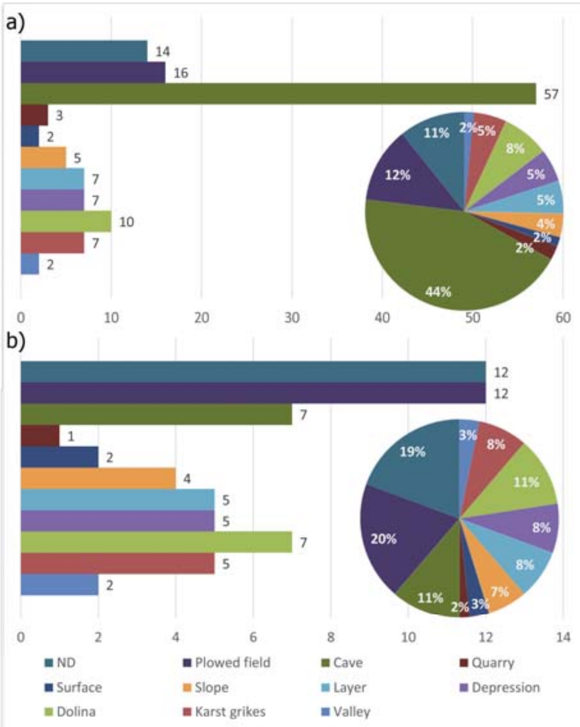

Fig. 3 - Archaeology discovery context of Monti Lessini: 3a, all sites; 3b, the multi-layered sites considered as single cases.

ed on slopes.

Few findings occurred during quarrying activities (3), within streambeds of small tributary valleys (2) or on the soil surface (2). In 14 cases it was not possible to trace the context of discovery.

Considering the multi-stratified sites as single cases (Fig. 3b), caves undergo a sharp downsizing (7) and match the number of dolinas. Plough zone contexts are still well represented (12), followed by grikes in limestone bedrocks (5), depressions in the ground (5), findings occurred during construction excavations (5), findings along slopes (4), findings in streambeds (2), surface findings (2) and only one in quarry contexts. No context can be assigned for 12 sites.

- As regard altitude (Fig. 4a), most of sites (112) lie under 800 m a.s.l., especially between 300-399 m (43) and 200-299 m (34), whereas finding between 800 and 1000 m are scarce (6). Above 1000 m a.s.l., evidence of frequentations is absent, except for those into the ranges of 1400-1499 m (4) and 1300-1399 m (3). Findings below 800 m a.s.l. prevail even counting each multi-stratified context as a single item (Fig. 4b). Sites between 800 and 1000m decrease to four. Beyond 1000 m the number of sites is four, all of them located between 1300 and 1500 m. In total, open-air findings confirm the most set below 800 m with a concentration between 200 and 299 m (12), followed by 500-599 m (11) and 300-399 m (11) (Fig. 4c). Above 1000 m a.s.l. frequentation evidences are rare and never exceeding four sites per altitude range. Open-air sites considered as a single element (Fig. 4d) did not show significant variations compared to all open-air frequentation.

According to the One-Sample Kolmogorov-Svirnov test of the data of the single sites (multi-stratified sites counted as single cases) (Fig. 5), this distribution seems to follow a normal distribution, and in consequence the concentration of the site between 200 and 700 m is not statistically significant, not even for the whole sample (Z =1,089, p 0,200).

Regarding drainage basin attribution analysis, where the multi-stratified sites are counted as singles cases, many sites do not produce evidence (42). Most of the useful sites are associated with second order basins (9), followed by those related to third order basins (8) and first order basins (3).

The relationship between each single site (despite multi-occupational ones) and the geological substrate (Fig. 6a) reveals Eocene limestones as the most occupied (31), followed by Oolitic limestones (11) and Maiolica (9 sites). Rosso Ammonitico Veronese (3), basalt (3), quaternary deposits (2), Scaglia Rossa (2), and Hyaloclastite (1) are rare. Open-air sites (multi-stratified sites counted as single cases) show a similar trend (Fig. 6b).

Analysing sites according to their topography (Fig. 7), a preference for medium slope (67) compared to the summit of the reliefs (39) and valley bottom (24) was detected. This range between medium slope and summit reduces (31 vs 27 respectively) considering multi-occupation sites as single cases. Sites placed at the

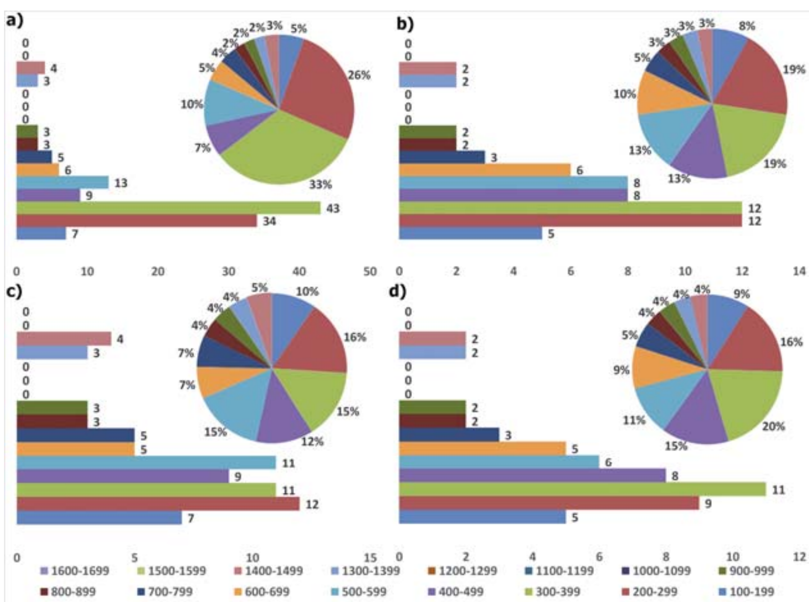

Fig. 4 - Graph of the altitude range of Monti Lessini, with interval of 100 m: 4a, all sites; 4b, the multi-layered sites considered as single cases; 4c, concerning all open-air sites; 4d, the multi-layered open-air sites considered as single cases.

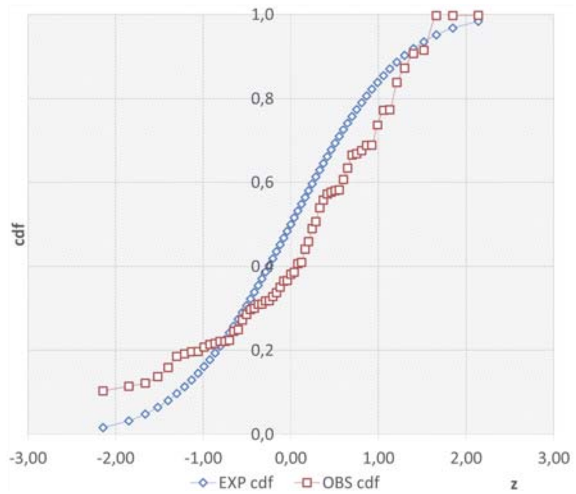

Fig. 5 - One-Sample Kolmogorov-Svirnov test of the altitude data of the single sites (multi-stratified sites counted as single cases). Technical notes: Number of sites 62; Average value 505,306; Standard deviation 308,137; Skewness 1,625; Kurtosis 2,758; D max absolute 0,138; D max+0,138; D max-1,205, K-S Z 1,089; P smaller than 0,200. Cumulative distribution function (cdf); OBS cdf =observed cdf; EXP cdf =expected cdf for a lognormal distribution; Z =Z Score.

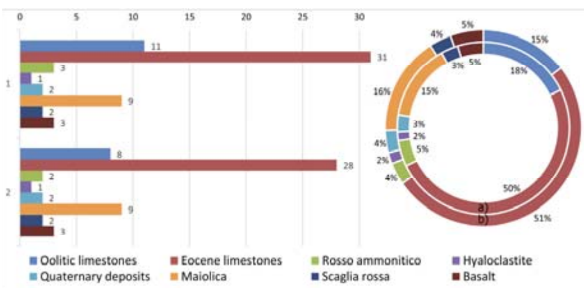

Fig. 6 - Geological substrate (multi-layered sites considered as singles cases) of Monti Lessini: 6a, all sites; 6b, only open-air sites.

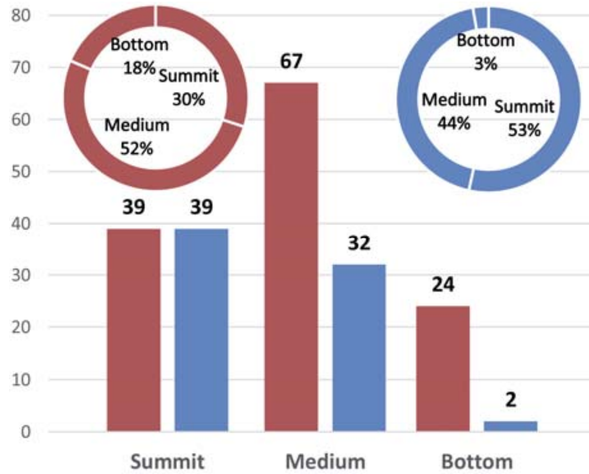

Fig. 7 - Topography positions of the sites in Monti Lessini, in red the quantity and percentage of all sites; in blue the quantity and percentage of only open-air sites.

bottom of the valley fall to three. Open-air findings are mostly located at the summit of the reliefs (39), while sites at the medium slope decrease significantly (32). Bottom valley sites are only two. Multi-stratified open-air sites counted as single cases are both located on the medium slope and at the summit count 27 cases. Only one site is positioned on the valley bottom

A peculiar case of relation between elevation, geomorphology, sedimentary basin and tectonic uplifting is the Mousterian context of Cà Verde. Deposits are contained in a dolina-like depression developed inside a paleo-channel track with partially preserved related sediments of variable thickness, still preserved for over one km in length (Brunetto & Chelidonio, 1990). The site is located at 100 m of elevation above the Adige Pleistocene flooding plain. Based on this evidence, Carton & Castaldini (1985) have argued that the Cà Verde track long pre-dates the Adige gorge at Ceraino.

Data relating to the slope exposures (Fig. 8a), show that most sites occurred on places exposed to the south - west (37), to west (25) and to south - east (20). On the other hand, less than half of the previous ones are located near slopes facing north - west (6), north - east (5) and south (5). The less frequented slopes are those facing east (3), and north (2). Numerous frequentations took place in flat areas with null slope exposure values (20). Considering multi-stratified sites counted as single (Fig. 8b), show that most sites are located on places exposed to the south - east (12). On the other hand, less than half of the previous ones are located near slopes facing south - west (6), west (6), south (5) and north - west (5). The less frequented slopes are those facing east (3), north - east (3) and north (2). Numerous frequentations took place in flat places with null slope exposure values (26). For open-air sites (Fig. 8c), many sites are exposed to the south - east (17). The remaining sites are relatively exposed to the north - west (6), west (6), north - east (5) and south (5). The less frequented slopes are those facing south - west (4), north (3) and east (1). The other sites are in flat places with null slope exposure values (26).

Open-air sites considered as a single element (Fig. 8d) did not show significant variations compared to all open-air frequentation.

The slope data refer to the total number of sites, with multi-stratified sites counted as single sites. Most of them lie on 0-10% (20) and 10-20% (18) incline, in comparison to 20-35% (12) and above 35% (12).

Regarding the visibility, most sites show very favourable viewpoints to different directions. At a first glance we notice two groups: the most frequent have a wider range of view over the horizon, with several adjacent sectors; in 10 cases, however, the orientation of the visible is less wide, but opened on two distant cardinal directions, sometimes opposite one another. There are 26 sites with visibility oriented in three or more contiguous directions. The most striking result regards Ceredo, whose potential viewpoint covers all the cardinal directions. Finally, analyses have not been successful in 11 cases.

The estimation of the amount of sunlight hours per year (Fig. 9) shows that most of the findspots receive over 1500 hours (122 sites; 94%). Only 8 cases (6%)

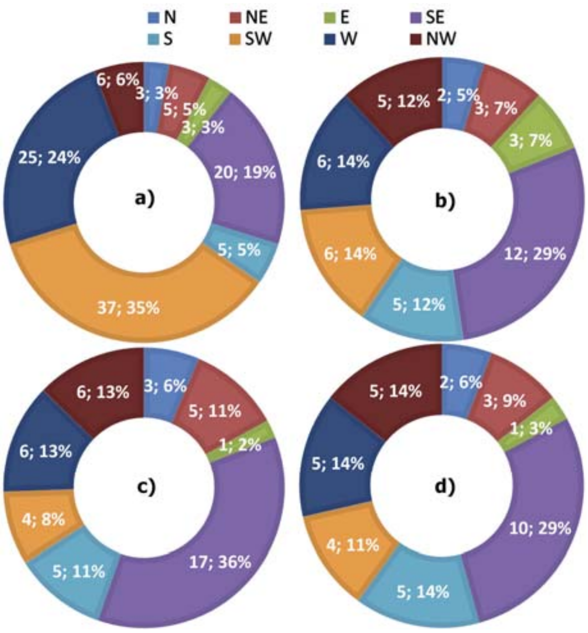

Fig. 8 - Slope exposure data in Monti Lessini refer to the: 8a, all sites; 8b, all findings, the multi-layered sites considered as singles cases; 8c, all open-air sites; 8d, multi-layered open-air sites considered as single cases.

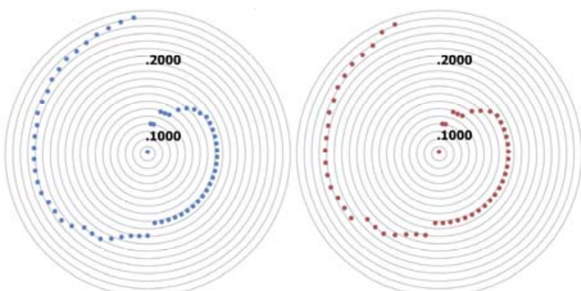

Fig. 9 - Values of the annual sunlight hours in Monti Lessini: in blue dots the values of multi-occupation contexts considered as single cases; in red dots the values of all open-air sites and the multi-layered sites considered as single cases.

record lower amounts and only one site (1%) stands below 1000 h/yr. Most recurrent values are 2547 (32; 25%) and 1725 (26; 20%) h/yr. The value of 1725 h/yr is assigned by default to sites located on a flat area with a maximum inclination of 10%. The highest peak stands at 2613 h/yr. For multi-occupation contexts, considered as single sites, we observed that only six (6%) cases receive less than 1500 hours per year, while only one (2%) less than 1000. 34 (55%) sites fall in the 1000 - 2000 sunlight h/yr with concentration around 1725 (20). Values above 2000 were assigned to 27 (43%) sites. The open-air sites (multi-stratified sites counted as single cases) show the predominance of those with an amount of sunlight hours above 1500 h/y (49; 89%). The sites that fall in the 1000 - 2000 values are 32 (58%). Values above 2000 were assigned to 22 (40%) sites.

According to the One-Sample Kolmogorov-Svirnov test of the data of the single sites (multi-stratified sites

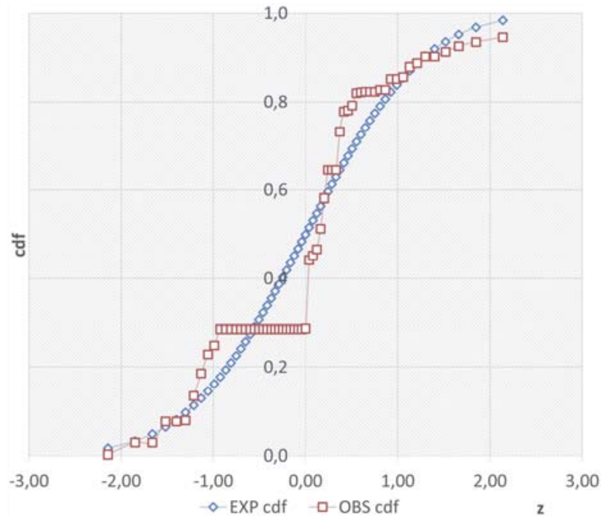

Fig. 10 - One-Sample Kolmogorov-Svirnov test of the annual sunlight hours data of the single sites (multi-stratified sites considered as single cases). Technical notes: Number of sites 62; Average value 1948,806; Standard deviation 395,417; Skewness -0,261; Kurtosis -0,335; D max absolute 0,213; D max+0,2013; D max-0,133; K-S Z 1,681; P smaller than 0,010. Cumulative distribution function (cdf); OBS cdf = observed cdf; EXP cdf =expected cdf for a lognormal distribution; Z =Z Score.

counted as single cases) (Fig. 10), these are not normally distributed, and consequently the concentration of the sites with 1725 (flat areas) of sunlight hours is statistically significant, referred for the whole sample (Z =1,681, p 0,010).

6.2. Monte Baldo

In Monte Baldo there are no multilayered sites, sites in caves or under shelter. Among the archaeological contexts (Fig. context Baldo), findings on the soil surface prevail (5 cases). Other discoveries took place in depressions (3), on slopes (2) and within streambeds of small tributary valleys (2). There are few fids in dolina (1), in sediments within karst fissures (1) and on the soil exposed during construction works (1). In 3 cases it was not possible to trace the context of discovery.

Considering elevation (Fig. 11), we note that all cases (18) lie over 600 m. The number of sites varies from 3 to 1 in the various altitudinal ranges between 600 and 1900 m, except for the range 1200-1300 m and 1700 -1800 m which do not present any findings. Beyond 1900 m no human presence was found for the chronological period in question.

Regarding drainage basin attribution analysis, many sites do not produce evidence (16). All useful sites are associated with second order basins (2).

The relation between each single site (despite multi-occupational ones) and the geological substrate reveals Oolitic limestones as the most frequent (7), followed by quaternary deposits (3), Eocene limestones (2), Maiolica (2), Scaglia Rossa (2) and gray limestones (2). Rosso Ammonitico Veronese, basalt and Hyaloclastite are absent.

Analysing the site topography, sites locate mostly on the medium side (9) than at the summit of the reliefs

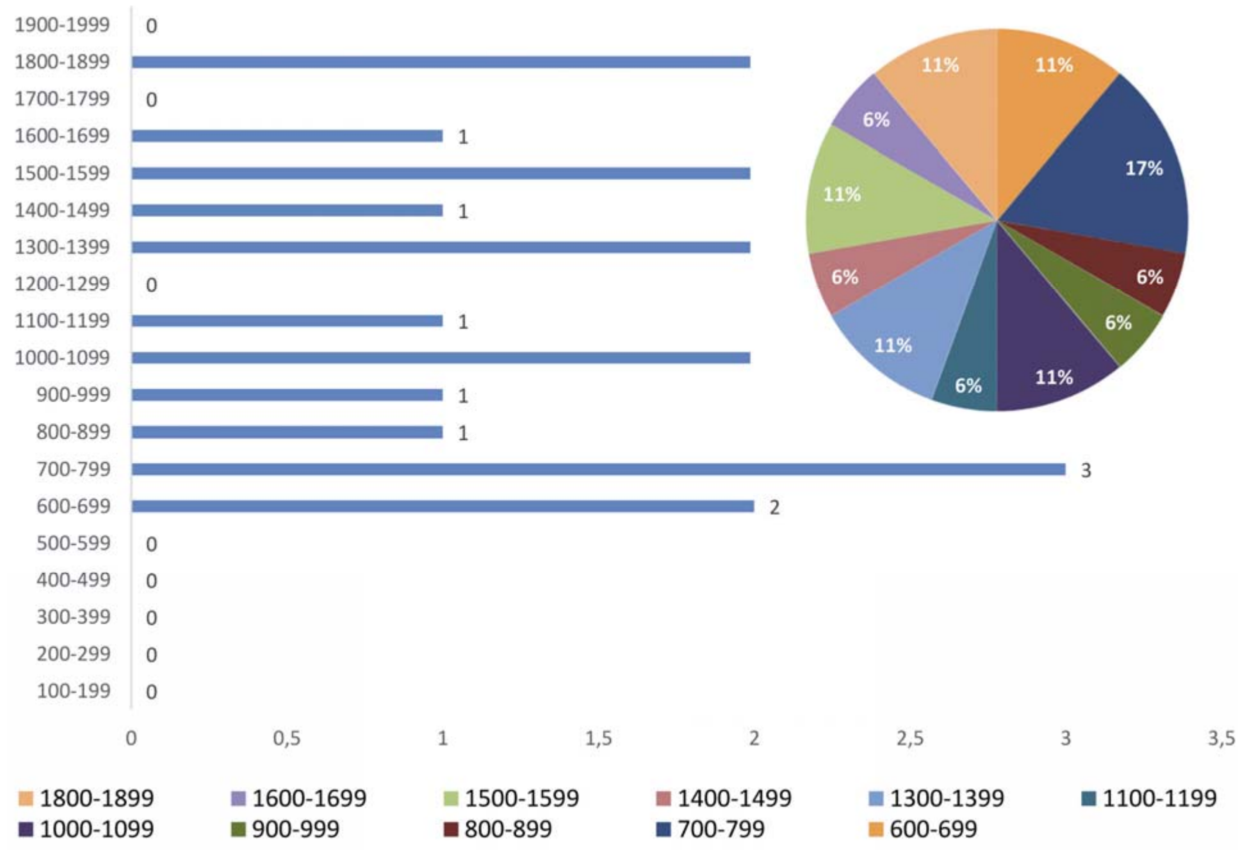

Fig. 11 - Graph of the altitude range of Monte Baldo, with interval of 100 m concerning all sites.

(4), on passes (4) and valley bottom (1).

Data relating to the slope exposures, show that most sites occurred on places exposed to the north - east (3) and east (3). The less frequented slopes are those facing north (2), west (1), south - west (1), south - east (1) and north - west (1). No frequented sites are south facing. Numerous frequentations took place in flat places with null slope exposure values (6).

Regarding the visibility, most sites show very favourable viewpoints to different directions with a wide range of view. In 3 cases, however, the orientation of the visible is less wide, but turned towards two far apart, sometimes opposite, directions. There are 7 sites with visibility oriented in three or more contiguous directions. Finally, analyses have not been successful in 1 case.

The estimation of the amount of sunlight hours per year shows that all findspots receive over 1200 hours. Only 2 sites (1%) stands above 2000 h/yr. Most recurrent values are 1725 (6; 33%) h/yr. The value of 1725 h/yr is assigned by default to sites located on a flat area with a maximum inclination of 10%. The highest peak stands at 2391 h/yr.

7. DISCUSSION

The GIS data produced in this study reveal the existence of a common trend among all the sites, despite the circumstances of their discovery being not uniform. Concerning the Monti Lessini area, although most of the human frequentations were investigated in primary position in stratified cave contexts, a portion of sites is positioned on morphological settings which are subjected to severe erosion; this reduced the optimal conservation of the archaeological record. However, the frequency of these discoveries marks out the importance of karst geomorphic processes for the conservation of the anthropogenic evidence - despite its primary or secondary position - in territories intensively subjected to erosive action. The development of this geomorphic process is closely related to the geological substrate and to its aptitude to karst morphogenesis, depending on the presence of faults and on the structural layout of the limestone formation. Data show that finds are located within dolinas, depressions in the ground and grikes. Most of these structures have developed into Oolitic limestones where lithic artefacts, loess-like deposits, palaeosols and reworked sediments are preserved, where otherwise would have disappeared. A representative example is the site of Contrada Barozze, discovered after a road cutting exposed a karst structure filled of loamy-clayey stratified sediments and palaeosols (Cremaschi et al., 1990) with Lower, Middle and Late Palaeolithic artefacts (Chelidonio & Solinas, 1983).

Most of the findings took place on Eocene limestone formations, which leaves room for different interpretations and hypotheses. The greater frequency of discoveries recorded on these limestones can be related to a choice of the human groups targeted towards places where this substrate emerges, alongside with other factors driving land use and distribution of resources. One variable that explains the reason that many sites are located on Eocenic limestones is certainly the fact that these formations prevail in the foothills area. Elevation could be considered as a driving factor, being the 400 m a.s.l. level largely below the lowermost position of the timber line during the Late Pleistocene. Besides, water springs are distributed on Eocene limestone bedrocks, sometimes in proximity of volcanic rocks. However, the intensive agricultural exploitation of the soils that developed on these bedrocks favours the surface findings, since ploughing enhances their visibility. It is therefore conceivable that the greater occurrence of findings on arable contexts and on substrates of Eocene limestone in comparison to others is the result of bias rather than of a precise choice of settlement.

With respect to the valley floor, the greater number of sites is located at medium elevation along the slope and on the top of the ridges. Considering individual spots in valley bottom, their frequency increases, even though as a mere consequence of the multilayering at Tagliente, Mezzena and Ghiacciaia rock shelters. Given the sedimentary nature of the valley bottoms, it can be assumed that many frequentations located in valley floor areas, at the lowermost elevation, are now covered by thick alluvial sedimentary sheets and are thus no longer explorable. This is confirmed by the exposition of archaeological layers at Quinzano and Cà Verde after intensive quarrying, and by geological data achieved from pits in the middle and lower Valpantena at Grezzana and San Felice Extra. No chronological data are currently available on these sedimentary sheets. In the lowermost clayey layer (from -148 to -129 m) of the "Verona Est" pit, positioned at 52 m a.s.l., pollen association reveals ecological conditions compatible with MIS 5e or 5c (Sorbini,1993).

In contrast, the high occurrence of places at summits might reveal systematic settling of the landscape along possible routinely paths covered by the hunter-gatherers for reaching the highest elevations and ecotones. It must be considered, however, that locations on top ridges and medium slopes are more visible as a result of exposure caused by erosive processes, favouring survey and surface discoveries.

The distribution of sites in relation to the drainage basin does not reveal specific occupational preference for one area but can be considered as a result biased by differences in survey intensity. Our data do not output possible correlations or specific recurring trends for the proximity to a precise hydrographic order, although we cannot neglect that this was an important parameter for settling down in the landscape.

Relation between slope intervals and finding contexts does not reveal any trends, if we except surface collecting on ploughed fields, depressions and soils, which are the most frequent in the two lowermost intervals (0-10% and 10-20%). We note the recurrence of caves in the > 35% range referring slope where they are located. Data relates to rough and steep slopes covered for reaching those favourable, stable positions. The distribution of single spots and multi-layered sites (Fumane and Tagliente) on slopes reveals a prevalence of SW and W expositions, despite most of the findings are located on flat areas with undeterminable orientation. The lowermost value has been recorded for slopes oriented to the N and, slightly higher, to the S. It can be assumed that the great frequency of sites exposed from NE to SE and SW-NW reflects the morphological characteristics of the ridges, aligned to directions converging to the North. Therefore, this result should be interpreted as an expression of the hilly landscape morphologies, rather than an evidence of locational preferences.

To reinforce this hypothesis, we explored the correlation between slope and solar exposure for all frequencies. Although sites facing south get the highest exposure values, most of the frequentations occur between 50° N and 150° N, and between 200° N and 310° N, with lower insolation values in some cases with discrepancies of over 1500 hours. The numerosity of sites exposed to the SE (112.5° N - 157.5° N) is remarkable: absolute values are high, between 2194 and 2428 sunlight h/y and play in favour of occupational choices driven by both the landform and profitable solar exposure. Therefore, insolation can be considered an important parameter in the settling of an area.

The computation of the yearly amount of sunlight hours for each single site reveals a major occurrence between 1300 and 2200 hours, with peaks at 1742 and 2451 and that these frequencies correlate to the peculiar characteristic of the landscape. As before, places with insolation over 1500 hours were probably targeted for the implantation of the seasonal camps. Moreover, several sites with values >2200 h/y testify the settling of specific areas with favourable characteristics in sun exposure, despite their poor representation among the totality of the investigated area.

From the data above, the occupational preference for some areas over others could be conceivable. In all cases, the most represented altitudinal range are 200-299 m and 300-399 m a.s.l., however it has be noted that the southern offshoots of the ridges were more surveyed than other morphological traits of the landscape (Fig. 12).

Being placed at medium-low altitudes, ridges

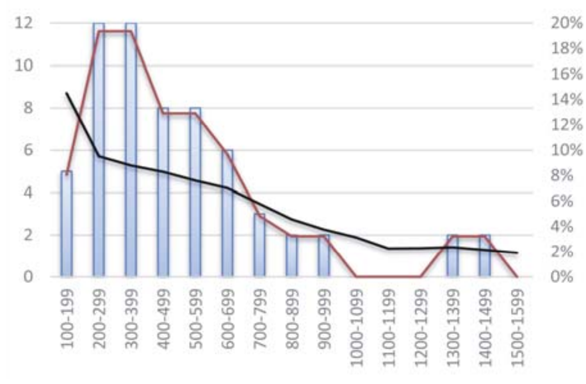

Fig. 12 - Graph of percentage curves: in red the percentage of surface of altitude ranges, in relation to the entire area; in black the percentage of the sites located in each altitude range. The columns show the number of the sites contained in the altitude ranges.

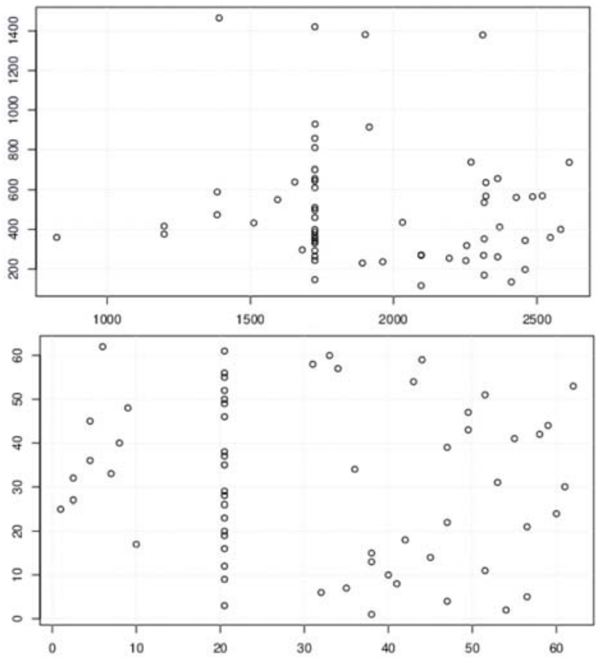

Fig. 13 - Kendal tau test for the correlation between the altitude of sites (multi-layered sites as single cases) and the annual sunlight hours. Wessa, (2017), Kendall tau Rank Correlation (v1.0.13) in Free Statistics Software (v1.2.1), Office for Research Development and Education, URL https://www.wessa.net/rwasp_kendall.wasp/.

might have led to over-representing some data. Figure 13 shows the correlation between the altitude of sites (multi-layered sites taken as single cases) and the annual sunlight hours and does not in favour of hypothesizing the existence of a specific strategy of settlement and territorial occupation. Criteria of settlement does not seem were influenced by the conditions of sun exposure, showing a wide variability at all altitudinal range. We infer that the exploitation of the landscape at high and low altitude does not was driven by significant differences in the sun light parameters for select a specific area.

We have seen how low and high altitude sites do not differ in parameters related to sun exposure, likewise the visibility does not significantly vary in function of the elevation. The data show that most of the sites have views that cover several contiguous slices of land towards some of the cardinal directions, while in 10 cases visibility is limited to two distinct directions. When we plotted the sites with a single large visual covering several contiguous cardinal directions, and the respective elevations, we noticed that the variability of width of the visual field does not follow a specific criterion as the elevation increases (fig. 14). The sites below 1000 m range in the number of visibility slices from one to eight cardinal directions, with a variability that does not indicate a specific occupational strategy. For the two sites over 1000 m does not exceed two slices, it emerges that at higher elevations the occupational choice did not consider such parameter as a priority. Both of spots set over 1000 meters falls within depressions with severe limitation in the visible slices of territory due to the geo-

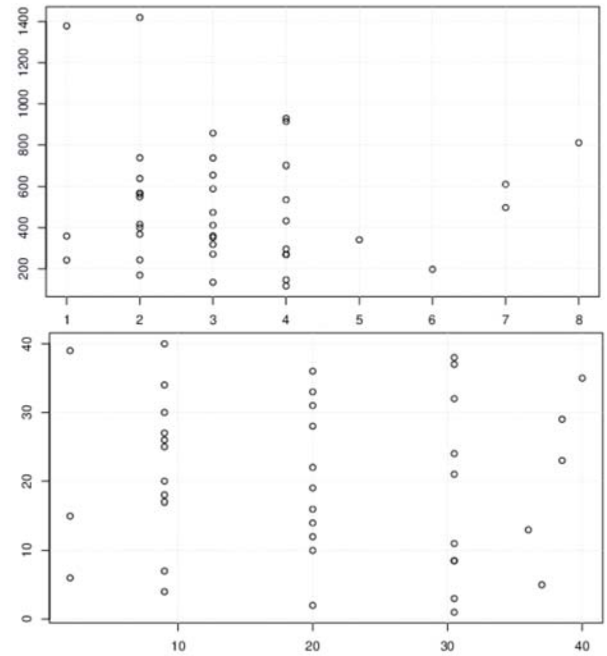

Fig. 14 - Kendal tau test for the correlation between the number of continuative visible directions of sites (multi-layered sites considered as singles cases) to their respective elevations. The graph does not include the sites located by place name and the sites that have returned two opposite portions of visible territory, to maintain compliance of the analysed data. Wessa, (2017), Kendall tau Rank Correlation (v1.0.13) in Free Statistics Software (v1.2.1), Office for Research Development and Education, URL https://www.wessa.net/rwasp_kendall.wasp/.

morphological context. Besides, a secondary position of the artefacts due to colluviation is conceivable in these sedimentary basins and, therefore, with bias in the divergence between the spots located at low and high altitudes. Sites located in valley, like Còal del Bota in Vaggimal and Riparo Tagliente, have both visible field and directionality oriented in concordance with the valley axis and morphological layout. Even for these cases, the visibility parameter does not seem to have been considered in the occupational choice.

8. CONCLUSIONS

The survey and geolocation of the Lower and Middle Palaeolithic sites and findspots on the Monti Lessini and Monte Baldo leads to the creation of an applicable database available for studies on settlement dynamics, for archaeological heritage archiving and for the developing of predictive thematic maps, archaeological risk evaluation and archaeological protection. This type of cartography would fill a gap between the tools available for the protection of archaeological and cultural heritage in such an important area for Prehistory. Using a methodology based on territorial and employment parameters, already successfully applied in various contributions (Miller & Barton, 2008; Garcia, 2012; 2013; Garcia et al., 2013), our results and considerations fulfil the proposed objectives.

From our output data we notice how in several cases the parameters here analysed have been considered in the settlement choice, at least in a certain part of the territory. In many others, however, it seems clear that some recurring values may not be the reflection of the precise search for an area that meets specific requirements. Rather, they would be related to the morphological characteristics of that specific part of landscape. In addition, it has been noted that the greater representation of some values does not depend on a choice that takes into consideration well-defined employment parameters, rather it may reflect a research deficit which affected some areas more than others. The attributes related to the context of discovery show that, although most of the frequentations have been found in cave excavations, a great divergence arises from site to site. Data inhomogeneity and difference in the location degree of the findings therefore affected the analysis, causing limitations in internal comparisons of our record.

Attributes inherent to the geological substrates are emblematic of this limit. The great representation of plough contexts on Eocene limestone substrates should not be interpreted like an evidence of a precise occupational choice, rather than of a research bias in favour of the ploughed fields, which were ubiquitously present only till the '70s of 20th century, often on the southern offshoots of the Lessini ridges. The same holds for positions on the top of the reliefs and on medium slope, where surveys were easier on ridges than in forested bottom valleys. Being ridges subjected to erosion, possibilities of making surface-type recoveries are enhanced compared to the valley floors, which are urbanized and covered by thick slope waste deposits and alluvial sediments. Nevertheless, in few but very meaningful sites such as Cà Palui, Monte Gazzo and Passo di San Valentino, Lower and Middle Palaeolithic artefacts were found in concentrations very likely attributable to knapping activities in proximity of extended outcrops of chert.

In the valley floors, the only discoveries occurred following cave research and building excavations, that allowed examining soils and sediments in depth. The same deficit could affect the possibility of proposing recurring trends in the relation of the sites to the river basins, being most of the finding points placed at the top of the reliefs and straddling multiple orders. Taking into consideration the data relating to the slope, we can see that the greatest representation of discoveries in the 0-10% and 10-20% ranges is well attested, frequently in ploughed fields, dolinas and depressions in the ground. On the other hand, the presence of five caves on >35% slopes attest the effort of encompassing steeped slopes for reaching stable and favourable niches. The distribution of data on slope exposures does not reveal any occupational preference in relation to a specific cardinal direction, rather it reflects landscape features of the Lessini area, with its ridges and slopes exposed from NE to SE and SW to NW. The major representation of the sites exposed to SE with insolation values between 2194 and 2428 hours per year leaves however the possibility that the choice of the settlements might also be driven by favourable conditions of annual hours of sunshine. Our data, for ranges between 1300 and 2200 h/y, seem to indicate that camps were positioned basically in function of the landforms. On the contrary, the location criteria for settlements exposed to over 2200 h/y are mostly driven by the preference for areas with matching characteristics of sun exposure. When we plotted sun exposure data with elevation, we did not notice a correlation between the altitude and the search of high number of sunshine hours. From these data it is therefore possible to assume that this parameter did not play a major role in settling within this hilly and mountain landscape, at least in relation to the altitude of the site.

The potential visibility related to each site indicates two general ranges. The most frequent are sites with multiple and continuous viewpoints, despite for only one slice of territory. In 13 cases, however, the orientation of the visible is less wide, but faces two markedly different directions, sometimes opposed one another. If we correlate sites with multiple continuous viewpoints to their elevation values, we do not reveal any divergence in land use between sites at low and high elevation.

In conclusion, we argue that parameters like geological substrate, position in respect to valley floor and attribution to an order of the river basin are affected by the degree of intensity of research.

This was so high in certain areas to generate overrepresentation of the most recurrent values.

The great frequency of findings on flat zones does not seem to be affected by this deficit.

Slope exposure compared to solar exposure allows us arguing a direct dependence of frequentations from the landforms. However, the sites facing SE and sites with sunlight values higher than 2200 h/y confirm that sun exposure should be excluded as main criteria adopted to settle that section of landscape.

Although sparse and fragmentary, current data on the Lower and Middle Palaeolithic settlement system in the hilly and mountain landscape of Verona reveal some aspects relatable with the paleogeographic, paleo -economic and cultural contexts of the sites. These could be an expression of the seasonal nomadism practiced by the Pre-Neanderthal and Neanderthal groups based on the settlements in the valley bottom, the upper Adige alluvial plain and the mountain range. Traces from ephemeral to consistent are scattered at 1300-1400 m a.s.l., peaking at 1600 m. Caves presumably had a main role thanks to their strategic position, being favourable for catchment in different ecological environments through short-range movements. The variety of hunted animal species confirms the possibility to diversify the exploitation of resources of animal origin. If we add the possibility human groups had to easily access the primary exposures and secondary deposits of chert, we can argue that the presence of Lower and Middle Palaeolithic hominins in this mountain range was driven by a set of factors (Bagolini & Broglio, 1985). Whether mountain sites were the edge of a large settlement system extended to the Po alluvial plain or were organized in a subsystem articulated in residential sites and specialized camps, it is however still far from being assessed.

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