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Article

A contribution to landscape reconstruction in the basin of Mondeval de Sora (Belluno Dolomites, N-E Italy): preliminary analysis of an anthracological sample from the Mesolithic layers of site VF1, sectors I and III

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Key words

- Vegetation landscape
- anthracology
- South-Eastern Alps
- Mesolithic
- palaeoenvironment

Parole chiave

- vegetazione
- antracologia
- Alpi sud-orientali
- Mesolitico
- paleoambiente

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Summary

We studied the Early and early-Mid Holocene landscape at the site of Mondeval de Sora, VF1 (Belluno, N-E Italy), preserving one of the best archaeological records of the Dolomites for this time span. Charcoal analyses are related to sectors I and III located under a dolomite boulder at an altitude of 2,150 m a.s.l. Samples were systematically picked up through wet sieving all over the stratigraphic sequence during archaeological excavations. For our analysis we sub-sampled 414 charcoals from the estimated total number of ca. 300.000. The analyzed charcoal come from levels dating to the Sauveterrian and the Castelnovian. They are mainly constituted of larch/spruce, followed by pine, probably mugo pine, and by cembran pine. Broadleaves are rare and represented by green alder. The larch, is more represented than spruce confirming its ability to occupy higher altitudes. Cembran pine, is less represented with respect to larch and spruce.

Riassunto

Nella presente ricerca è stato studiato il paesaggio durante l'Olocene antico e medio iniziale del sito di Mondeval de Sora, VF1 (Belluno, N-E Italia), che preserva uno dei migliori record archeologici delle Dolomiti per questo lasso di tempo. Le analisi dei carboni sono relative ai settori I e III situati sotto un masso dolomitico a un'altitudine di 2.150 m s.l.m. I campioni sono stati raccolti in modo sistematico attraverso setacciatura a umido lungo tutta la sequenza stratigrafica durante gli scavi archeologici. Per le analisi è stato effettuato un sotto-campionamento di 414 carboni dal numero totale stimato di ca. 300.000. I carboni analizzati provengono dai livelli risalenti al Sauveterriano e al Castelnoviano. I carboni sono principalmente costituiti da larice / abete rosso, seguita da pino, probabilmente pino mugo, e pino cembro. Le latifoglie sono rare e rappresentate da ontano verde. Il larice è più rappresentato dell'abete rosso, a conferma della sua capacità di occupare quote più elevate. Il pino cembro, è meno rappresentato rispetto al larice e all'abete rosso.

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Introduction

Land use and exploitation strategies at high altitudes in the South-Eastern Alps by the last groups of hunter-gatherers have been already addressed and developed using a wide repertoire of complementary approaches (e.g. Cusinato and Bassetti 2007, Peresani *et al.* 2009, Fontana *et al.* 2009 a, b, 2011). Models of vertical nomadism characterized by a seasonal shift from valley-bottom winter camps to the high altitude settlements during the favorable season have been proposed and, more recently, also a system based on a circular nomadism (Broglio 1992, Grimaldi 2005). Lastly, it has also been suggested that the current record for the early Mesolithic of north-eastern Italy indicates a much more complex system than previously envisaged, as evidenced by the varied location of the known sites (Fontana *et al.* 2011; Fontana and Visentin in press).

The study of organic materials from a Mesolithic site, particularly macroscopic plant remains and pollens, besides helping the reconstruction of the surrounding environment, can point out the modalities of supply of key resources, such as wood used as fuel, as well as fruits and seeds (e.g. Kubiak-Martens 1996, Mason and Hather 2002, Regnell 2012) and therefore give an important contribution to the reconstruction of natural resource exploitation.

Among the numerous Mesolithic sites known in the southern slope of the Alps and especially in its central-eastern side only a few have yielded organic remains, both animal and vegetal. This aspect especially concerns high-altitude camps whereas valley-bottom rock-shelter sites present a more varied range of findings (Broglio 1992, Fontana *et al.* 2011). Within this context the mountain camp-site of Mondeval de Sora represents a real exception with its excellent preservation conditions which can be connected to its location under a dolomite boulder that has protected archaeological layers from erosion and favored preservation. Therefore the Mesolithic layers from this site have yielded large quantities of charcoal remains with good preservation also during the following occupation of the site, up to present times. Such evidence represents a unique opportunity to investigate aspects concerned with the exploitation of wood resources at high altitudes in the Dolomites by the last groups of hunter-gatherers.

The site

The basin of Mondeval de Sora (San Vito di Cadore, Belluno) is located in the Belluno Dolomites (NE Italy), in the upper part of Fiorentina Valley, a tributary of the river Piave, with altitudes ranging between

2,100 and 2,360 m a.s.l (Fig. 1).

The basin is surrounded by a jagged ridge of Dolomia Principale and San Cassiano Formation, while the substrate is formed by rocks of the Wengen Group: volcanic turbidites, tuffaceous sandstones, conglomerates and marly limestones (Frescura and Zinato 2010). During the Last Glacial Maximum the basin was occupied by two small confluent glaciers. The one to the W had a mainly erosive action, with minor deposition consisting almost exclusively of dolomitic erratic boulders while the one to the E deposited massive moraines and some moraine bars that originated a small proglacial lake now disappeared (Alciati *et al.* 1992).

In the basin of Mondeval two main wet environments are still attested called Laghetto delle Baste and Busa dei Ciavai. Nowadays the basin of Mondeval de Sora is covered by herbaceous formations while arboreal species lack, except for some rare *Larix decidua* reduced to shrub. Due to human impact, especially referable to pastures, the timberline is nowadays located at an altitude of 1,850 - 2,050 m, i.e. lower than the site.

Vegetation of pastures is mainly characterized by *Sesleria* and *Festuca* coenoses while where grazing is more intense *Poion alpinae* is favoured. Herbaceous formations in the wet environments are composed especially of *Arabis soyeri*, *Cardamine amara*, *Juncus triglumis* and *Carex frigida*. Geobotanical surveys conducted in the area of Croda da Lago, about 2 km away from Mondeval, indicate that at altitudes higher than 1,950 m *Picea abies* is scarcely present compared to *Pinus cembra* and especially to *Larix decidua*, which is the most widespread species up to 2,200 m (Soraru and Carner, 2007). In this area the timberline is attested at 2,100 m and the tree-line at 2,200 m.

Site VF1 of Mondeval de Sora (San Vito di Cadore, Belluno) is located at 2,150 m under an erratic boulder (Fig.2). Two sectors have been investigated respectively facing S (sector I) and N (sector III). Both of them have yielded complex stratigraphic sequences indicating human frequentation with repeated interruptions from the Early Mesolithic to recent times.

In sector I the stratigraphic sequence (Fig. 3 A) shows different phases of settlement dating back to the Mesolithic, the Bronze Age and the historical period (Alciati *et al.* 1992). The Mesolithic is represented by a Sauveterrian sequence located in the southern part of the shelter and a well-preserved Castelnuovian burial (SU 4B) accompanied by some disturbed Castelnuovian layers (SUs 100 and 25) also present in the southern part of the site but in the portion closer to the rock wall. In the northern area the Mesolithic layers are absent since they have been completely erased by the following occupation of the site. The Sauveterrian sequence consists of a series of dwell-

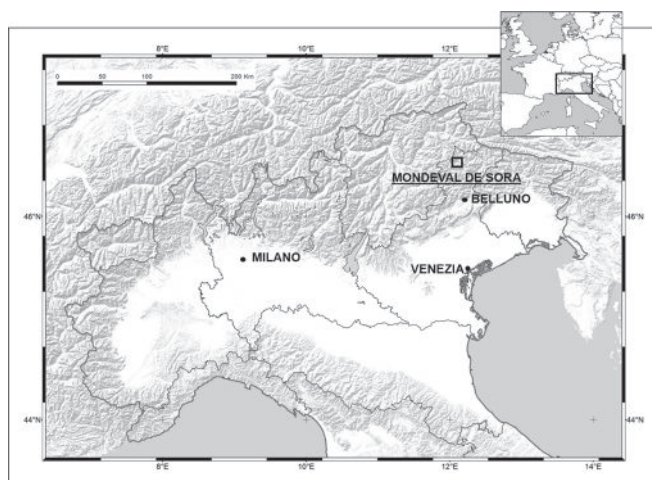


Fig. 1 - Location of the site of Mondeval de Sora in NE Italy and in Europe. / Posizione del sito di Mondeval de Sora in Italia Settentrionale in Europa.



Fig. 2 - The basin of Mondeval de Sora: left in the background the erratic boulder with the prehistoric site. / Il bacino di Mondeval de Sora: a sinistra sullo sfondo il masso erratico con il sito preistorico.

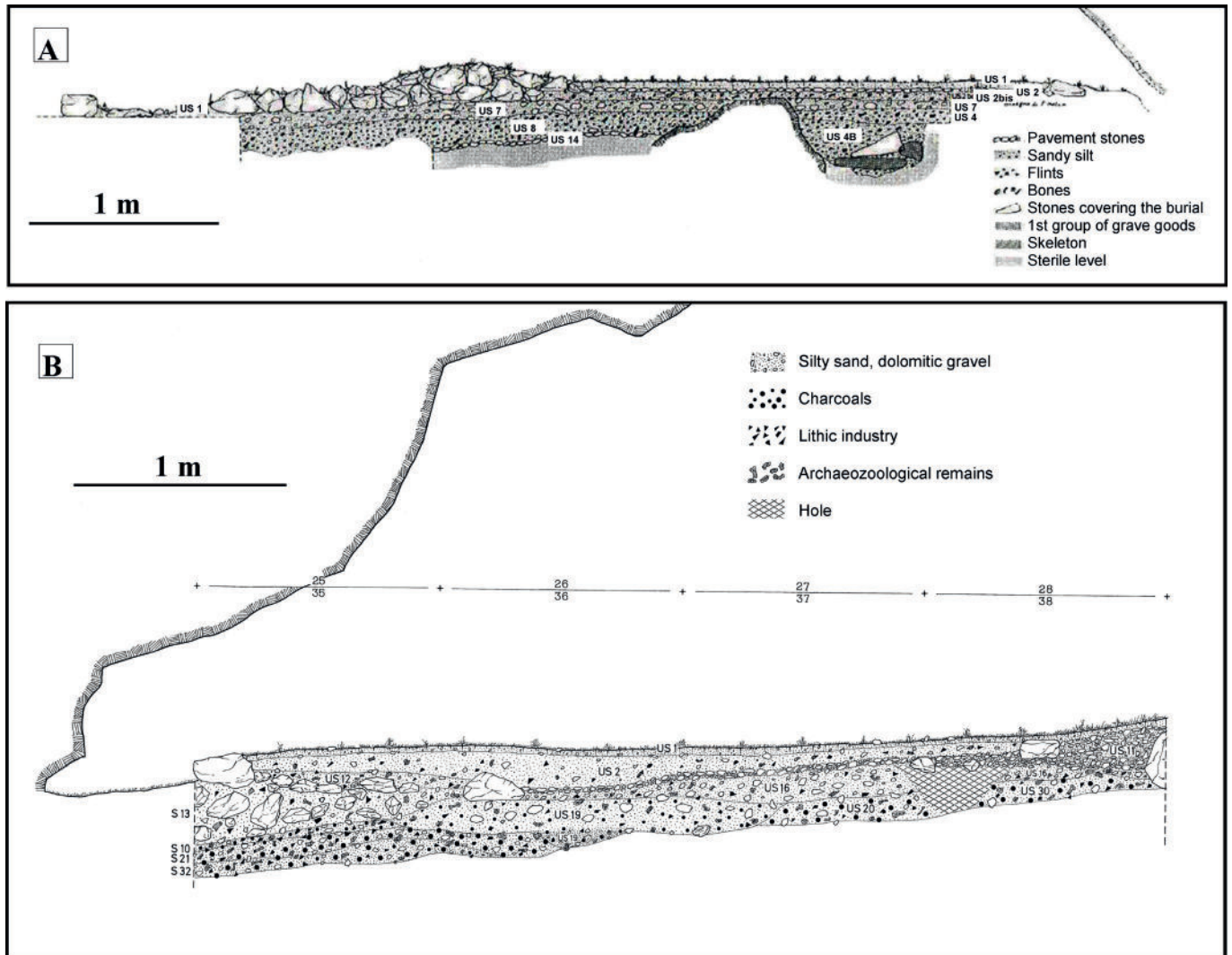


Fig. 3 - Stratigraphic sequences from sectors I (A) and III (B) of site VF1 of Mondeval de Sora. The numbers above and below the bar refer to the square grid system used during fieldworks. / Sequenze stratigrafiche dei settori I (A) e III (B) del sito VF1 di Mondeval de Sora. I numeri sopra e sotto le barre si riferiscono alla griglia quadrata utilizzata durante il lavoro di campo.

ling structures (a paved area made of small tufa slabs - SU 14 and an accumulation of dolomite blocks surrounding it - SU 33, within which a fireplace could be distinguished - SU 32) and some anthropogenic soils that covered them (SUs 7, 8, 31) and that were extremely rich of lithic waste, tools and armatures along with organic remains, mainly charcoals and bones. Two radiocarbon dates are available for the Sauveterrian sequence (GX-21788: S.U. 8 and GX-21793: S.U. 7II) (Tab. 1). Both have a wide standard deviation for which no definite explanation exists, although archaeological data indicate that the corresponding layers (with SU 7II overlying SU 8) must have formed as a result of multiple seasonal occupations. As far as the Castelnuovian burial is concerned, one AMS radiocarbon date carried out on a bone from the skeleton (OxA-7468) has yielded a date of 7,425±55 BP (6,428-6,212 cal BC). This date fits only one of the two dates obtained from the charcoal samples collected in the sediment filling of the burial pit (SU 4B, R-1939). The other one (SU4B, R-1937) is older and possibly comes from a charcoal deriving from an older occupation layer dismantled during the excavation of the burial pit (Alciati *et al.* 1992, Fontana *et al.* in press). During archaeological excavations levels referred to the Bronze Age and historical periods have been also identified (Alciati *et al.* 1992, Fontana and Guerreschi 1998, Asolati *et al.* 2005, Fontana *et al.* 2009 a). Preliminary anthracological analyses have been carried out also on these levels

(Colombo 2014), although in the present paper we will focus only on the palaeobotanical data referred to the Mesolithic.

Sector III (Fig. 3 B) has also yielded a complex stratigraphic sequence documenting different occupation phases: Early Mesolithic (SUs 10, 20, 21, 30, 32), Bronze Age, Roman and post-Roman period (Fontana *et al.* 2009 b, 2015) (Tab. 1). Particularly, a combustion structure has been attributed to the Bronze Age on the base of the potsherds typology (SU 19) while two SUs (11 and 16) have been dated to the Roman period based on the presence of two coins (Asolati *et al.* 2005). Only two radiocarbon dates are available for this sequence, both referring to the Sauveterrian (SUs 32 and 10; Tab. 1) in accordance with the characteristics of the lithic assemblages recovered from these layers (Valletta *et al.*, in press). No evident dwelling structures were identified within this Mesolithic sequence which was interrupted in the external part of the shelter by levels that formed during the following occupation.

Materials and methods

Charcoals were integrally picked up with naked eyes during the archaeological excavation from wet sieving of the sediments with a mesh size of 2 mm. This procedure was applied to recover all the

Tab. 1 - Mondeval de Sora. Radiocarbon dates obtained from charcoals of the Stratigraphic Units of Sectors I and III (R = Rome, Italy; GX = Geochron Laboratories, USA). / Mondeval de Sora. Datazioni radiocarboniche ottenute da carboni delle Unità Stratigrafiche dei Settori I e III (R = Roma, Italia; GX = Geochron Laboratories, USA).

CODE	SECTOR	SU	YEARS BP	CALIBRATED DATE ($\pm 1\sigma$) BC	CALIBRATED DATE ($\pm 2\sigma$) BC
R-1939	I	4B	7,330 \pm 50	6,235-6,100	6,355-6,065
R-1937	I	4B	8,380 \pm 70	7,530-7,355	7,580-7,195
GX-21797	III	10	8,445 \pm 50	7,570-7,495	7,590-7,370
GX-21793	I	7	8,260 \pm 175	7,485-7,080	7,600-6,755
GX-27748	III	32	9,160 \pm 90	8,525–8285	8,615–8,245
GX-21788	I	8	9,185 \pm 240	8,780-7,995	9,155-7,750

findings from the different Stratigraphic Units using diverse size grids (mainly 33x33cm, but also 20x20cm and 10x10 cm). Due to the extremely high density of the archaeological evidence recording of the position of the single findings with a coordinate system was not possible. Considering an approximate number of 50 fragments contained in 5000 paper bags a total number of ca. 250.000- 300.000 charcoal fragments has been estimated divided into different squares and Stratigraphic Units. The ratio between the volume of washed sediment and the quantity of charcoals sampled with naked eyes was not recorded during the excavations. Samples arrived at the Laboratorio di Archeobiologia dei Musei Civici di Como accurately divided.

960 charcoal fragments coming from layers dating back to the Mesolithic (Sauveterrian and Castelnovian), the Bronze Age and to historical times were analyzed (Colombo 2014). Palaeobotanical data related to the Mesolithic were obtained from the analysis of 414 charcoals from 12 Stratigraphic Units. For sector I 250 fragments from 7 Stratigraphic Units were analyzed; for sector III 164 fragments from 5 Stratigraphic Units (Tab. 2). We selected SUs that could be related to the stratigraphic/chronological sequences derived either from radiocarbon dates or artifacts typology.

Charcoals were analyzed at reflected light microscope by the observation of the three fundamental fractures, at 50, 200 and 400 x magnification. As exposed below, 6 taxa were identified allowing reconstructing the features of tree and shrub vegetation in the basin of Mondeval de Sora during the Mesolithic. Carpological remains were recognized and extracted from charcoal samples and analyzed at the stereomicroscope at 8 -100 x magnification. Reference collections of the Laboratorio di Archeobiologia were used both for charcoal and carpological remains identification.

Results

Charcoal determination

The 6 taxa are: *Larix/Picea* (larch/spruce), *Larix* (larch), *Picea* (spruce), *Pinus mugo/sylvestris* (mugo pine/scots pine), *Pinus cembra* (cembra pine), *Pinus* sp. (pine), *Alnus viridis* (green alder).

Difficulties in the distinction between *Larix* and *Picea* are known in the literature (Greguss 1955, Sárkány and Stieber 1955, Schweingruber 1982, Schweingruber 1990, Bartholin 1979, Anagost *et al.* 1994, Talon *et al.* 1998, Marguerie *et al.* 2000; Ali *et al.* 2005). In order of importance and recurrence, the characteristics

that distinguish *Larix decidua* are the sharp transition between earlywood and latewood in traversal section (fig. 4A), the presence of biseriate bordered pits in radial section and the asymmetry of resin canals in tangential section; sometimes these pits are difficult to see because of the narrowness of the growth rings and particularly of the latewood. Whenever these characters were not clearly observable we preferred to mark charcoals as *Larix/Picea*. However, palaeobotanical considerations (Ravazzi 2002, Drescher-Schneider 2008) and ecological (Andreis *et al.* 2009) corroborate the hypothesis that charcoals can be mainly attributed to larch. Nowadays the larch reaches 2100 m a.s.l. and prefers fresh soils rich in bases, silts and/or clay; it is an heliophilous plant which favors bright and dry places (Oberdorfer 1979, Soraruf and Carrer 2007). It could form associations with cembra pine and spruce. Spruce needs natural wet soils, both soft and coarse; it is a pioneer species and spreads especially in pure woods or sometimes with *Fagus* and *Ulmus*, up to 900 m a.s.l. (Oberdorfer 1979).

In addition to regular analyses, we analyzed some charcoals of SU 32 Q. 6/3 in sector I (see Tab. 1) in order to test the possibility to discriminate *Larix* and *Picea* based on the characteristics of these woods reported in literature (e.g. Anagost *et al.* 1994, Talon 1998 *et al.*, Marguerie *et al.* 2000). Most charcoals fragments are branches with very narrow growth rings (e.g. 42 rings in 8 mm); consequently not all the important characters could be observed. Other fragments allowed recognizing the most important features although only seldom we could identify the characteristics reported in literature. For example, because of the combustion the epithelial cells of the vertical resin canals were badly observable and thickenings in tracheids were not visible. However, the most important characteristics let us conclude that in this sample most charcoals can be attributed to *Larix*.

Another problem in charcoal determination concerns the impossibility to distinguish *Pinus mugo* from *Pinus sylvestris* since both are characterized by pinoid large pits and transversal tracheid tooth-shaped walls. Considering the ecological needs of these species it is possible to affirm that they are mainly attributable to *Pinus mugo*. Generally, the scots pine does not reach altitudes higher than 1,800 m while *Pinus mugo* reaches 2,700 m a.s.l. (Pignatti 1982).

The peculiarity of *Pinus cembra* is the presence of smooth-walled transversal tracheids in the rays in radial section (Fig. 4B). The smooth transition between earlywood and latewood is less reliable for species determination (Schweingruber 1982). It spreads along

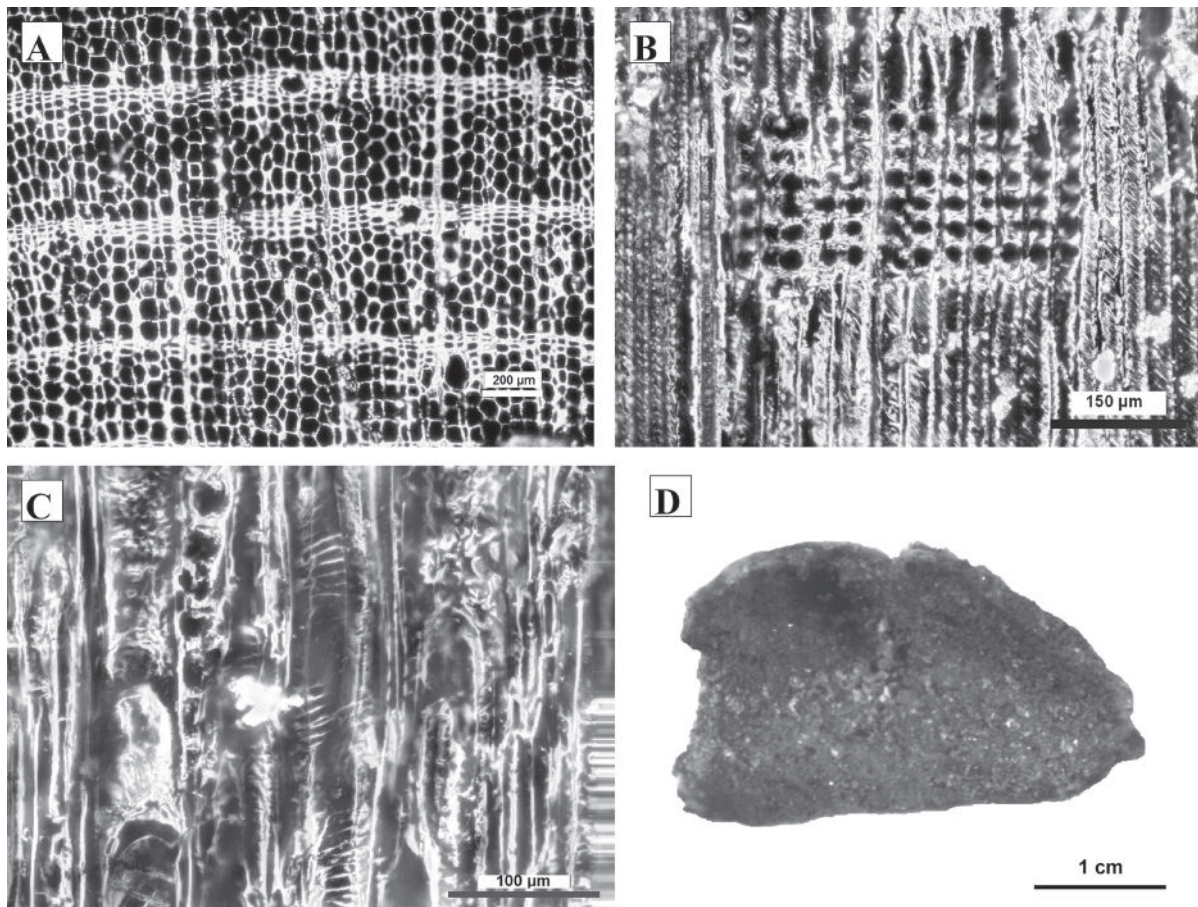


Fig. 4 - Charcoal remains (taken at the reflected light microscope) and carpological remains (taken at the stereomicroscope). **A.** Transversal section of *Larix* (larch) showing the sharp transition between earlywood and late wood. Bar = 200 µm. **B.** Tangential section of *Pinus cembra* (cembran pine) showing smooth-walled, transversal tracheids in the rays. Bar = 150 µm. **C.** Radial section of *Alnus viridis* (green alder) showing scalariform perforations. Bar = 100 µm. **D.** *Pinus cf. cembra* seed testa. Bar = 1 cm. / Immagini di carboni (scattate al microscopio a luce riflessa) e resti paleocarpologici (scattate al microscopio ottico stereoscopico). **A.** Sezione trasversale di *Larix* (larice) che mostra la netta transizione tra legno primaticcio e legno tardivo. Barra = 200 µm. **B.** Sezione tangenziale di *Pinus cembra* (pino cembro) che mostra le tracheidi trasversali con pareti lisce nei raggi. Barra = 150 µm. **C.** Sezione radiale di *Alnus viridis* (ontano verde) che mostra le perforazioni scalariformi. Barra = 100 µm. **D.** Testa di seme di *Pinus cf. cembra*. Barra = 1 cm.

the upper limit of tree-line up to ca. 1,950 m, especially on acid soils with raw humus in cold climate. It is a slow growing heliophilous plant, very resistant to bad weather (Oberdorfer 1979).

As to the genus *Alnus*, the transversal section of the species *viridis* presents a clearly lower pore number with respect to the species *glutinosa* and it is widespread and not semi-ring porous. *Alnus viridis* presents typical scalariform perforations in radial section (Fig. 4 C). *Alnus glutinosa* and *A. incana* reach respectively altitudes of 1,200 m and 1,300 m, while *A. viridis* reaches 2,300 m (Pignatti 1982).

Charcoal and carpological remains related to the Mesolithic layers of VF1, sectors I and III

During the Mesolithic *Picea abies* is very scarce (0.8% in sector I; 1.8% in sector III) and *Larix* prevails, especially in sector III (7.6% in sector I; 25.0% in sector III), also in the uncertain form *Larix/Picea* (50.4% in sector I; 61.2% in sector III). *Pinus mugo* is present in both sectors (23.2% in sector I; 8.5% in sector III), while *Pinus cembra* is

fairly abundant in sector I (14.8%) and absent in sector III (Tab. 2). The presence of *Alnus viridis* during the Mesolithic is sporadic and limited to two SUs (4 B and 30, respectively in sector I 2.0%, I and in sector III 3.0%).

Carpological remains are represented by a fragment of larch strobilus (SU 31, sector I), a stalk of alder infructescence (SU 8, sector I) and a cf. *Pinus cembra* seed testa (SU 8, sector I; Fig. 4D).

Discussion

During the Sauveterrian, at the higher limit of the subalpine belt, the presence of *Larix decidua*, *Picea abies*, *Pinus cembra*, *Pinus mugo* and some broadleaves is attested. After the Early Mesolithic we observe no evidence of the gradual expansion since ca. 7,000 BC of *Picea abies* that appears in the pollen diagrams of the Eastern Alps (Oeggl and Wahlmüller 1992, Kofler 1992, Drescher-Schneider 2008, Festi *et al.* 2014), Central Alps (Pini 2002, Gobet *et al.* 2003) and the Alps as a whole (Tinner and Vescovi 2007).

Larix decidua seems to be more represented than *Picea abies*

confirming its ability to occupy higher altitudes, while the latter is currently present at altitudes not exceeding 1,800 m (Soraru and Carrer 2007) also in the area of Mondeval. It is not to be completely excluded that *Larix decidua* was selected because of its effective higher heating value (Ilarioni 2007).

Even the values of *Pinus cembra*, a species now spread in Italy between 1,400 and 2,300 m (Pignatti 1982) are coherent with the analyses carried out on pollen and plant macrofossils (*Pinus cembra* needles) at Hirschbichl, Austria located at 2,140 m a.s.l. where this species is present since 9,370 +/- 170 years ago (Oegg and Wahlmüller 1992).

The presence of *Alnus viridis* may have been favored by the fact that this species is less sensitive to fire passages with respect to the other plants found among charcoals (Gobet *et al.* 2003), as it is well documented also in the area of the Trentino Dolomites (Kofler 1992). Namely pollen curves show a strong increase of this species around 9,000 BP, followed by its reduction about one millennium later (Oegg and Wahlmüller 1992, Filippi *et al.* 2005). However, we neither have data about vegetation evolution in the area through pollen series, nor about the fires frequency from pedoanthracological studies. Actually, fire passages favor especially *Alnus viridis* and, among the species documented at Mondeval *Larix decidua*, *Pinus mugo*, *Pinus cembra* and *Picea abies*.

According to pollen data from the South-Eastern Alps, reforestation started very quickly after the Lateglacial, bringing the limit of the forests up to 2,100 m not later than 10,800 yrs cal BP. In the high zones of the subalpine belt the forest was dominated by *Pinus cembra* and *Larix decidua* since about 8,000 years ago, as indicated by the pollen diagrams from the southern area of the Eastern Alps (Oegg and Wahlmüller, 1992; Drescher-Schneider, 2008). Based on pollen and plant macrofossils in the Tyrolean Alps, forests reached the maximum spread approximately 5,200 uncal BP (Oegg and Wahlmüller 1992).

With the support of palynological analysis carried out at Alpe Fedèra located 2,5 Km northeast of Mondeval at ca. 2,050 m a.s.l. (Soldati *et al.* 1997), it is possible to hypothesize the presence of woods mainly composed of conifers in the basin of Mondeval during the Mesolithic (between 9,155-7,750 BC and 6,355-6,065 BC 2σ cal), while during the following phases especially in historical times, when the area was exploited for pastoral purposes, the fuel had probably to be searched a few hundred meters below the site. However, this evidence seems to be in contrast with the palynological analysis of the filling of the Castelnovian grave, where the herbs percentage exceeds 91% (Cattani 1992).

A few anthracological comparisons in the Eastern Italian Alps are available for the Mesolithic sites of Colbricon at 2,100 m a.s.l. (Foresta Demaniale di Paneveggio - Trento) and Plan de Frea IV at 1,930 m a.s.l. (Val Gardena - Bolzano) (Bagolini *et al.* 1975: pp. 29-32, Angelucci *et al.* 2001: p. 100). In the first site *Pinus montana* and *Pinus cembra* are very common while *Picea/Larix* is rarer and one finding of *Rhododendron* sp. is recorded. In the second site *Larix decidua*, *Pinus cembra*, *Pinus sylvestris/mugo* and *Juniperus* sp. were collected. This study shows that *Larix/Picea* and *Pinus mugo/sylvestris* appear constantly among the identified taxa, in greater percentages than all other species.

The tree line in the Eastern Alps during the Mesolithic was at the same altitude of Mondeval or even higher. Therefore, it is possible that the area was mostly covered by open larch parkland and with diversified areas, such as woods of *Alnus viridis*, also on the basis of the superficial hydrography and of the geolithology. The presence of other species, not necessarily associated one another, such as *Pinus mugo* and other conifers, can be explained by the existence nowadays of a mosaic of tree formations around the basin or even inside; this mosaic is partly preserved also nowadays on the slopes at the edge of Mondeval basin.

The only carpological remains that were found are constituted by one fragment of *Larix decidua* strobilus and one *Alnus viridis*

stalk, both woody and inedible plant organs, and by one millimetric fragment of *Pinus cf. cembra* seed testa. Other findings of *Pinus cembra* seed are not known for the Mesolithic of the Alps, except for the one of Staller Pass (Kompatscher *et al.* 2016, in press), while they are a bit more frequent in the Middle Neolithic of the French Alps (Martin *et al.* 2008, Martin 2012: p.127) and in the Middle - Late Neolithic of Lake Constance area (Hosch and Jacomet 2004, Jacomet 2009). This absence could be explained by a combination of phenotypic factors of the species, symbiosis with vertebrates and resource accessibility. Theoretically this resource would be represented by huge productions per hectare, in the case of pure forests of *Pinus cembra* as in the North of Eurasia (Formosoff 1933), with high values also in the Alps (Zong *et al.* 2010). Two months after flowering, in September, *Pinus cembra* cones are ripe with still closed leathery scales that rarely fall to the ground without the intervention of vertebrates, especially the nutcracker (*Nucifraga caryocatactes*) and the eurasiatic squirrel (*Sciurus vulgaris*) (Abs 2004, Zong *et al.* 2010). The pine cones fall and open in the following spring and the collection of seeds from the litter under the trees by animals takes place between April and November. The presence of the squirrel during the Mesolithic at Mondeval is supported by palaeontological remains (Berto *et al.* this volume).

A good ethnographic documentation referred to the nineteenth and early twentieth century confirms the autumn collection of pine seeds "when the scales of the cones have lost the resin and the seeds are brown", but also of the immature cones from the tree to directly consume the seeds. In turn, the cones fall by the spring of the second year from fructification (Bürgi and Stuber 2003: p. 368). At the altitude of Mondeval the collection period of closed mature cones would be between September and November and the one of pine seeds fallen to the ground from April to May. But in the latter case the collection would be compromised by the strong competition of nutcrackers and squirrels. For example, a single nutcracker can gather and hide under the ground up to 60.000 pine seeds that will constitute its reserves only for the winter. Both seasonal data based on the analysis of the faunal assemblage from the Mesolithic layers (Fontana *et al.* 2009) and the altitude at which the site is located indicate that occupation could occur between the late spring and the beginning of autumn.

Conclusions

The anthracological association of *Picea abies*, *Larix decidua*, *Pinus cembra* and *Pinus mugo* (*P. sylvestris/mugo*), with the probable prevalence of *Larix decidua* and *Pinus mugo*, identified at the site of Mondeval de Sora (VF1) during the Mesolithic (especially in the Sauveterrian) testifies the spread of these arboreal formations at high altitudes during this time span. Such species started to diffuse in the early Holocene along the tree-line zone of the south-eastern Alps with variations due to the local geolithology. Such associations are consistent with those of uncharred macroscopic remains found in the Eastern Alps such as at Hirschbichl - Austria (Oegg and Wahlmüller 1992), 50 km N of Mondeval, while they differ from those of the esalpic region where broadleaves such as *Laburnum alpinum* and *Sorbus* sp. appear, such as at Laghetti del Crestoso (Brescia - Italy), about 100 kilometers S-W of Mondeval (Nisbet 1997).

Based on the scarcity of carpological remains, it is not possible to draw any conclusion about the choice and the use of plant food resources by the Mesolithic groups that occupied the site of Mondeval de Sora. The question remains open on whether and how, during the summer camps at high altitude, a collection of edible species to be stored or eaten fresh was practiced, which did not leave any substantial traces among the carbonized remains.

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