Research Article

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Investigating the Early-to-Late Mesolithic Transition in Northeastern Italy: A Multifaceted Regional Perspective

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Abstract: This article focuses on the Mesolithic record of northeastern Italy, one of the key European regions for studying the last prehistoric hunter-gatherer groups. Most specifically, it aims to compare the rich Early and Late Mesolithic evidence, trying to shed some light on the shift between these two periods. Such a topic is approached at a regional scale, that is to say, by comparing the overall record and trying to identify similarities and divergences concerning different aspects of past lifeways such as settlement strategies, technology, exploitation of faunal resources, ornamental traditions and burial rituals. Overall, by providing an updated regional synthesis, the presented data highlight aspects of continuity and discontinuity between these two periods and contribute significantly to the debate concerning the modalities in which this transition took place in Southern Europe.

Keywords: Mesolithic, Sauveterrian, Castelnovian, northeastern Italy, transition

1 Introduction

The Early-to-Late (or First-to-Second) Mesolithic transition is the primary large-scale cultural change that occurred at the time of the last European hunter-gatherer-fishers (Marchand, 2014). While the recognition of different cultural entities attributed to successive phases of the Mesolithic is dated to the first part of the twentieth century (Coulonges, 1935 and Octobon, 1926 in France), it was only during the 1950s that the Late Mesolithic started attracting the attention of scholars. This is shown by the first comprehensive studies published in France (Barrière, 1954) and the United Kingdom (Clark, 1958). As for most Palaeolithic techno-complexes, the definitions of Early and Late Mesolithic assemblages were performed starting from the

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morpho-typological features of lithic assemblages. Thus, armatures and lamellar blanks were the main diagnostic features to identify these two periods in the stratigraphic sequences. In the following decades, by applying a broader analysis to lithic assemblages at a European scale, Kozlowski (1976) defined the differences between the two techno-complexes as S (for Sauveterrian) and K (for Castelnovian and Tardenoisian) components, respectively. Rozoy (1978), on the other hand, gave a definition based on “flaking styles”, which he termed, respectively, as Coincy (Early Mesolithic) and Montbani (Late Mesolithic). Since then, two main hypotheses for the origin of the Late Mesolithic in Europe have been proposed: one of continuity or local evolution (Rozoy, 1978) and one supporting a break related to an external origin (Clark, 1958; Kozlowski, 1976).

Recently, this latter hypothesis has prevailed thanks to the adoption of a techno-economical perspective in lithic studies and the refinement of radiocarbon chronologies (Perrin et al., 2009). Thus, differences at first identified from a morpho-typological viewpoint have been recognised to reflect relevant technical changes. These changes are mainly related to the introduction and rapid spread in the Second Mesolithic of sophisticated knapping techniques, such as indirect percussion and pressure. Both techniques allowed producing regular blades and bladelets from which new categories of armatures, namely trapezes, and tools, the so-called Montbani (denticulated) bladelets, were obtained (Binder, Collina, Guilbert, Perrin, & Garcia-Puchol, 2012; Marchand, 2014). As for the possible areas where the new techniques originated and reached Southern Europe, some older hypotheses were reconsidered: Northern Africa (Perrin et al., 2009) and Eastern Europe (Biagi & Starnini, 2016). Nonetheless, no unquestionable evidence may confirm any of the two at the present state of knowledge. However, the large-scale development and the rapid diffusion of the Second Mesolithic during the first part of the 7th millennium cal BC support the external origin hypothesis (Marchand & Perrin, 2017).

Another main issue related to this transition concerns the modality in which the new technologies spread. Should these be connected to a colonisation process or transmission among the native populations? For Southern Europe, two opposing theories have been advanced. The first one involves a rapid shift related to the arrival of groups who replaced Early Mesolithic populations (Perrin et al., 2009), while the second implicates a progressive inclusion of the new technologies into the previous technical background, reflecting a cultural transmission pattern (Baroni & Biagi, 1997).

The processes underlying this transitional phase have rarely been debated in the Italian peninsula. Based on the Northern Italian evidence, most authors have recognised that beyond the impressive technological innovation related to the diffusion of new debitage techniques and new tools, a technical continuity appears, primarily related to the presence of typical Sauveterrian microliths in the Late Mesolithic (Biagi, 2001; Ferrari & Fontana, 2016; Franco, 2011). More recently, also the persistence of some features of the Sauveterrian technical tradition has been observed, such as an expedient production of irregular bladelets and flakes by direct percussion with a soft hammer-stone in the final stage of reduction of regular bladelet cores. Although doubts about the integrity of stratigraphical sequences may be evoked against this continuity, it must be underlined that all open-air and sheltered Italian Late Mesolithic sites attest to the presence of Early Mesolithic types of microlith, the only possible exception being Latronico (Fontana, Flor, & Duches, 2016a).

As both the origin and modality of diffusion of the Late Mesolithic were not necessarily homogeneous all over the European continent, to challenge these hypotheses, we aim to investigate the underlying phenomena of this technological transition from a regional perspective (Marchand, 2014). This article will adopt a multidisciplinary perspective applied to the large and varied record discovered throughout several decades of research in northeastern Italy to overcome the most traditional typological approach applied to lithic assemblages and implement the technological one. We thus aim to seek to what extent the lithic technologies introduced during the Late Mesolithic in this area also involved changes in other aspects of the daily life of the Mesolithic groups. This research will also allow us to discuss the modes and paces of diffusion of the new cultural trends in this region starting from the first half of the 7th millennium cal BC. For this purpose, the main Early and Late Mesolithic archaeological evidence from northeastern Italy has been analysed and compared. This region represents one of the European areas with the richest record. Here, the Mesolithic was first identified at the beginning of the 1970s by A. Broglio after comparing the lithic assemblages discovered in the Adige valley and the Dolomite area with those of Southern France (cf. Broglio, 2016).

2 Study Region, Site Distribution and Chronology

This work focuses on the evidence of the Trentino-Alto Adige, Veneto and Friuli-Venezia Giulia regions in northeastern Italy (Figure 1). Geographically, this area encompasses most of the south-eastern Alps and a large plain zone known as Veneto-Friulan plain that connects them to the Adriatic Sea. This area includes a high diversity of environments spanning from the lagoons close to the seaside to the Alpine valleys and uplands and passing through the sandy and gravelly soils that characterise the lower and upper portions of the plain, respectively (Fontana, Mozzi, & Bondesan, 2010).

Archaeologically, this area is by far the richest in Italy and one of the richest in Europe as far as the Mesolithic record is concerned. Since the end of the 1970s, numerous excavations and surveys allowed building a large corpus of sites distributed all over this territory. A sample of 252 sites was selected and

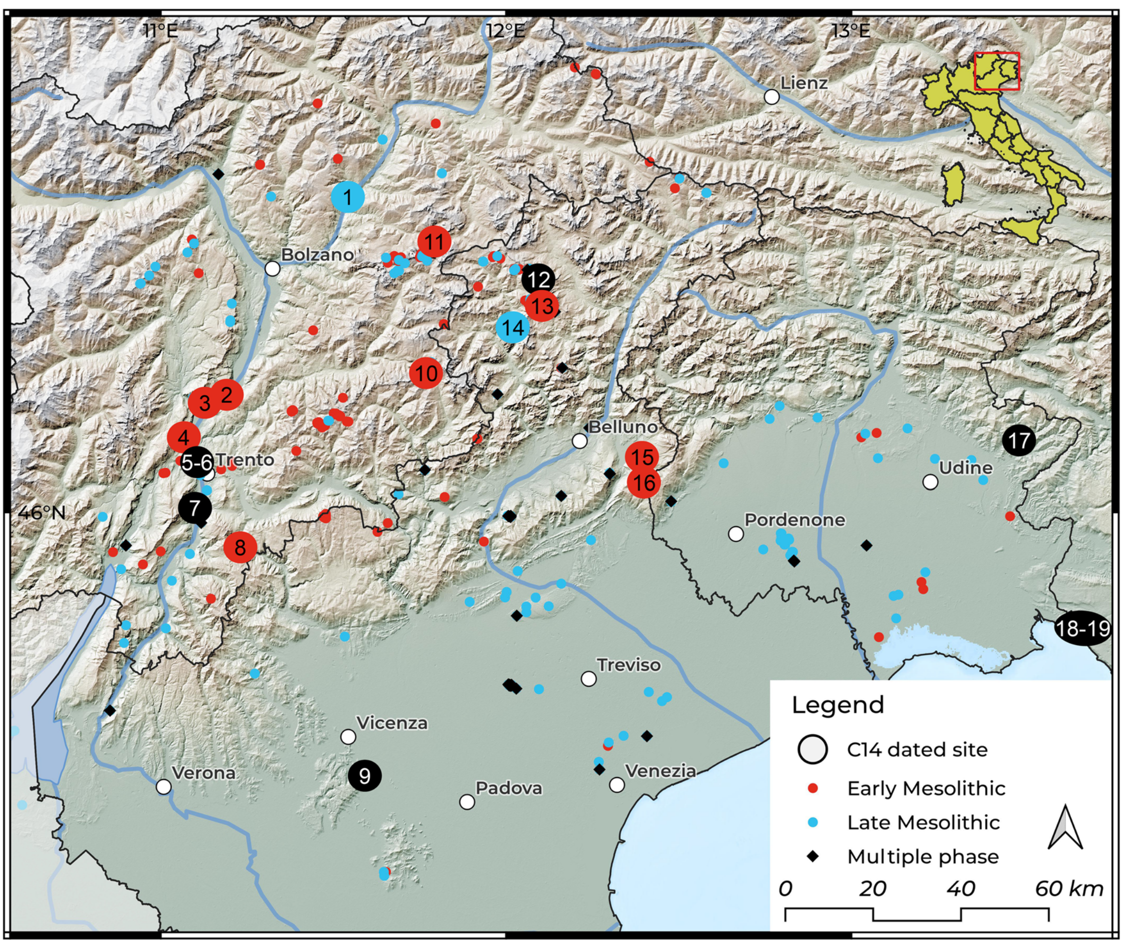

Figure 1: Distribution of the Mesolithic sites in the study region (map data from: https://doi.org/10.13127/TINITALY/1.0). Sites indicated with numbers are those for which radiocarbon dates are available and are as follows: (1) Villandro, (2) Galgenbühel, (3) Mezzocorona Borgonuovo, (4) Vatte di Zambana, (5) Riparo Pradestel, (6) Riparo Gaban, (7) Romagnano Loc III, (8) Riparo La Cogola, (9) Grottina dei Covoloni del Broion, (10) Colbricon, (11) Plan de Frea, (12) Mondeval de Sora – VF1, (13) Casera Staulanza, (14) Pian de la Lora, (15) Palughetto, (16) Casera Lissandri, (17) Riparo di Biarzo, (18) Grotta Benussi and (19) Grotta dell'Edera (map elabrated with QGIS, 3.22.14 LTR).

Table 1: Frequency of open-air and rock-shelter/cave Mesolithic sites by elevation range

	Elevation <800 m a.s.l.				Elevation >800 m a.s.l.				
	Open air		**Rocksh./cave**		**Open air**		**Rocksh./cave**		**Total**
Early Mesolithic	13	12.4%	4	3.8%	82	78.1%	6	5.7%	105
Late Mesolithic	50	54.9%	7	7.7%	32	35.2%	2	2.2%	91
Multiple phases	28	50.0%	15	26.8%	11	19.6%	2	3.6%	56
Total	91	36.1%	26	10.3%	125	49.6%	10	4.0%	252

plotted using QGIS (3.22.14 LTR) to investigate the transition between Early and Late Mesolithic in this region (Figure 1). Criteria used to select the sites are a reasonably certain chronological attribution (particularly relevant for surface lithic scatters) and the availability of precise geographic data for their positioning. Among these, 105 are Early Mesolithic sites (41.7%), 91 are Late Mesolithic (36.1%) and 56 yielded evidence of both phases (22.2%). The great majority of them are open-air sites (Table 1). This applies to upland and lowland contexts and both chronologies. Regarding rock-shelters, remarkable is the relatively high frequency of sites located in the valley bottoms that yielded evidence of both occupational phases. Most of the cultural attributions reported here are based on techno-typological grounds, as most of the evidence is represented by surface lithic scatters. Radiocarbon-dated sites are reported in Figure 1. Most of them correspond to lowland rock-shelter or cave sites with multiple occupational phases.

The distribution of Early and Late Mesolithic sites seems to follow similar criteria from a topographical viewpoint. All of them are clustered in areas with particular ecological resources and characterised by the high availability of a variety of animal and vegetal species: e.g. the spring area in the lowland, the hilly piedmont belt and next to cols and small lakes above the tree-line in the Alpine uplands. Previous studies highlighted a minor difference in the vertical distribution of Sauveterrian and Castelnovian upland sites (Kompatscher, Hrozny

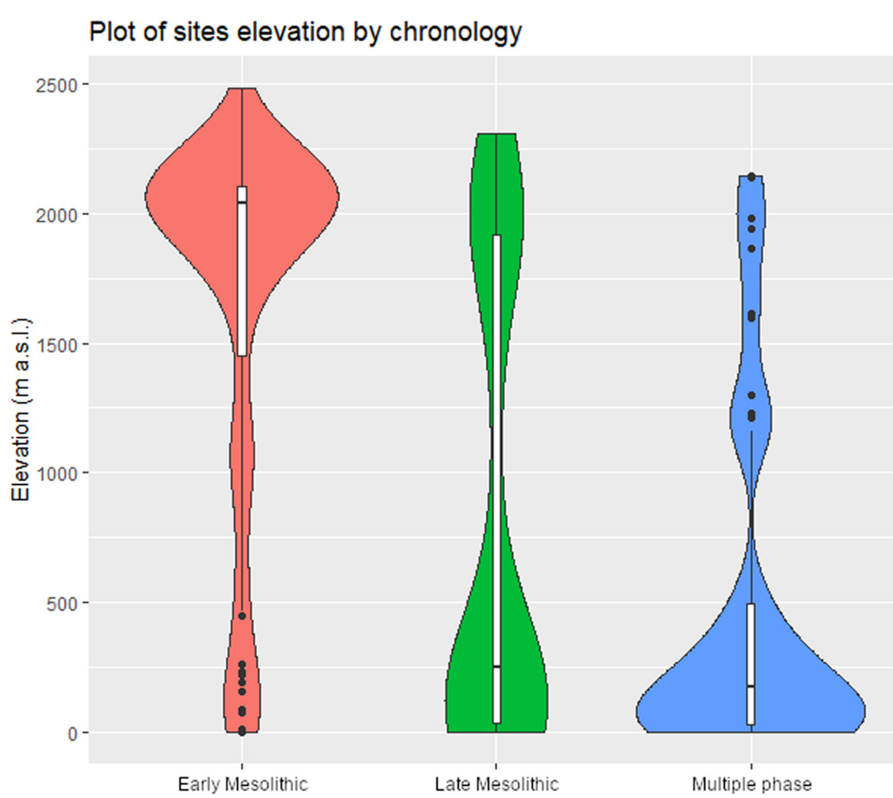

Figure 2: Violin plots showing the vertical distribution of the sites divided by chronology.

Kompatscher, & Bassetti, 2020; Visentin et al., 2016b), with the latter generally located at lower altitudes. Nonetheless, current evidence does not allow for statistically assessing this trend and determining if the lower altitude of Castelnovian sites is a general pattern or a feature related to specific contexts.

By looking at the general altitudinal distribution (Figure 2), significant differences are visible between the subgroups. Early Mesolithic sites are predominantly located within the uplands. The first-to-third quartile range indicates that 50% are located between 1,448 and 2,105 m a.s.l. with a median value of 2,038 m a.s.l. On the other hand, the Late Mesolithic ones have a more homogeneous distribution, spanning from 32 to 1918 m a.s.l. (1st–3rd quartile range) with a median value of 246 m a.s.l. Minimum and maximum values are comparable, respectively, 0–2,482 for Early Mesolithic and 0–2,309 for Late Mesolithic. Nonetheless, it must be specified that research activities may have played a significant role in the archaeological record's current distribution and cultural attribution. In the uplands, the absence of trapezes or elements presenting features typical of pressure or indirect percussion flaking within lithic scatters generally led to their interpretation as Early Mesolithic sites (cf. Visentin et al., 2016b). The presence of trapezoidal armatures, on the other hand, led to the attribution of many lowland sites to the Late Mesolithic. At the same time, a later comprehensive reassessment of the lithic assemblages indicated that both phases were attested (Fontana et al., 2016c). Moreover, it is not possible to exclude that some of the sites attributed to the Late Mesolithic may be referred to Early Neolithic occupations due to the continuity of traditions and the similar technical features of their respective assemblages (cf. Perrin, 2006).

From a chronological point of view (Figure 3), the appearance of lithic assemblages with marked Early Mesolithic features can be dated to the beginning of the Holocene (~9300 cal BC). The most recent dates for the Sauveterrian are those of Vatte di Zambana (layers 10 and 7), indicating a radiocarbon age of around 7000–6500 cal BC. During this time span, other sites such as Laghetti del Crestoso (structures F9, F10; Baroni & Biagi, 1997) and Romagnano Loc III (Layer AB2-1; Broglio & Kozlowski, 1984) indicate the appearance of Late Mesolithic assemblages. Although current evidence does not allow us to go further and define better the boundary between the two phases, what seems clear is that starting from around 6500 Cal BC, the whole region is inhabited by groups characterised by Late Mesolithic lithic technical traditions. The Castelnovian lasted for about a thousand years when the first evidence of neolithisation in the area appeared (Pedrotti et al., 2015).

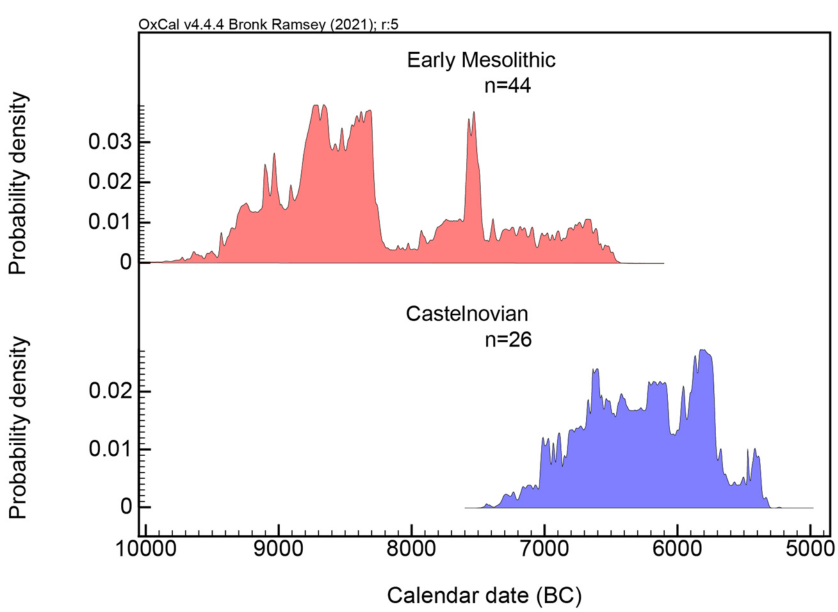

Figure 3: Summed probability density of Early Mesolithic (Sauveterrian) and Late Mesolithic (Castelnovian) radiocarbon evidence.

3 Exploitation of Faunal Resources

Data analysis on the exploitation of faunal resources in the region is made difficult by multiple problems, such as the different protocols of analysis applied by research groups (i.e. zooarchaeological counting units and analysis of mortality profiles) and the diverse chronological divisions adopted. Moreover, the faunal assemblages from some of the sites used for our synthesis are currently under study, and the same occurs for other sites that are not included here (i.e. Mezzocorona Borgonuovo and Dos de la Forca di Mezzocorona). The sites that have returned faunal data and which have been taken into consideration are as follows (Table 2): two upland sites placed under rock boulders (Mondeval de Sora and Plan de Frea), a rock-shelter (Cogola) at mid-altitude and seven valley-bottom sites in the Adige valley, six of which are rock-shelters (Galgenbühel, Pradestel, Vatte di Zambana, Gaban, Romagnano, Soman) and one is open air (La Vela). One rock-shelter in the Natisone valley was also included (Riparo Biarzo).

Throughout the Mesolithic of the studied region, a progressive change in the spectrum of exploited faunal species is attested. This trend, which started with the Late Epigravettian, consists of an increased variability of the hunted species and a change in their associations (Fiore & Tagliacozzo, 2005a). Thus, the spectrum of species expands through time, especially freshwater ones (Boscato & Sala, 1980; Clark, 2000; Wierer et al., 2018). This is evident in the valley-bottom sites, while high altitudes show a more limited range of species. Several factors are responsible for that, such as the low number of upland sites with significant faunal remains, the size of the investigated deposits and their preservation.

Table 2: Sites considered in the zooarchaeological study: site typology, chronology and reference publication

Site	Type of site	Chronology	Publications
Plan de Frea (BZ)	Under rock boulders	Middle Preboreal Sauveterrian; transition Preboreal-Boreal	Angelucci et al., 2001
Mondeval de Sora (BL)	Under rock boulders	Early Sauveterrian	Thun Hohenstein, Turrini, Guerreschi, & Fontana, 2016b
Riparo Cogola (TN)	Rock-shelter	Epigravettian-Sauveterrian transition; Sauveterrian	Fiore & Tagliacozzo, 2005b
Galgenbühel (BZ)	Rock-shelter	Five phases of the Sauveterrian	Bazzanella, Betti, & Wierer, 2007; Crezzini, Boschin, Boscato, & Wierer, 2014; Wierer, Betti, Gala, Tagliacozzo, & Boscato, 2016; Wierer & Boscato 2006; Wierer et al. 2018
Riparo Pradestel (TN)	Rock-shelter	Middle Preboreal Sauveterrian, middle Boreal Sauveterrian, recent-final Sauveterrian; early Castelnovian, recent Castelnovian	Boscato & Sala, 1980; Clark, 2000
Vatte di Zambana (TN)	Rock-shelter	Final Sauveterrian	Boscato & Sala, 1980; Clark, 2000
Romagnano Loc III (TN)	Rock-shelter	Middle Preboreal Sauveterrian, transition Preboreal Boreal, middle Boreal Sauveterrian, recent-final Sauveterrian; early Castelnovian, recent Castelnovian	Boscato & Sala, 1980; Clark, 2000
Riparo Gaban (TN)	Rock-shelter	Sauveterrian; Castelnovian Castelnovian	Koszlowski & Dalmeri, 2002 Thun Hohenstein, Bertolini, Valverde, Dalmeri, & Pedrotti, 2016a
La Vela (TN)	Open air	Middle-recent Sauveterrian; early Castelnovian	Bazzanella, 2002
Riparo Soman (VR)	Rock-shelter	Epigravettian-Sauveterrian transition; early Sauveterrian, recent Sauveterrian	Tagliacozzo & Cassoli, 1993
Riparo Biarzo (UD)	Rock-shelter	Sauveterrian; Castelnovian	Bertolini, Cristiani, Modolo, Visentini, & Romandini, 2016; Rowley-Conwy, 1996

Table 3: Quantity of remains and determined remains of the analysed Mesolithic faunal assemblages*

Site	Quantity of remains	NR. determined remains	Zooarchaeological analyses carried out and considered indexes
Plan de Frea (BZ)	797	205	NISP; NMI; anatomical elements (for red deer and ibex); mortality profiles
Mondeval de Sora (BL)	116,762	997	NISP; NMI; NME (for red deer and ibex); eNE (for red deer and ibex); MNE/eNE (for red deer and ibex); anatomical elements (for red deer and ibex); mortality profiles; remains distributions; taphonomical analisys
Riparo Cogola (TN)	7,518	205	NMI; anatomical elements (for ibex); MNE/eNE (for ibex and red deer); mortality profiles; taphonomical analisys
Galgenbühel (BZ)	more than 10,000 mammals fragments; 9,200 fishes remains ND; 598 birds remains ND	853 mammals; 6,387 fishes; 373 birds	NISP (for mammals and birds); NMI; anatomical elements; mortality profiles; taphonomical analysis (only for the cats and the birds); seasonality; analysis of edible freshwater molluscs
Riparo Pradestel (TN)	—	1,029	NISP; anatomical elements; (currently under zooarchaeological revision)
Vatte di Zambana (TN)	—	192	NISP; anatomical elements; (currently under zooarchaeological revision)
Romagnano Loc (TN)	—	1,228	NISP; anatomical elements; (currently under zooarchaeological revision)
Riparo Gaban (TN)	7,671 [archaeological excavations 1982–1983 (Koszlowski & Dalmeri, 2002)]	997 (archaeological excavations 1982–1983)	NISP; taphonomical analysis
	1,287 [archaeological excavations 1970s (Thun Hohenstein et al., 2016a)]	989 (archaeological excavations 1970)	NISP; anatomical elements; mortality profiles; taphonomical analysis
La Vela (TN)	221	146	—
Riapro Soman (VR)	—	426	NMI; mortality profiles
Riparo Biarzo (UD)	? (Rowley-Conwy, 1996); 25,370 (Bertolini et al., 2016)	972 (Rowley-Conwy, 1996); 719 (Bertolini et al., 2016)	NISP, NMI, MAU; NISP; NMI; seasonality (Rowley-Conwy, 1996); anatomical elements (for wild boar and red deer); mortality profiles; taphonomical analysis; analysis of edible freshwater molluscs (Bertolini et al., 2016)

*The zooarchaeological studies carried out for each site are also indicated; for the description of the indexes, see Gifford-Gonzales (2018).

Regarding upland sites, faunal data are only available for the Sauveterrian period. These sites are scarce of remains (Table 3, Figure 4, and Table A1). Although Mondeval de Sora has about a thousand determined faunal remains, their number is still insufficient to develop reliable statistical considerations. In this site, as in Plan de Frea, where fewer remains are preserved, a predominance of red deer and ibex is recorded. Other taxa such as chamois, roe deer and hare are sporadic (Angelucci et al., 2001; Thun Hohenstein et al., 2016b).

Looking at the Adige valley, numerous sites have yielded good zooarchaeological documentation (Table 3, Figure 4, and Table A1). The most significant one for paleoenvironmental and seasonality reconstructions during the Sauveterrian is Galgenbühel. This site is the most recently excavated one and has the most reliable and detailed chronology, although shorter than the one from the other sites in the same valley. Beaver is the best-represented species associated with wild boar; the role of fish and other

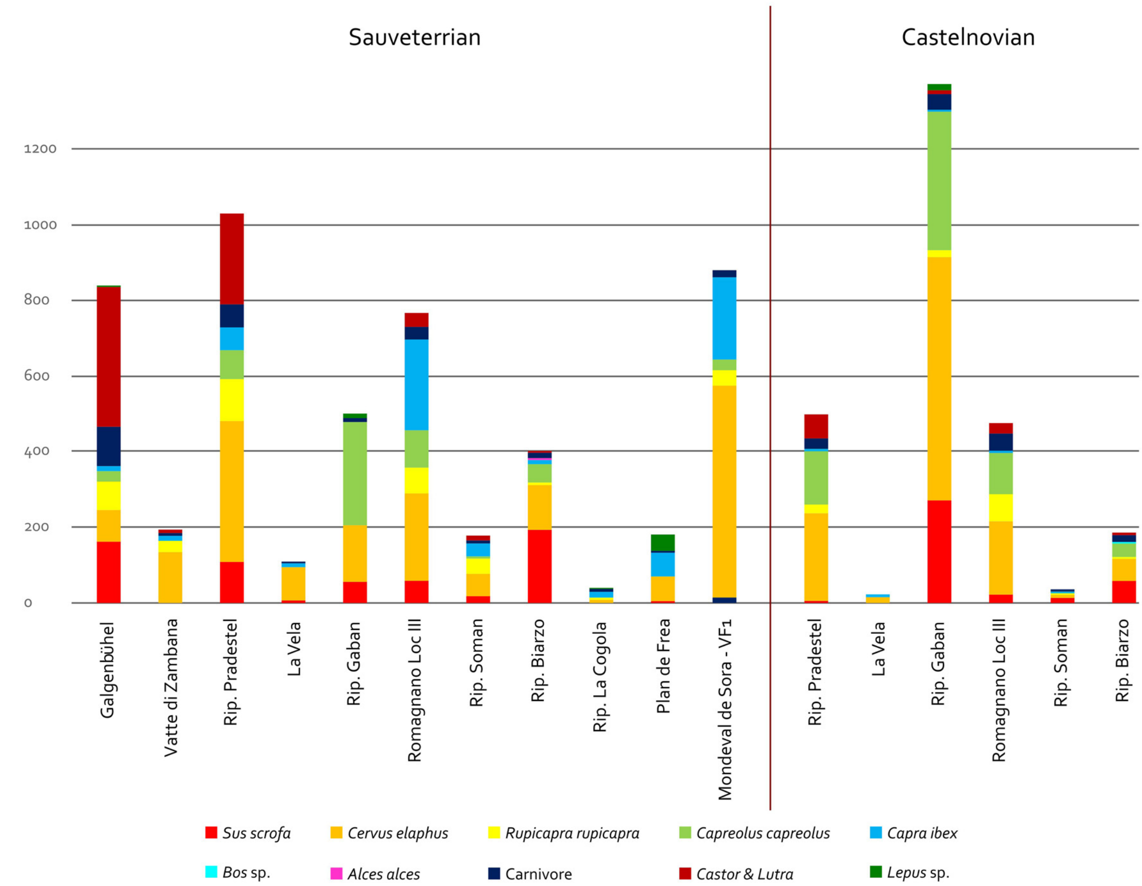

Figure 4: Sauveterrian and Castelnovian faunal remains from northeastern Italy. The histograms show the ratios between the determined findings for the studied sites. Regarding Gaban, it was decided to merge the data obtained from Koszlowski and Dalmeri (2002) with those of Thun Hohenstein et al. (2016a) as these two works have considered different sectors.

freshwater species is relevant (Wierer et al., 2018). Thanks to studies of fish remains, site seasonality has been reconstructed, indicating occupation in spring and summer along with autumn. In addition to ungulates, wild cats are attested mostly in relation to fur exploitation (Crezzini et al., 2014). The other Adige valley-bottom sites show red deer as one of the best-represented species, associated with ibex and chamois at Soman and Vatte di Zambana, ibex at Romagnano, roe deer at Gaban and chamois at La Vela. The faunal association of Pradestel is more varied. Red deer is associated with beaver, chamois, roe deer and wild boar. Carnivores and lagomorphs are present but not abundant in all the sites.

Despite the favourable habitat of the valley bottom, wild boar is consistently present only at Pradestel. Unlike the other sites, hare remains are present at Gaban, although they are only marginally represented. Furthermore, Gaban is the site that best documents the Late Mesolithic. The most evident pattern that characterises the Castelnovian at Gaban is the decrease of ibex and the predominance of roe deer. At Biarzo, wild boar dominates over red deer throughout the Sauveterrian period, while the two species are almost equivalent in the Castelnovian.

4 Lithic Raw Materials Supply

Lithic raw material supply systems have been widely investigated for the Sauveterrian, while fewer data are available for the Castelnovian. For a long time, a raw material mobility pattern that relates the pre-alpine area to the inner Dolomites, following the main valley systems that cross the region north to south (Adige, Brenta, Piave, Tagliamento), has been highlighted for the Sauveterrian (Broglio, 1994; Wierer & Bertola, 2016). In this vast area, a regionalisation process has also been recognised. To the west, the sites distributed along the Adige-Isarco valleys feature local raw materials belonging to geological formations palaeogeographically attributed to the western Trento Plateau. The Maiolica, Scaglia Variegata Alpina and Scaglia Rossa cherts represent the best quality types and the most intensively exploited ones. These cherts had a wide circulation along the valley and crossed the Alps as they have also been identified in the Early Mesolithic Ullafelsen site (Sellrain, Innsbruck) (Bertola, 2011; Bertola, Fontana, & Schaefer, 2020). Further east, the sites of the Belluno-Friuli Dolomites yielded good-quality cherts belonging to the Belluno-Carnian basin (Peresani & Bertola, 2010; Visentin, Bertola, Ziggiotti, & Peresani, 2016a), which are distributed along the Belluno and Friulian pre-Alps. These are associated with local raw materials of lower quality (mainly Triassic Buchenstein cherts). In both areas, the innermost mountain sites, which lay 60–100 km far from the pre-Alpine chert provisioning areas, testify to the intensive exploitation of the local rock crystal as complementary raw material (Bagolini, Broglio, & Lunz, 1983; Broglio & Lunz, 1983; Kompatscher et al., 2016).

Mondeval de Sora is possibly the only site in the region for which detailed data on Late Mesolithic lithic raw materials are available. Here, the Castelnovian lithic raw materials differ significantly from the Sauveterrian ones (Figure 5). This was highlighted through a detailed analysis aimed at identifying the micropalaeontological content of the cherts for a chrono-stratigraphic identification of the formations of origin and the textural features for the reconstruction of the palaeogeography of the sedimentary basins.

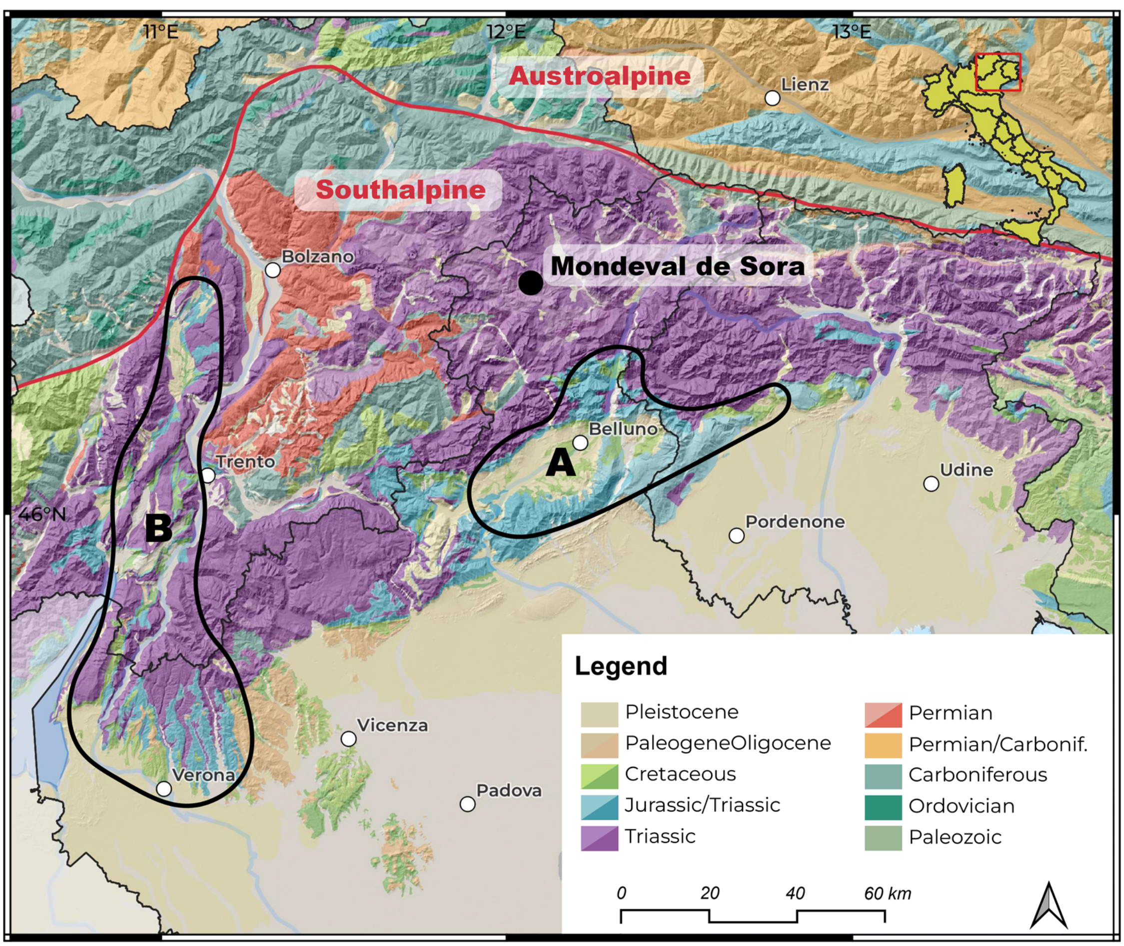

Figure 5: Main chert provisioning areas identified at the site of Mondeval de Sora. Sauveterrian (A): Belluno-Friulian Pre-Alps; Castelnovian (B): Trento-Venetian Pre-Alps (map data from: http://www.europe-geology.eu/EGDI-GE-1M-SURFACE and https://doi.org/10.13127/TINITALY/1.0).

Although most of the items from the Late Mesolithic are affected by a white patina, it was possible to assess a radical change in the provisioning areas with respect to the Early Mesolithic (Fontana et al., 2009). For the most recent period, the majority of the chert types come from the Adige valley, particularly from the outcrops of the Non Valley and the Baldo/Lessini area. Moreover, other provisioning sources are likely located in the Folgaria-Asiago areas, where good Maiolica cherts are abundant (Bertola & Cusinato, 2005). This pattern significantly differs from the Early Mesolithic one, where most provisioning occurred within the Piave valley.

Moreover, the rich Late Mesolithic burial context from the same site also yielded some exceptional lithic artefacts such as blades, tools and bladelet cores made on very characteristic rounded small pebbles whose provenance can be traced in alluvial deposits of the high Friulan plain (Fontana & Ferrari, 2020). This assemblage, thus, highlights a quite vast provisioning area with cherts primarily introduced from the rich pre-Alpine belt, spanning from the Adige valley to the Tagliamento (150 km east-west). The chert sources lie within a radius of around 100 km from the site. To the southwest, the most distant sources are represented by the high-quality Maiolica and Scaglia Variegata Alpina cherts of the Lessini/Baldo area. From the southeast come the characteristic Plio-Pleistocene alluvial rounded and pedogenised cherty pebbles distributed in the high Friulan plain.

The Sauveterrian raw material exploitation patterns appear more flexible and opportunistic, mainly addressed to optimising the available lithic resources with fewer technical constraints. The Castelnovian assemblage indicates that most chert types were supplied within the Adige valley system and reflect a break with respect to the Sauveterrian layers where cherts from the Piave valley were used together with local varieties. What is evident is an enlargement of the provisioning areas in favour of the quality of the exploited cherts, thus highlighting a more complex raw material network in the Late Mesolithic.

5 Lithic Technology

The best-known long sequence to investigate Mesolithic lithic technology in northeastern Italy is Romagnano Loc III, where both the Sauveterrian and Castelnovian are attested, each represented by different archaeological layers (Flor, Fontana, & Peresani, 2011; Fontana et al., 2016a). Other sites (i.e. Mondeval de Sora, Galgenbuhel, Casera Lissandri 17, Cima XII, Grottina dei Covoloni del Broion) have yielded relevant data for the Early Mesolithic (Broglio, De Stefani, & Peresani, 2006; Fontana et al., 2009; Valletta, Fontana, Bertola, & Guerreschi, 2016; Visentin et al. 2016a; Visentin, 2018; Wierer, 2008) while for the Castelnovian, the primary complementary information has been obtained from the analysis of the lithic burial goods of Mondeval de Sora (Fontana, Guerreschi, Bertola, Briois, & Ziggiotti, 2016b; Fontana et al., 2020). Moreover, a recent study of lithic assemblages from occupation layers of the same site (SU 36) has confirmed the trends observed in the burial goods assemblage (unpublished data). However, these layers appear severely affected by post-depositional disturbance. At a general level, the Sauveterrian is better known than the Castelnvovian.

5.1 Reduction Sequences

Sauveterrian reduction sequences aim to produce a wide range of products of small size spanning from irregular lamellar blanks (bladelets and elongated flakes) to flakes. Larger lamellar blanks and blades are rarely attested (Figure 6).

Two main reduction sequences are known: the first one started from the production of large laminar blanks (length >40–50 mm), followed by lamellar ones after core reorientation/platform rejuvenation; the second reduction sequence – which is by far the most diffused one – depended upon the use of smaller raw material supports (including thick flakes deriving from the first reduction sequence) and was aimed at the production of small blanks (length <40 mm, median values around 20–25 mm). This second scheme was

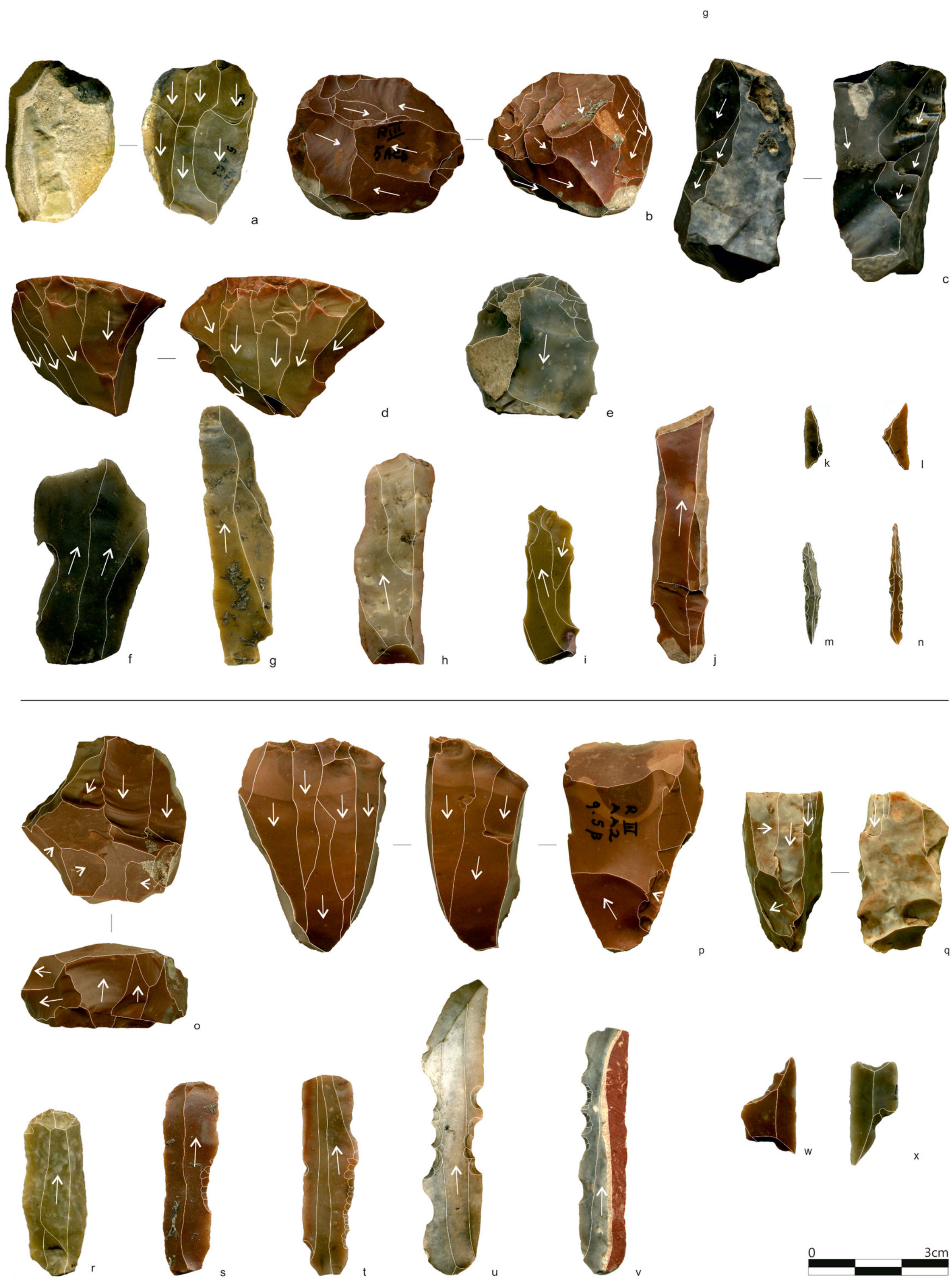

Figure 6: Romagnano Loc III rock shelter: selection of lithic artefacts from the Sauveterrian layers AF-AE, AC9-1 (a – facial exploitation, b – peripheral exploitation, c – on-edge exploitation, d – semi-tournant exploitation, e – endscraper, f–j – débitage products, k, l – triangles, m, n – double backed points) and the Castelnovian layers AB3-1 and AA2-1 (o – facial exploitation, p – semi-tournant exploitation, q – on edge exploitation, r – endscraper, s, t – retouched bladelets, u, v – retouched blades, w, x – trapezes).

executed by applying three different methods: (1) starting from the natural edges of small blocks/thick flakes (production of thicker bladelets); (2) starting from slightly convex surfaces/natural crests of nodules/blocks (production of thin and elongated blanks); and (3) starting from the ventral faces of thick flakes (production of small, thin flakes and laminar flakes). In all the methods, knapping proceeded unidirectionally, either with facial or *semi-tournant* exploitation. Intensive exploitation frequently involved core reorientation either on the same (peripheral scheme) or new surfaces (multidirectional scheme).

Castelnovian reduction sequences highlight a break in the objectives of production, which are mainly aimed at obtaining regular and highly standardised lamellar blanks (lengths mostly included between 20 and 50 mm; width 11 ± 2 mm), while the production of blades is sporadic and that of flakes is primarily related to the final stages of cores reduction (Figure 6). For bladelets production, frontal/facial reduction is the most frequently applied method associated with edge extraction, both schemes potentially evolving into a *semi-tournant* exploitation. As it is well known, the regularity of such production was favoured by the introduction of new techniques, namely pressure and indirect percussion. To this concern, the knapped lithic implements accompanying the burial of Mondeval de Sora highlight a clear pattern: bladelets were extracted by pressure and blades by punch technique. Blades represent a highly reserved production, rarely documented in habitation contexts (Fontana et al., 2016b, 2020).

Besides such differences, common technical procedures have been observed between the Early and the Late Mesolithic, namely: the absence of core preparation with production starting either from natural convex surfaces/natural crests; the intensive exploitation of cores, involving a shift to the use of direct percussion for the extraction of laminar flakes/flakes in the final stages of core exploitation in the Castelnovian; and the use of the bipolar technique for even more exhaustive exploitation. Another relevant topic concerns the continuity of Sauveterrian-like reduction sequences in the Castelnovian (such as peripheral exploitation for flake production and bladelets production with direct percussion). In the sequence of Romagnano Loc III, the Castelnovian is represented by two main layers: AB and AA, divided into three and two artificial "cuts", respectively. The lower cut (AB3) was considered by excavators as partially reworked (Broglio & Kozlowski, 1984). Analysis of lamellar blanks and cores from these layers shows a progressive increase in the number of lamellar blanks obtained by indirect percussion/pressure against those knapped by direct percussion (Fontana et al., 2016a).

5.2 Blanks Transformation

Sauveterrian and Castelnovian systems also diverge from the viewpoint of blank transformation, especially as far as armature manufacturing is concerned (Figure 6). Nonetheless, in both phases, the microburin technique is widely attested. Generally speaking, Sauveterrian systems involve a marked process of blank transformation. In most cases, at least one edge is entirely transformed by retouch, while the length is reduced (triangles, crescents, backed and truncated bladelets); in other cases, the original shape of the blank is entirely transformed by abrupt retouch (double-backed bi-points, cf. Sauveterre) (Figure 7, nos. 19–21, 29–31). Blank selection includes thickness as a feature discriminating the production of triangles from that of backed points, cf. Sauveterre, and especially double-backed ones (Flor et al., 2011). The latter type is preferably obtained from thicker bladelets (ca. 2 mm) and sometimes on the transversal portions of flakes (Fontana & Guerreschi, 2009). Backed and truncated bladelets, which are rarely attested, are realised on the most regular bladelets (Figure 7, nos. 1–6).

The production of the most characterising Castelnovian armatures, represented by different types of trapezes, involves the creation of two opposite truncations. At the same time, the lateral margins of the original blanks remain unchanged. The techniques of trapeze manufacturing include truncations realised by an abrupt retouch, truncations obtained with the microburin technique (presence of *piquant-trièdre*) and truncations realised by a single blow creating a notch. A recent study has highlighted an increase throughout the stratigraphic sequence of Romagnano of truncations with *piquant-trièdre* as opposed to truncations created by a notch (Fontana et al., in preparation) (Figure 8). This pattern also influenced the

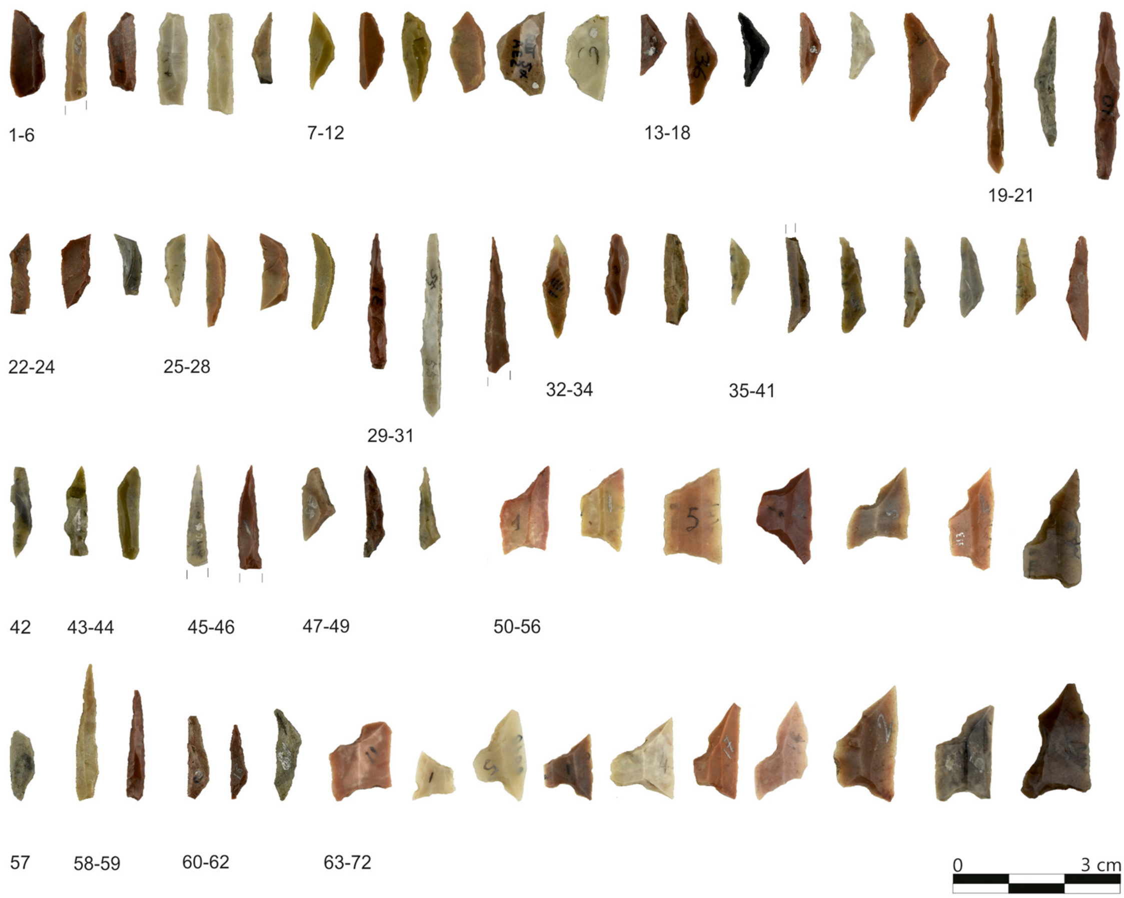

Figure 7: Romagnano Loc III rock-shelter: selection of lithic armatures from Ancient Sauveterrian, layers AF–AE (1–6 backed and truncated bladelets, 7–12 crescents, 13–17 isoscele triangles) and AC8–AC7 (18 triangle, 19–21 double backed points, cf. Sauveterre), Recent Sauveterrian, layers AC2–AC1 (22–24 backed and truncated bladelets, 25–28 crescents, 29–31 double backed points, cf. Sauveterre, 32–34 backed points, 35–41 scalene triangles), Early Castelnovian, layers AB2–AB1 (42 crescent, 43–44 backed and truncated bladelets, 45–46 double backed points, 47–49 triangles, 50–56 trapezes) and Late Castelnovian, layers AA2–AA1 (57 crescent, 58–59 double backed points, cf. Sauveterre, 60–62 triangles, 63–72 trapezes). Trapezes are displayed according to G.E.E.M. typological list (1969): 50: asymmetric; 51–52, 64: short symmetric; 53, 65–67: symmetric with concave truncations; 54–56, 68–72: trapèze de Montclus; 63: trapeze with décalées bases.

morphology of trapezes. Thus, asymmetric and symmetric types with retouched or mixed truncations dominate the bottom layers (AB3–AB2). Starting from layer AB1, symmetric (isosceles) types with two concave truncations and very asymmetric ones with a truncation obtained through the microburin technique and the other by a single blow (cf. trapeze de Montclus) progressively increase and become dominant in layer AA (Figure 7, no. 50–56; 64–72). Short rhomboid types are constantly present throughout the sequence, although with few elements (Figure 7, no. 63). Concerning tools manufacture, the main innovation of Castelnovian assemblages is related to the diffusion of denticulated bladelets (Montbani type) (Figure 6, u,v).

In the sequence of Romagnano, the appearance of trapezes is recorded in layer AB3. However, in this layer, Sauveterrian types dominate, especially triangles followed by double-backed points (cf. Sauveterre). The following layers (AB2-1 and AA) are marked by a clear increase in the number of trapezoidal armatures, while Sauveterrian types become rare (Figure 8, no. 42–49, 57–62).

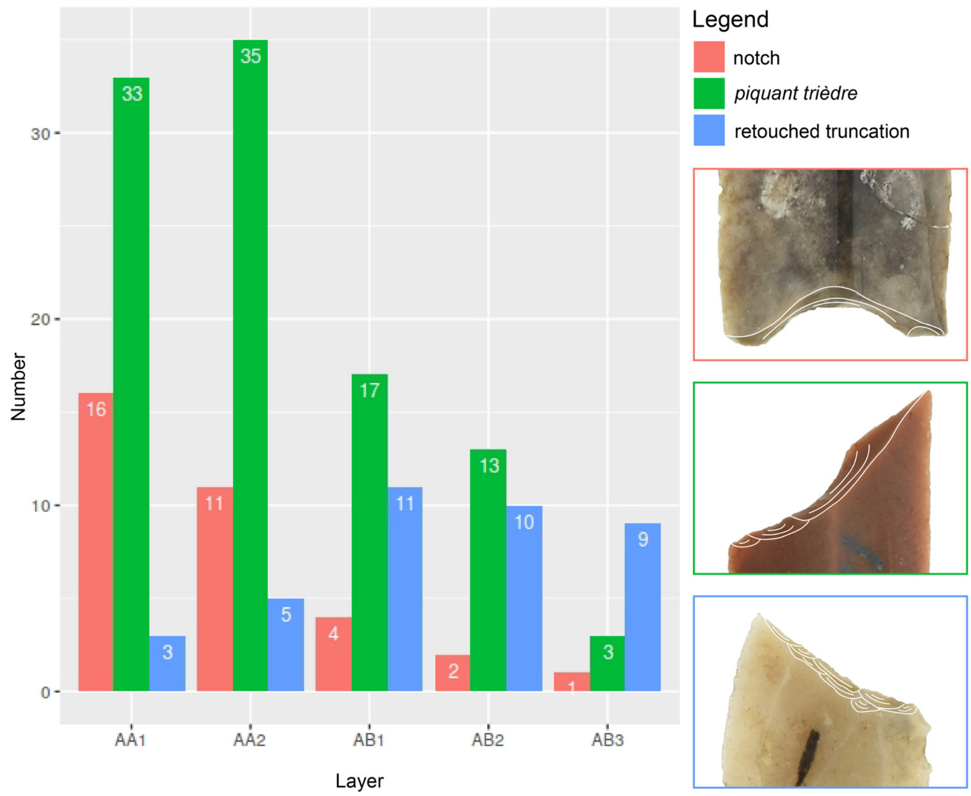

Figure 8: Changes in the modality of shaping the trapeze truncations throughout the Romagnano Loc III sequence (AB3 is the oldest Late Mesolithic level, AA1 is the latest one).

6 Osseous Technology and Ornamental Beads

In northeastern Italy, osseous technology has been well documented since the Late Epigravettian. The site of Riparo Dalmeri in the Venetian Prealps yielded a rich bone and antler industry mainly characterised by pointed tools (points and awls), which testify to the use of artefacts of hard animal tissues in hunting and domestic activities (Cristiani, 2018). Osseous pointed tools continue to be used in the region during the Mesolithic, and their presence is well documented at the site of Riparo Pradestel in the Adige Valley. Besides points and awls, Mesolithic osseous technology is characterised by the introduction of a significant innovation, i.e. barbed points. Harpoons, in particular, spread by the 9th millennium cal. BC, at the end of the Sauveterrian, in the Adige Valley, the southern Dolomites, the Julian Alps and the Alpine region (Cristiani & Boric, 2020) (Figure 9).

A total of 15 complete and fragmentary tools were found in the Late Sauveterrian and the Castelnovian levels of the site of Romagnano Loc III (n = 4), Riparo Pradestel (n = 5), Riparo Gaban (n = 4) and Doss de la Forca. One entire specimen comes from the burial of Mondeval de Sora in the Southern Dolomites, while another two fragments were recovered at the site of Riparo Biarzo and Cladrecis in the Julian Alps (Cristiani & Boric, 2020). So far, no direct dates are available for these artefacts. Their chrono-cultural attribution has been based on the material culture found in association with them or by dating charcoals preserved in the layers harpoon technology was recovered. The attribution of the harpoon from the burial of Mondeval de Sora to the Castelnovian was obtained by dating the buried individual (Fontana et al., 2020). Overall, the harpoons have all been recovered in layers attributed to the end of the Sauveterrian and the Castelnovian.

Typologically, specimens from the eastern Alpine region are defined as “bilateral harpoons with straight barbs and basal bilateral gorge” (Averbouh et al., 1995) and bevelled bases. These weapons

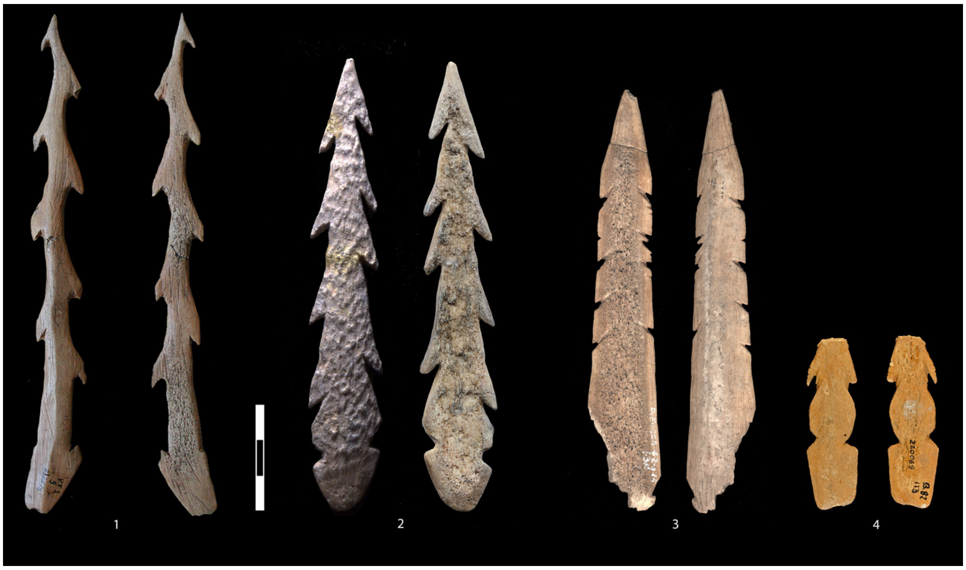

Figure 9: Selections of Mesolithic harpoons found in the northeastern Alpine region (0.8×): (1) Mondeval de Sora; (2) Romagnano Loc III; (3) Dos de la Forca; and (4) Cladrecis.

were produced on regular blanks extracted from long bones or deer antlers by longitudinal grooving. Lateral barbs were created by deep oblique incision and transversal lateral sawing, while gorges and bevel bases were successively carved by lateral chiselling and/or sawing. Surfaces were later regularised by scraping with a lithic cutting edge. A recent analysis of use-wear traces has revealed that all Mesolithic harpoons from the northeastern region of Italy show traces of prolonged use as detachable-head harpoons. Barbs are often missing, possibly damaged while extracting the weapon from the animal's carcass, while their surfaces are well-rounded (Cristiani & Boric, 2020). Moreover, rounding, compression marks, macro-scars and modifications of the outline of the bases suggest that these parts were fixed to the shaft and retained with a line.

Based on their technological features and production modalities, a common technological tradition characterises the production of harpoons between the end of the Sauveterrian and the Castelnovian. Detachable-head harpoons represented a critical technological innovation for successfully adapting to mountainous landscapes rich in freshwater resources. During the Boreal, an increase in fish remains reflects an intensification in the exploitation of aquatic resources in northeastern Italy and the Adige Valley. Namely, numerous ichthyic remains were found at Riparo Pradestel (Albertini comm. pers. 2009), Riparo Biarzo (Rowley-Conwy, 1996) and Galgenbuhel/Dos de la Forca (Bazzanella et al., 2007). A systematic analysis of the ichthyofauna from the latter site allowed the identification of the remains of pike (*Esox lucius*), Cyprinidae such as rudd (*Scardinius erythrophthalmus*) and roach (*Rutilus erythrophthalmus*). Specialised fishing of pike (*E. lucius*) is documented in the most recent phases of the occupation of this site (Bazzanella & Wierer, 2001; Bazzanella et al., 2007; Wierer & Boscato, 2006). Pike's vertebrae, as well as those of other freshwater fish species, were also used as ornaments during the Mesolithic in the eastern Alpine region (Dalmeri, Grimaldi, & Lanzinger, 2001).

Overall, information about ornamental beads in northeastern Italy comes from old excavations (especially from the rock shelters in the Adige valley) when no systematic sieving techniques were applied (Figure 10; Table A2). Throughout the Mesolithic, marine gastropod shells, namely *Columbella rustica*, were the most diffused ornamental elements used by Mesolithic forager communities of northern-eastern Italy (Cristiani, 2021). However, a different number of perforated shells have been recovered in the Sauveterrian and Castelnovian layers, which could indicate a change in the symbolic role of such gastropods throughout time. During the Castelnovian, we observe the disappearance of *Tritia neritea* and *Dentalium* shells along with the persistence of freshwater gastropod shells (*Lythogliphus naticoides* and *Theodoxus*

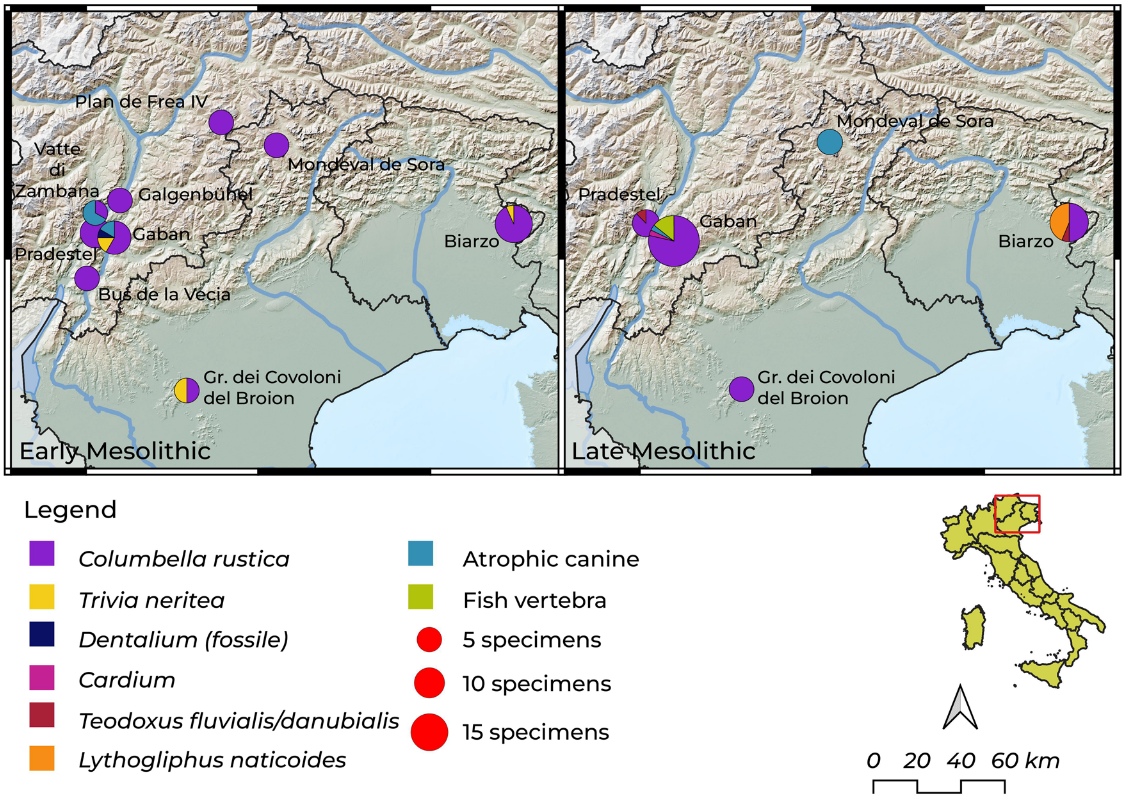

Figure 10: Distribution of ornamental beads in Early and Late Mesolithic contexts of northeastern Italy.

danubialis) (Cristiani, 2021). Among the hard animal materials, red deer atrophic canines, so characteristic of previous Late Epigravettian ornamental tradition, continue to hold a special place in the Mesolithic symbolic vocabulary. The retrieval of various perforated canines in the burial goods of Mondeval de Sora certainly hints at their role in the construction of social identity of Castelnovian groups (Fontana et al., 2020).

7 Burial Rituals

Only three burials are attested in the region. The burials of Vatte di Zambana and Borgonuovo di Mezzocorona in the Adige valley-bottom are attributed to adult females and referred to the Early Mesolithic (Corrain, Graziati, & Leonardi, 1976; Dalmeri, Mottes, & Nicolis, 2002). The individual of Vatte is dated to the final phase of the Sauveterrian (KIA-12442: 7943 ± 46 BP, 7036–6690 cal BC, 95.4%, Dalmeri et al., 2002). Although radiocarbon dates place the individual from Mezzocorona in the transition phase between the Late Mesolithic and Early Neolithic, an Early Mesolithic attribution has been proposed based on the stratigraphic position of the burial pit and the type of ritual (Dalmeri et al., 2002). The third burial is of an adult male about 40 years old from Mondeval de Sora, in the Belluno Dolomites (2,150 m a.s.l.) and is dated to the Late Mesolithic (Fontana et al., 2016b, 2020). All three individuals were in elongated burial pits covered with stones. The two females had no associated grave goods except for some traces of ochre, but an accumulation of chosen faunal remains was identified outside the burial structure of Borgonuovo, to the east of the skull (SU 151). These consisted of a deer antler and a few deer mandibles with traces of reddish colour, interpreted as probably associated with the burial rite (Corrain et al., 1976; Dalmeri et al., 2002).

On the other hand, the individual of Mondeval de Sora was accompanied by rich grave goods amounting to 60 items, while a small patch of red ochre was identified near the right hand (Fontana et al., 2016b, 2020). The typology of the objects and their position in relation to the individual point to a role in the funerary ritual. Seven pierced atrophic canines were recovered in the upper part of the body. One awl was found on the sternum and another between the knees, while three blades were identified above the shoulders and below the head. Lastly, three groups of various objects (grave assemblages I, II and III) were present along the left side of the body. These included lithic flaked artefacts, limestone/dolomite pebbles, osseous artefacts and two lumps of organic substances (respectively made of propolis and resins from pines and spruce). An AMS radiocarbon date from the individual's remains (OxA-7468) yielded a result of 6429–6121 cal BC (7425 ± 55 BP, 95.4%).

8 Discussion and Conclusions

Northeastern Italy is a geographically varied region with a large flat area, the Venetian-Friulian plain and a vast diversified mountain zone, the south-eastern Alps. Over the last 50 years, this territory has yielded rich Mesolithic evidence, which offers promising perspectives for reconstructing human occupation over this time (Broglio, 2016). In this article, we have analysed this record by comparing updated data of the Early and Late Mesolithic to highlight elements of continuity and discontinuity and thus contribute to the debate on the transition between these two periods from a regional perspective.

The quantity and quality of the evidence related to game exploitation contribute to tracing a rather reliable paleoenvironmental reconstruction while yielding clues on some aspects of the groups' subsistence. A great variety of species can be observed. Valley-bottom sites display the most comprehensive spectra, including species related to humid environments (beaver, fish, shells) that reflect the presence of lakes and dump areas. Ungulates also play a relevant role. Among the latter, a progressive decrease in ibex across time is recorded, along with an increase in red deer. The latter species becomes more and more significant also at highland sites. Nonetheless, red deer is replaced in some valley-bottom sites, as the main species, by roe deer and wild boar. Altogether this evidence matches the increased density of forests during the Boreal and the Atlantic, as also attested by palynological studies (Cattani, 1994; Drescher-Schneider, 2009). Such conditions must have favoured the spread of forest-adapted species while reducing the distribution of those typical of Alpine grasslands, such as the ibex and chamois.

Concerning site distribution and settlement strategies, available data highlight a substantial continuity during the Early and Late phases of the Mesolithic. At a general level, the same territories seem to have been occupied and the same ecological niches exploited. These include plain areas near the present coastline, the transition zone between the high and low plain and the Alpine area with its different altitudinal stages (from the foothills and valleys to uplands). A similar pattern showing continuity of occupations was previously observed also in the Emilian area, encompassing the Southern Po Plain and Northern Apennines (Ferrari & Fontana, 2016; Fontana, Ferrari, & Visentin, 2013). Differences in the geographical distribution of the sites are thus essentially quantitative, although it is still unclear how much research biases influence this pattern. Two of the most problematic issues are: (1) the cultural attribution of the sites, which, for surface lithic scatters, is exclusively based on the techno-typological features of lithic assemblages and (2) the shorter chronological depth of the Late Mesolithic (ca. 6700–5000 cal BC) with respect to the Early Mesolithic (ca. 9500–6.700 cal BC). Moreover, natural and anthropic agents could be responsible for erosive processes, which may have affected mostly Castenovian occupations, where both phases are attested, considering their higher position in stratigraphic sequences.

Data on lithic raw material provisioning strategies are still insufficient for advancing definitive considerations, especially for the Late Mesolithic. Nonetheless, the first results obtained at Mondeval de Sora show striking changes between the two Mesolithic phases. During the Early phase, raw materials exploited at this upland site indicate a strong connection with the Piave valley bottom. Seasonal mobility is thought to have developed preferentially along this river basin. This pattern is also well known from other sites of the south-eastern Alps and was proposed in the 1980s by Broglio for the Adige river basin (Broglio, 2016). Conversely, during the Late Mesolithic, a wider provisioning area is attested, spanning eastwards from the Adige river basin (around 100 km as the crow flies to the southwest) to the Friulian plain westwards. This enlargement of the provisioning territory of Late Mesolithic groups has been proposed to be related to the selection of higher quality cherts as a consequence of the adoption of more sophisticated techniques, i.e. punch percussion and pressure (Fontana et al., 2020).

Lithic technology is the best-known aspect of the Mesolithic in the region, showing marked differences between the two phases as well as elements of continuity. Sauveterrian technology persisted through time during the Late Mesolithic, as highlighted by the stratigraphic sequence of Romagnano Loc III, where the opportunistic use of direct percussion and bipolar flaking, especially in the final phases of core reduction, is documented in the Castelnovian layers (Fontana et al., 2016a). Patterns related to bladelet production and arrowhead manufacturing at Romagnano Loc III indicate the beginning of the Late Mesolithic in correspondence to the formation of layer AB, at the bottom of the Castelnovian sequence, where the first trapezoidal armatures appear along with the production of more regular bladelets by the use of new knapping techniques. In the same sequence, trapeze manufacturing techniques reflect a possible change between layers AB and AA while the presence of Sauveterrian microliths decreases over time (Fontana et al., in preparation). Also, open-air sites show the persistence of the typical Sauveterrian microliths during the Castelnovian (i.e. Pian della Lora, Franco, 2016).

Differences between these two phases are less evident from the viewpoint of osseous technology. Points and awls characterise the production of both periods. However, barbed points and harpoons spread in northeastern Italy towards the end of the Sauveterrian. By the end of the 9th millennium cal BC, these new hunting tools represented a key technological innovation for a successful adaptation to mountainous landscapes rich in freshwater resources (Cristiani & Boric, 2020), as also attested by faunal evidence and isotopic data (Bazzanella et al., 2007; Gazzoni et al., 2021). Apparently, data related to ornamental traditions do not seem to highlight any significant change, except for the disappearance of some shell types that were attested since the Late Epigravettian (Cristiani, 2021).

Burials are rare, and the one found at the site of Mondeval de Sora is exceptional for its preservation state. The funerary ritual documented at this site highlights features that follow the previous Late Palaeolithic tradition, while others reflect the technical innovations of the Late Mesolithic. The deposition of a set of tools on the left side of the buried individual recalls the Late Epigravettian toolkit of Villabruna burial, which is also referred to as a male individual. At the same time, three blades occupying a prominent position (on the shoulders and under the head) seem to revitalise a symbolism lost during the Late Palaeolithic and Early Mesolithic. It has been suggested that this symbolism is connected to the adoption of sophisticated knapping techniques in the Late Mesolithic, allowing the production of large and regular blades on high-quality cherts. Namely, such elements could either represent an attribute related to sex, as suggested by a continuity in the association of blades to male individuals during the Neolithic in Northern Italy, or hint at the peculiar role of this man as a flint-knapper, as the presence of two antler tines used in flint knapping (as either punch or pressors) could also indicate. Notwithstanding the meaning of this gesture, the rituality documented by this burial indicates that the technological transformations of the Late Mesolithic also involved the social organisation and symbolic world of human groups (Fontana et al., 2020).

Despite the preliminary nature of this study, it seems possible to propose that the Mesolithic of this region, spanning around 3500–4000 years, was a dynamic period characterised by several elements of innovation, primarily in the technology of the last hunter-gatherer groups, but also affecting their mobility, rituality and social organisation. Despite the wideness and heterogeneity of the discussed territory, the main archaeological data that allow carrying out considerations on the changes of this period come from the Alpine area thanks to the higher visibility and good preservation of the prehistoric record. Some technological innovations, namely the spread of harpoons starting from the Late Boreal, appear to have a macroregional origin and to be related to the peculiar environmental conditions of the Alpine and Balkan areas. As previously stated, the appearance of this tool seems to be related to the increased exploitation of freshwater resources. Nonetheless, the major innovations during the transition between the Early and Late

Mesolithic at the beginning of the Atlantic corresponded to the diffusion of the new lithic technologies. For northeastern Italy, there are no data allowing to trace the origin of such changes. The available evidence shows that innovations originated outside this region and were progressively incorporated into previous cultural traditions, as highlighted by the persistence in the use of some technical procedures and the continuity and progressive disappearance of Early Mesolithic lithic technologies. Continuity is also highlighted by the osseous equipment and settlement choices. Nonetheless, the potential intensification of occupation across plain areas and the extension of raw material provisioning territories in the Late Mesolithic suggest increased logistic mobility (Fontana, 2006). Furthermore, the evidence from the burial of Mondeval de Sora indicates that the technological innovations of this period affected the rituality and social organisation of Mesolithic groups (Fontana et al., 2020).

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Appendix

Table A1: Frequency of animal species in the considered faunal assemblages

Site		*Sus scrofa*		*Capreolus capreolus*		*Cervus elaphus*		*Rupicapra rupicapra*		*Capra ibex*		Carnivore		*Castor* + *Lutra*		*Lepus* sp.		Other		Total
		n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	
Sauveterrian	Biarzo	194	48.6	51	12.8	118	29.6	6	1.5	10	2.5	12	3.0	2	0.5	—	—	6	1.5	399
	Gaban	56	11.2	273	54.6	149	29.8	—	—		0.0	10	2.0	—	—	—	—	12	2.4	500
	Galgenbuhel	161	19.2	29	3.5	86	10.3	74	8.8	13	1.6	102	12.2	369	44.0	4	0.5	—	—	838
	La Vela	1	0.6	—	—	96	60.8	17	10.8	8	5.1	4	2.5	—	—	—	—	32	20.3	158
	Mondeval de Sora	14	1.6	26	2.9	561	63.6	42	4.8	218	24.7	19	2.2	—	—	—	—	2	0.2	882
	Plan de Frea IV	1	0.6	—	—	70	39.3	—	—	62	34.8	4	2.2	—	—	41	23.0	—	—	178
	Pradestel	109	10.6	80	7.8	372	36.2	109	10.6	60	5.8	57	5.5	242	23.5	—	—	—	—	1,029
	Romagnano Loc III	58	7.6	99	12.9	231	30.2	69	9.0	240	31.4	31	4.1	37	4.8	—	—	—	—	765
	Soman	18	10.0	8	4.4	59	32.8	40	22.2	35	19.4	6	3.3	—	—	—	—	14	7.8	180
Castelnovian	Biarzo	58	32.0	36	19.9	60	33.1	4	2.2		0.0	19	10.5	1	0.6	—	—	3	1.7	181
	Gaban	270	19.8	366	26.8	641	46.9	12	0.9	12	0.9	37	2.7	—	—	—	—	28	2.0	1,366
	La Vela	1	3.3	—	—	18	60.0	—	—	3	10.0	—	—	—	—	—	—	8	26.7	30
	Pradestel	6	1.2	141	28.4	234	47.1	22	4.4	2	0.4	30	6.0	62	12.5	—	—	—	—	497
	Romagnano Loc III	23	4.9	108	22.8	194	41.0	71	15.0	7	1.5	44	9.3	26	5.5	—	—	—	—	473
	Soman	13	40.6	2	6.3	10	31.3	2	6.3	4	12.5	1	3.1	—	—	—	—	—	—	32
Tot. Sauveterrian		612	12.4	566	11.5	1,742	35.3	357	7.2	646	13.1	245	5.0	650	13.2	45	0.9	66	1.3	4,929
Tot. Castelnovian		371	14.4	653	25.3	1,157	44.9	111	4.3	28	1.1	131	5.1	89	3.5	—	—	39	1.5	2,579

Table A2: Frequency of ornamental objects by site

	Site	*Columbella rustica*		*Trivia neritea*		*Dentalium* (fossile)		*Cardium*		*Teodoxus fluvialis/ danubialis*		*Lythogliphus naticoides*		Atrophic canine		Fish vertebra		Total
		n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	
Sauveterrian	Bus de la Vecia	1	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
	Galgenbuhel	2	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2
	Grottina dei Covoloni del Broion	1	50.0	1	50.0	–	–	–	–	–	–	–	–	–	–	–	–	2
	Mondeval de Sora – VF1	1	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
	Plan de Frea IV	1	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
	Prà Comun – PC1	–	–	–	–	–	–	–	–	–	–	1	100.0	–	–	–	–	1
	Riparo di Biarzo	14	93.3	1	6.7	–	–	–	–	–	–	–	–	–	–	–	–	15
	Riparo Gaban	7	58.3	2	16.7	1	8.3	–	–	–	–	–	–	2	16.7	–	–	12
	Riparo Pradestel	10	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10
	Vatte di Zambana	1	33.3	–	–	–	–	–	–	–	–	–	–	2	66.7	–	–	3
Castelnovian	Grottina dei Covoloni del Broion	3	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3
	Mondeval de Sora – VF1	–	–	–	–	–	–	–	–	–	–	–	–	7	100.0	–	–	7
	Riparo di Biarzo	7	87.5	–	–	–	–	–	–	1	12.5	–	–	–	–	–	–	8
	Riparo Gaban	8	50.0	–	–	–	–	–	–	1	6.3	7	43.8	–	–	–	–	16
	Riparo Pradestel	22	78.6	–	–	–	–	1	3.6	–	–	–	–	1	3.6	4	14.3	28
Tot. Sauveterrian		38	79.2	4	8.3	1	2.1	–	–	–	–	1	2.1	4	8.3	–	–	48
Tot. Castelnovian		40	64.5	–	–	–	–	1	1.6	2	3.2	7	11.3	8	12.9	4	6.5	62