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Abstract

The arrival of Modern Humans (MHs) in Europe between 50 ka and 39 ka coincides with significant changes in human behaviour, notably regarding the production of tools, the exploitation of resources and the systematic use of ornaments and colouring substances. The emergence of the so-called modern behaviour is usually associated with MHs, although claims of symbolic thinking in non-MH groups have been advanced in past decades. In this paper, we present a synthesis of the Italian evidence concerning bone tool manufacturing and the use of ornaments and pigments in the time span encompassing the replacement of Neandertals by MHs. Current data show that Mousterian bone tools were mostly obtained from bone fragments used "as is". Conversely an organized production of "finely shaped" bone tools is characteristic of the Uluzzian and the Protoaurignacian, and the complexity inherent in the manufacturing processes suggests that bone artefacts are not to be considered expedient. Some traces of symbolic activities are associated with Neandertals in northern Italy. Ornaments (mostly tusk shells) and pigments used for decorative purposes are well recorded during the Uluzzian. Their features and distribution suggest an intriguing cultural homogeneity within this technocomplex. The Protoaurignacian is characterized by a wider range of archaeological evidence, consisting of personal ornaments (mostly pierced gastropods), pigments and engraved items.

Keywords

Italy, Mousterian, Uluzzian, Protoaurignacian, bone tool, ornament

1.Introduction

The dispersal of Modern Humans (MHs) in Europe between 50 ka and 39 ka BP and the concomitant disappearance of Neandertal populations are central to the emergence/diffusion of the so-called "modern human behaviour" that has usually been associated with "advanced" cognitive and technological skills. Concepts like "behavioural modernity", "symbolic thinking", and others like these are particularly sensitive topics, especially in the context of the Middle-Upper

Palaeolithic transition, where different human species with most probably different (though not inherently necessarily inferior or superior) cognitive characteristics and social structures are involved. We agree with other scholars (Eren et al., 2013 and references therein; see also session A21a-Neanderthals on their own terms: new perspectives for the study of Middle Palaeolithic behaviour by Chacón M.G. and Rivals F. of the XVII World UISPP Congress Burgos, 1-7 September 2014) in questioning the utility of indistinctly applying these notions, in a comparative way, to extremely varied realities (cognitively, geographically, climatically, environmentally, chronologically). Indeed, since notions like "modernity" and "symbolism" (and their degrees of expression) are relative and abstract concepts, they are risky foundations for objective scientific comparison (Henshilwood and Marean, 2003; Nowell, 2010; Shea, 2011; Ames et al., 2013; Burdukiewicz, 2014; Moro Abadía and Nowell, 2015). This premise is all the more necessary as our paper focuses on some categories of archaeological materials (i.e. bone tools, ornaments, colouring substances and other non-utilitarian artefacts) displaying a suite of attributes that are often considered as indicators of behavioural modernity for their innovative characteristics (Mc Brearty and Brooks, 2000). While an in-depth consideration of what constitutes “modern human behaviour” falls beyond the scope of this paper, we use here common terminology with no direct implications for the link between symbolic thinking/modern behaviour on the one hand and the use of ornaments and non-utilitarian objects in general on the other. In other words, we do not equate the simple presence of ornaments and non-utilitarian objects as markers of symbolic thinking/modern behaviour.

Among technological innovations, however, bone tool manufacture appears to have been a pivotal element in outlining what is commonly defined "behavioural modernity", as it entails the occurrence of complex technical skills that make possible the creation of a multi-stepped technical system. Complex bone technologies allow the manufacture of functional implements by means of anticipation of tasks expressly tailored to working hard animal tissues, such as scraping, grinding, grooving and polishing (Mellars, 1973; Klein, 1999).

Artistic evidence, ornaments, and the use of pigments play a major role in defining "modern behaviour" because of the symbolic value they have at least since the Early Upper Palaeolithic (Vanaheren and d’Errico, 2006; Stiner et al., 2013). From an archaeological perspective, the systematic use of personal ornaments and pigments (possibly also connected to body painting) is a proxy from which a number of behavioural characteristics, involving social relationships within a group (in terms of age, gender, social status etc.) and ethnic identity, can be assumed.

Bone tool manufacturing first emerges in Africa during the Middle Stone Age (Brooks et al., 1995; Yellen, 1998; McBrearty and Brooks, 2000; Henshilwood et al., 2001; Jacobs et al., 2006 and 2008; d’Errico and Henshilwood, 2007; d’Errico et al., 2012a) where it dates back to between ≃90-60 ka.

There are claims for very early evidence of symbolic thinking reported from Indonesia (geometric engravings ca. 500 ka BP - Joordens et al., 2015), eastern Africa (colouring substances 300- 260 ka BP - Brooks et al., 2018), Morocco, and Israel (possible stone figurines - 500-233 ka BP - Goren-Inbar, 1986; Kuckenburg, 2001). However, a true florescence of symbolic activities (ornaments, pigments, engravings), is first witnessed among MHs in Africa and the Levant between 135 and 70 ka BP (Vanhaeren et al., 2006 and 2013; d’Errico et al., 2008 and 2009; Bar-Yosef Mayer et al.,

2009), and they become widespread in the Upper Palaeolithic. In Europe, findings suggesting complex thinking in Neandertal groups have been claimed (e.g. Zilhão et al., 2010; Soressi et al., 2013), however the large-scale expression of these so-called "modern behaviours" is usually associated with the arrival of Modern Humans during the Middle to Upper Palaeolithic transition.

This paper is intended as a the most up-do-date bibliographic review of the evidence for bone tool production, ornament use and the creation of other material evidence of possible symbolic thinking (i.e. colouring substances and engraved items) during the Middle to Upper Palaeolithic transition in Italy namely the period corresponding to the intermediate phases of MIS3 (Table 1 and Fig.1; details on the chronology of sites dating to MIS3 in Italy can be found in Marciani et al., in this special issue). In this review, we also attempt to reconcile and match data from the literature that have offered often quite disparate degrees of information as a result of the age of publications, research traditions, and the content, level (preliminary, exhaustive etc.) and applied methodologies of the studies. Furthermore, our review does not aim to reassess the evidence, but more modestly to provide a complete overview of the published data. For this reason, in our description of the archaeological finds (bone tools, ornaments, etc.), we rely on the nomenclature used in published papers.

Despite these limits, such a comprehensive overview can be of great help in addressing future research on the transitional period in Italy. This is because the Italian peninsula plays a key role in the understanding of the dynamics that drove the shift from Neandertals to MHs, thanks to the presence of a several Late Mousterian, transitional and Early Upper Palaeolithic sites located in markedly different settings (Badino et al. and Romandini et al., in this special issue). Moreover, Southern Italy (Grotta del Cavallo – Benazzi et al., 2011) has arguably yielded the earliest evidence of MHs in Mediterranean Europe, offering an ideal starting point from which to begin investigations into this critical chapter of recent human evolution. While some authors have questioned the integrity of Grotta del Cavallo stratigraphic sequence (Zilhão et al., 2015), its reliability has been recently validated by Moroni and colleagues (2018) and reaffirmed by Zanchetta et al. (2018). This allows us to discuss the Italian evidence in the context of the coeval European record, to highlight those elements which reflect changes or continuities in human behaviour.

Tab. 1: List of Italian sites (corresponding to Fig. 1) that have yielded osseous tools, ornaments, pigments and other non-utilitarian evidence with MIS3 human occupations. Short names of the sites discussed in the paper are in brackets.

Techno-complex	Site	Layers	Osseous tools	Pigments	Ornaments	Other non-utilitarian evidence
	Grotta di Rio Secco (Rio Secco)	8, 7 base/5 5, 5 top	•		•	
	Grotta Maggiore di S.	II	•			

Mousterian (ca. 50-42 ka cal. BP)	Bernardino (S. Bernardino)					
	Riparo Tagliente (Tagliente)	37, 36, 35	•			
	Grotta di Fumane (Fumane)	A9, A5+A6, A6	•	•	•	
	Riparo Bombrini (Bombrini)	MS		•		
	Grotta Reali (Reali)	5	•			
	Grotta di Castelcivita (Castelcivita)	lower rsi	•			
	Riparo l'Oscurusciuto (Oscurusciuto)	4	•			
	Grotta del Cavallo (Cavallo)	FIII-Fa				?
Uluzzian (ca.45-40 ka cal BP)	Riparo Broion (Broion)	1g, 1f	•	•	•	•
	Grotta di Fumane	A3	•			
	Grotta La Fabbrica (La Fabbrica)	2	•			
	Grotta di Castelcivita	upper rsi, rpi, rsa"	•		•	
	Grotta della Cala (Cala)	14	•		•	
	Grotta del Cavallo	EIII, EII-I, DII, DI	•	•	•	
Protourignacian (ca.42-36 ka cal BP)	Grotta di Fumane	A2, A1	•	•	•	•
	Riparo Mochi (Mochi)	G	•	•	•	•
	Riparo Bombrini	A3, A2, A1	•	•	•	•
	Grotta di Castelcivita	rsa', gic, ars	•		•	
	Grotta della Cala	13,12,11,10	•		•	
	Grotta Paglicci (Paglicci)	24	•			

	Grotta di Serra Cicora A (Serra Cicora A)	B	•	•		

2. Bone tools

2.1 The Late Mousterian

Bone tools are mainly represented by the so-called "retouchers", usually diaphysis fragments used without any modification to retouch stone tools. Although bone fragments defined as retouchers (Giacobini and Pathou-Matis, 2002) occurred previously (i.e., for instance, at Grotta de Nadale - Jéquier et al., 2015- and Grotta Ghiacciaia - Bertola et al., 1999; Thun Hohenstein et al., 2018), they are much more frequent during MIS3 at the end of the Mousterian, especially in northern sites (Table 2). Grotta di Fumane (ex-Grotta Solinas) and Riparo Tagliente (Monti Lessini) have yielded the most abundant evidence. In the very Late Mousterian of Fumane, most of the over 200 bone retouchers were made on ungulate bones (mainly *Megaceros* sp.), and only occasionally on those of bear and ibex (Jéquier et al., 2012 and 2018). Tibiae and femora were the preferred anatomical portions, but metapodials, phalanxes and, exceptionally, canines were also used (Fig. 2).
Riparo Tagliente (Monti Lessini) (layers 37, 36, 35) has yielded a total of 75 bone retouchers (Leonardi, 1979; Thun Hohenstein et al., 2018), of which 63 have a certain stratigraphic provenance. Long bone diaphyses of red deer are the most exploited raw material, but aurochs/bison and elk bones are also documented. In the lowermost layers, the exploitation of smaller-sized animals such as roe deer and chamois for retouchers is recorded as well. Metapodials, tibiae, humeri, radi and femora along with a phalanx and a rib were selected for retouchers. At Rio Secco (Pradis Plateau) (layers 8, 7base/5, 5, 5 top), six retouchers on bone fragments from large mammals (one of which probably an elk, and another four bear) were recovered (Peresani et al., 2014a and Romandini et al., 2018). Three bone retouchers have been reported also at Grotta Maggiore di San Bernardino (Colli Berici) (layer II) (Malerba and Giacobini, 1996).

In Southern Italy there is little evidence of bone retouchers as such implements were found only at Grotta Reali (Molise) (layer 5) (Thun Hohenstein and Bertolini, 2012) and at Riparo L'Oscurusciuto (Apulia) (layer 4). Two of the three retouchers found at Reali were obtained from long bone diaphyses while the other was made on red deer metapodial. At the Oscurusciuto rockshelter, two retouchers (unpublished) were obtained from large-sized ungulates. As the research stands now, it is unclear why retouchers in southern sites should be so scarce. The frequent presence of concretions on bones in most southern sites may be one potential reason why percussion traces are not easily identifiable.

Exceptionally, a "hammer" made from a red deer antler was found at Grotta di Castelcivita (Campania) (layer lower rsi) (Gambassini, 1997), and a jaw fragment (probably of an auroch) with striations has been recovered at Grotta Breuil (Latium) (layer 7) (Alhaique et al., 2006).

Furthermore, a retouched bone shaft was retrieved in the Late Mousterian layers of Grotta Fumane (dated to 45-44 ka cal BP) (Romandini et al., 2014a).

Finally, some so-called "points" from Mousterian layers (Mussi, 1990) were found at Riparo Mochi, Grotta del Broion, Grotta Bernardini (Apulia) and Grotta di Serra Cicora (Apulia); however, no analytical data are available for these artefacts, so distinguishing whether anthropic or taphonomic agents were responsible for their modification remains an open question, and they are therefore excluded from further consideration here.

Table 2: Taxonomical attribution of the retouchers recovered in Late Mousterian (<50ka) sites in Italy (compiled after: Malerba and Giacobini, 1996; Thun Hohenstein and Bertolini, 2012; Peresani et al., 2014a; Jéquier et al., 2018; Romandini et al., 2018; Thun Hohenstein et al., 2018).

	Fumane	**Tagliente**	**Rio Secco**	**S. Bernardino**	**Reali**	**Oscurusciuto**	**Total**
Ursus arctos	1		4				5
Ursus sp.	1						1
Cervus elaphus	106	7			1		114
Alces alces	1	3					4
Megaloceros giganteus	13						13
Cervidae	25						25
Bison priscus	2						2
Bos/Bison	1	3					4
Bos-or *Equus.*						2	2
Rupicapra rupicapra	4	1					5
Capra ibex	2						2
Capreolus capreolus	3	1					4
Ungulata	1	48					49
Unid. big size			2		2		4
Unid.	87			3			90
Total	**247**	**63**	**6**	**3**	**3**	**2**	**324**

2.2 The Uluzzian

Uluzzian bone technology displays substantial changes with respect to the Late Mousterian, especially due to the emergence of formal tools. The technological process by which bone tools were produced appears to be part of a tradition shared by all Uluzzian groups in Italy, with the exception of those from Fumane (Tables 3 and 4). This process entails obtaining awls and cylindrical or conical elements, from specific anatomical parts, like metapodials of red deer and fibulae and metapodials of horse.

The Uluzzian deposits that have yielded the most bone tools are in Southern Italy. At Grotta del Cavallo (Apulia) (layers EIII, EII-I and D) eight specimens (Fig. 3, 1-8), mostly awls or fragmentary awls, were recovered (Palma di Cesnola, 1966; d'Errico et al., 2012b). Grotta di

Castelcivita (Campania) (layers upper rsi, rpi and rsa") yielded six pieces: four awls (Fig. 3, 10,11, 14), a fragment of a point (Fig. 3, 12) and a double pointed element (Fig.3, 13), interpreted as a straight-hook (d'Errico et al., 2012b). A single awl (Fig. 3, 9) has been found at Grotta della Cala (d'Errico et al., 2012b) (layer 14), while a single specimen (Fig. 3, 15) is known from Central Italy, at Grotta La Fabbrica (Tuscany) (layer 2) (Pitti et al., 1976; Villa et al., 2018), which shows a coating of ochre at its base and other residue traces along its shaft. Villa et al. (2018) draw a parallel between this object and the ochred bone tools of the Still Bay phase from Blombos Cave (Henshilwood et al., 2001; Henshilwood, 2012).

According to d'Errico and colleagues (2012b), Uluzzian bone tools were produced using at least three different technique steps: regularizing by scraping the end of naturally pointed elements; modifying by scraping thin lengthened shaft fragments; and shaping elongated epidiaphyseal fragments by scraping. The same authors argue that these implements were utilized to perforate a range of materials from relatively hard, like thick leather at Cavallo and La Cala, to soft, like skin, furs and vegetal substances at Castelcivita. Additionally, a single bone splintered piece was also recovered at Grotta del Cavallo (Borgia et al., 2017).

In Northern Italy, Riparo Broion (layer 1g) has yielded four artefacts: two awls, a tip fragment of a pointed tool and a probable needle (Fig. 3, 16-19) The *ad hoc* exploitation of naturally pointed anatomical elements (like the distal end of the ulna, or even the natural pointed end of the vestigial metapodials) and their subsequent shaping by mean of a lithic tool is attested at least for two of these implements. The other tools, obtained from unidentified skeletal portions, were shaped by longitudinal scraping. *Lustre* aspects were identified on three pointed tools, nevertheless a specific functional study was not carried out (Peresani et al., 2019a).

The Uluzzian bone tool assemblage from Fumane (layer A3) includes a basal part of an awl (Fig. 3, 20) and a worked bone piece (Fig. 3, 21). Unlike the rest of the Uluzzian bone tools, the skeletal portions exploited at Fumane are exclusively ribs (Peresani et al., 2016). The awl was obtained by longitudinally incising and splitting a medium-large mammal bone and later shaping its distal active end by scraping. Use-wear analysis suggests this tool was used for perforating ochred leather (Peresani et al., 2016). The second worked object is made from the mid-lateral posterior rib portion of a medium-large mammal, with one side shaped by scraping with the aim to obtain a bevelled edge. At Fumane the use of bone retouchers (eight) is documented also during the Uluzzian (Jéquier et al., 2012).

Table 3: Archaeozoological classification of the Uluzzian bone tools recovered in Italy (compiled after: d'Errico et al., 2012b; Peresani et al., 2016; Villa et al., 2018; Peresani et al., 2019a).

		Broion	**Fumane**	**La Fabbrica**	**Castelcivita**	**Cala**	**Cavallo**
E. ferus	Metapodial			1	1		2
	Metatarsal						

	Fibula						1
C. elaphus	Metatarsal					1	2
Medium-large size mammals	Rib		2				
Unid.	Metatarsal						1
	Ulna/ Telemetapodial	2					
	Unidentified	2			5		2
Total		**4**	**2**	**1**	**6**	**1**	**8**

Table 4: Typological classification of the Uluzzian bone tools recovered in Italy (compiled after: d'Errico et al., 2012b; Peresani et al., 2016; Villa et al., 2018; Peresani et al., 2019a).

	Broion	**Fumane**	**La Fabbrica**	**Castelcivita**	**Cala**	**Cavallo**
Awls	3	1	1	2	1	7
Needles						1
Unidentified pointed tools	1	1		4		
Total	**4**	**2**	**1**	**6**	**1**	**8**

2.3 The Protoaurignacian

The Protoaurignacian shows a marked regional difference, with northern Italy having yielded a richer and typologically diverse record of bone artefacts, whilst the record is poor in southern Italy (Table 5).

In northern Italy, Grotta Fumane stands out for its conspicuous assemblage (Bertola et al., 2013) recovered in the oldest Protoaurignacian complex (layers A2 and A1), composed of points (mainly awls), often showing fractured ends due to use (Fig. 4. 9-10). These pieces were mainly obtained from cervid diaphyses (but in some cases also ribs). Manufacture involved only the shaping of the active part, according to a process called *poinçon d'économie* (Camps-Fabrer, 1990). Use-wear analysis suggests their use for piercing. Some specimens, displaying a very thin (diameter less than 5 mm) and elongated tip, were probably used as needles. A split-based point (Fig. 4.8) has been retrieved at the interface between layers A1 (Protoaurignacian) and D3 (Aurignacian *sensu lato*) (Bertola et al., 2013). Furthermore, several bone retouchers (34) and some *lissoirs* (2) were found (Jéquier, 2014; Jéquier et al., 2018).

Bone tools from Riparo Bombrini (layers A3-A1) (Liguria) comprise eight mostly fragmentary artefacts (Bertola et al., 2013; Holt et al., 2018). These include pointed pieces, needle tips and awls (Fig. 4. 1-7). A bevelled tool obtained from cervid antler previously ascribed to the Protoaurignacian and coming from a disturbed area, has been dated to the Epigravettian (Holt et al., 2018). The points were made on blanks obtained by indirect percussion, then shaped by scraping.

The presence of specific traces (rounding, flattening and transversal striations on mesial and proximal parts) on the base of a large pointed piece suggests that this tool was hafted.

Diaphyseal fragments obtained by direct percussion from long bones of large size ungulate were used as blanks for the awls, which were later regularized on the distal part only, like the ones from Fumane. The needles were obtained from elongated splinters that were carefully shaped by scraping all over the surface. Use–wear analysis indicates their use on hide (Holt et al., 2018).

Riparo Mochi (layer G) (Liguria) yielded seven pointed artefacts, including probable awls and needles (Kuhn and Stiner, 1992 and 1998). The presence of production by-products testifies to a local manufacturing of these tools. Another two antler split-based points originally ascribed to the Protoaurignacian (Kuhn and Stiner, 1992 and 1998), were recently reattributed to the Aurignacian (layer F) rather than the Protoaruginacian following a recent reassessment of their stratigraphic provenance (Tejero and Grimaldi, 2015).

Contrary to the north, bone implements are rare and scarcely diversified in Southern Italy, where the Uluzzian rather than the Protoaurignacian returned the majority of these artefacts (Riel-Salvatore and Negrino, 2009). Few Protoaurignacian specimens (Table 4) are documented at Grotta di Castelcivita (an awl from a metapodial of roe deer) (layer gic) (Gambassini, 1997), Grotta della Cala (four fragmentary bone points of which one is from a rib) (layers 13 and 12) (Benini et al., 1997; Fig. 4.13-16) and Grotta Paglicci (an awl made on a shaft fragment of a medium-large mammal) (layer 24) (Borgia et al., 2016; Fig. 4.12). A fragmented awl has been also recorded in the so-called "Uluzzo-Aurignaziano" of Serra Cicora A (layer B) (Spennato, 1981; Palma di Cesnola, 1993).

Table 5: Protoaurignacian bone tool kits (compiled after: Spennato, 1981; Benini et al., 1997; Gambassini, 1997; Kuhn and Stiner, 1998; Bertola et al., 2013; Jéquier, 2014; Tejero and Grimaldi, 2015; Borgia et al., 2016; Holt et al., 2018).

	Fumane	**Mochi**	**Bombrini**	**Castelcivita**	**Cala**	**Paglicci**	**Serra Cicora A**
Awls	23		4	1		1	1
Needles			2				
Unidentified pointed tools	19	7	1		3		
Lissoirs	2						
Bone retouchers	34						
Unidentified			1				
Total	**74**	**7**	**8**	**1**	**3**	**1**	**1**

3 Ornaments and other unusual objects

3.1 The Late Mousterian

The earliest evidence connected to symbolic behaviour can be found in the Late Mousterian. The exploitation of animal resources for ornamental purposes has been reported in the North, where eagle claws and raptor bones with cut-marks (Fig. 5), indicating the intentional removals of the claws themselves and of the flight (remex) feathers, were found at the caves of Rio Secco (Romandini et al., 2014b) and Fumane (layers A9, A5 and A6) (Peresani et al., 2011). Both the claws and the feathers have been interpreted by the authors as ornamental items. Layer A9 of Fumane, dated to 47.6 cal ka BP (minimum age), also yielded the only Italian Mousterian shell (Fig.5) interpreted as an exotic object, coloured with red ochre and suspended by a "thread" for visual display as a pendant (Peresani et al., 2013). This is a fossil *Aspa marginata* marine shell, probably collected in Miocene or Pliocene fossil outcrops located, at least, about one hundred kilometres south of the site.

To this, we can add a number of engraved bones and stones bearing linear signs. This is the case of several objects retrieved at Riparo Tagliente, Grotta S. Bernardino, Grotta di Fumane in Veneto which were described in old publications (Leonardi, 1975, 1980, 1981, 1983, 1988). Despite their unquestionably anthropogenic origin, there is no evidence that these engravings had any symbolic function (Peresani et al., 2014b). At Grotta Costantini (Liguria), a horse rib showing three groups of linear marks (Bachechi, 2001) has been reported as coming from the top of the Mousterian but it more likely is an intrusive Upper Palaeolithic artefact. In Central Italy, osseous objects with linear incisions are present in the Middle Palaeolithic contexts of Grotta di Gosto (Tuscany) (Tozzi, 1974 but see Moroni et al., 2019 for doubts on the chronology of this site) and Valle Radice (Latium) (Biddittu et al., 1967). In Southern Italy, Grotta del Cavallo (Martini et al., 2004) and Grotta dell'Alto (Borzatti von Löwestern and Magaldi, 1967) yielded four and two stones bearing incisions respectively, though again, a symbolic function for these remains has to be demonstrated.

Furthermore, several small ochre fragments have been recovered at Bombrini (MS levels), but given their association with concentration of faunal remains, we cannot rule some kind of functional as opposed to ritual/symbolic use for pigments (Riel-Salvatore et al., 2013).

3.2 The Uluzzian

In the Uluzzian the use of ornaments becomes systematic, thus revealing the emergence of a well-established decorative tradition. The use of shell beads, usually from tusk species (*Antalis* sp.), for ornamental purposes is common in Uluzzian sites (Table 6). Grotta del Cavallo yielded the largest ornamental assemblage (a few hundred), composed mainly of tusk shells, from the whole Uluzzian sequence (Fig. 6, 19-30) (layers EIII, EII-I, DII and DI). Gastropods are fewer in number and overall occur in the final phase (Palma di Cesnola, 1993) (Fig. 6, 17-18). Some fragmentary bivalves are also recorded. 78 marine shells along with a coral branch were found in the Uluzzian layer of Grotta della Cala (layer 14) (Ronchitelli et al., 2009), 24 of which were scaphopods and eight were perforated (six gastropods and two *Glycymeris nummaria* - syn. *G. insubrica*) (Fiocchi, 1998; Ronchitelli et al., 2009) (Fig. 6, 7-16). Several marine shells (gastropods and bivalves) are also documented in the Uluzzian of Castelcivita (layer rsa"), but none of them show any kind of

perforation (Gambassini, 1997). In the north, Riparo Broion (layers 1g and 1f) yielded five worn tusk beads and a pierced freshwater gastropod (*Theodoxus danubialis*) (Peresani et al., 2019a) (Fig. 6,1-6). Furthermore, this site has yielded a splintered flake with linear engravings on the cortical back (Peresani et al., 2019a), but the symbolic value of this evidence remains to be clarified. Engraved cortexes are documented since the Lower Palaeolithic, but their occurrence can be the result of varied utilitarian and/or non-utilitarian activities (Majkić et al., 2018a).

Colouring materials (lumps of ochre and limonite) were recovered at Grotta del Cavallo, Grotta Mario Bernardini (Palma di Cesnola, 1989) and Castelcivita (Gambassini, 1997). Some oxidized glomeruli were found at Grotta della Cala (Ronchitelli et al., 2009). Traces of ochre have been identified on two tusk beads from Riparo Broion (Peresani et al., 2019a) and on several stone tools from the whole Uluzzian package of Grotta del Cavallo (Moroni et al., 2018)

Table 6: Marine and freshwater shells (•) and shell beads (x) from Uluzzian sites (compiled after: Palma di Cesnola, 1993; Fiocchi, 1998; Ronchitelli et al., 2009, Peresani et al., 2019a). Classification and nomenclature used for molluscs is based on the systematics index of S.I.M. - Società Italiana di Malacologia (www.societaitalianadimalacologia.it) and WoRMS - World Register of Marine Species (www.marinespecies.org). * The revision of the ornamental shell assemblages from Grotta del Cavallo and Grotta della Cala is currently ongoing, therefore data presented here are based on previous publications.

Class	Family	Species	Cavallo*	Cala*	Broion	Total
Gastropoda	Unidentified			•		
	Archeogastropoda unidentified			•		
	Haliotidae	*Haliotis tuberculata lamellosa*		•		
	Trochidae	*Clanculus* sp.		•		
	Coloniidae	*Homalopoma sanguineum*		• x		
	Cerithiidae	Unidentified genus		•		
	Triviidae	*Trivia mediterranea* (syn: *T. pulex*)		•		
		Trivia sp.		•		
	Naticidae	cf. Naticidae Unidentified genus		•		
	Cassidae	*Galeodea echinophora*		•		
		cf. *Galeodea* sp.		•		
	Ceritithiopsidae	Unidentified genus		•		
	Nassaridae	*Tritia incrassata* (syn: *Nassarius incrassatus*)		•		
		*Tritia neritea (*syn: *Cyclope neritea)*	• x			
		Tritia pellucida (syn: *Cyclope pellucida*)		• x		

	Columbellidae	*Columbella rustica*	• x		
	Neritidae (Freshwater)	*Theodoxus danubialis*			• x
Bivalvia	Unidentified			•	
	Glycymerididae	*Glycymeris nummaria* (syn: *G. insubrica*)		•	
	Pectinidae	Pectinidae sp. Gen. unidentified		•	
		Pecten jacobeus		•	
	Veneridae	Veneridae unidentified (cfr. *Callista chione*)		•	
		Callista chione		•	
Scaphopoda	Dentaliidae	*Antalis dentalis/inaequicostata*	• x	• x	• x
		Antalis vulgaris	• x	• x	• x
		Antalis cfr. *vulgaris*		• x	
		Antalis sp.		• x	
	Fustiariidae	*Fustiaria rubescens*		• x	
Unidentified				•	

402
403
404 *3.3 The Protoaurignacian*

405 The Protoaurignacian is characterized by a wider range of personal adornments, mainly consisting
406 of marine shell beads (Tables 7 and 8). Compared to the Uluzzian, the number of recovered beads
407 increases markedly, as does the number of sites where they have been found (Riparo Mochi - layer
408 G-, Riparo Bombrini - layer A3-A1, Grotta di Fumane - layers A2 and A1-, Grotta della Cala -
409 layers 13-10 - and Grotta di Castelcivita - layers rsa", gic and ars) (Fig.7). Concerning Riparo
410 Mochi, it should to be stressed that the stratigraphic reassessment which involved bone tools and
411 non-shell ornaments, until now has not been extended to shell beads. Hence, the data here reported
412 for this site are based on available published reports.
413
414 Ornamental species mostly include gastropods (e.g. *Tritia* sp. and other Nassaridae, *Homalopoma*
415 *sanguineum* and Trochidae) and to a lesser extent, bivalves (e.g. *Glycymeris nummaria* and other
416 Glycymerididae). Tusk specimens are generally very rare. Shell assemblages from coastal sites
417 (Mochi, Bombrini, Cala) do not show any selective preference for particular species (Fiocchi,
418 1998), however a remarkable presence of *H. sanguineum* can be noted. At Fumane, which during
419 the Protoaurignacian was located about 200 km from the Tyrrhenian coast and 400 km from the
420 Adriatic one, there was, on the contrary, a selection in favour of externally red-coloured species:
421 *Homalopoma sanguineum*, *Clanculus corallinus* and *Clanculus cruciatus* (Peresani et al., 2019b).
422 Some authors have suggested an Adriatic provenance of these shells (Bertola et al., 2013). The taxa
423 spectrum of the ornamental shells of Fumane shows analogies with the Ligurian sites, supporting

evidence for contacts between the two areas. Furthermore, the use of fossilized belemnite fragments to produce pendants is documented at Bombrini (Bertola et al., 2013; Holt et al., 2018).

Interestingly, only seashells seem to have been used as ornaments in southern Italy, whereas, in the North, beads include examples made on hard animal tissue and stone. Teeth pendants have been recovered at Grotta di Fumane and stone ornaments occur at Bombrini (Fig. 7), where drilled and scraped soapstone beads have been recovered (Bertola et al., 2013; Holt et al., 2018). The provenance of the soapstone collected at Bombrini is almost certainly from the Apennine chain between Liguria and Emilia (Gernone and Maggi, 1998; Chella, 2002; Negrino et al., 2017; Holt et al., 2018). At Bombrini have been retrieved also bone pendants. They consist of three incised bird bone diaphysis resembling other Early Upper Palaeolithic bird bone tubular beads (Zilhão, 2007; Wright et al., 2014; White and Normand, 2015).

The non-shell ornaments from Mochi – three beads made on soapstone, resembling *craches* of red deer, two pendants made on fossil belemnite, an ivory basket-shaped bead and two teeth pendants – previously ascribed to the Protoaurignacian, have been recently attributed to the Early Aurignacian of Layer F (Tejero and Grimaldi, 2015).

Further evidence for non-utilitarian artefacts is extremely scant in the Protoaurignacian, where it is limited to northern Italy. This consists of notch and incision patterns on bones from Riparo Bombrini (the above-mentioned tubular beads), Riparo Mochi and Grotta di Fumane (Fig.7). Despite these patterns are very schematic and linear, a symbolic value could be assigned to this evidence, as the engraved motifs are arranged in a clear decorative way and their occurrence does not appear related to any functional activity. Ochre is well documented in the northern sites (Kuhn and Stiner, 1998; Bietti and Negrino, 2008; Cavallo et al., 2017) with evidence of heat treatment at Fumane (Cavallo et al., 2018).

Table 7: Presence of non-utilitarian items in Protoaurignacian sites of Italy.

	Fumane	**Bombrini**	**Mochi**	**Castelcivita**	**Cala**	**Serra Cicora A**
Shell ornaments	•	•	•	•	•	
Fossil shells (belemnite)		•				
Bone ornaments	•	•				
Stone ornaments		•				
Pigments	•	•	•			•
Incised objects	•	•	•			

Table 8: Marine and freshwater shells (•) and shell beads (x) found in the Protoaurignacian layers of Italian sites (Modified after Bertola et al., 2013; compiled after: Barge, 1983; Gambassini, 1997;

Fiocchi, 1998; Kuhn and Stiner, 1998; Stiner, 1999; Holt et al., 2018, Peresani et al., 2019b). Classification and nomenclature used for molluscs is based on the systematics index of S.I.M. – Società Italiana di Malacologia (www.societaitalianadimalacologia.it) and WoRMS - World Register of Marine Species (www.marinespecies.org).

Class	Family	Species	Fumane	Bombrini	Mochi	Cala	Castelcivita
Gastropoda	Patellidae	*Patella* cfr. *ulyssiponensis*	•				
	Fissurellidae	*Fissurella* sp.			•		
	Haliotidae	*Haliotis tuberculata lamellosa*			•	•	
	Trochidae	*Gibbula albida*				•	
		Gibbula ardens				•	
		Gibbula turbinoides	•				
		Gibbula sp.	•		• x	•	
		Steromphala adansonii (syn: *Gibbula adonsonii*)	•	•x		•	
		Steromphala varia	•x				
		Jujubinus striatus				•	
		Jujubinus sp.	• x		•	•	
		Phorcus articulatus (syn: *Osilinus articulates*)	• x	•		•	
		Phorcus richardi (syn: *Gibbula richardi*)	• x				
		Phorcus turbinatus (syn: *Osilinus turbinatus*)				•	
		Phorcus sp.				•	
		Clanculus corallinus	• x			• x	
		Clanculus cruciatus	•	• x		•	
		Clanculus jussieui	• x	•		•	
		Clanculus sp.	•	•	• x	•	
		Unidentified genus	•	•	•	•	
	Turbinidae	*Bolma rugosa*			•	•	
	Coloniidae	*Homalopoma sanguineum*	• x	• x	• x	• x	• x
	Phasianellidae	*Tricolia pullus*	•			•	
		Tricolia speciosa				•	
	Cerithiidae	*Bittium latreillii*	•				
		Bittium reticulatum	•			•	
		Cerithium vulgatum	•			•	
		Cerithium sp.			• x	•	•
	Cerithiopsidae	*Cerithiopsis* sp.	•				
	Turritellidae	*Turritella communis*	• x	•x			
		Turritella sp.			•		
	Littorinidae	*Littorina obtusata*	•				
		Littorina saxatilis	• x				
		Littorina sp.			• x		
		Melaraphe neritoides (syn: *Littorina neritoides*)					•
	Rissoidae	*Rissoa variabilis*	•				

		Rissoa sp.	•			
	Aporrhaiidae	*Aporrhais pespelecani*		•	•	
	Triviidae	*Trivia arctica*	• x	•		•
		Trivia mediterranea (syn: *T. pulex*)				• x
		Trivia sp.		• x	• x	•
	Cypraeidae	*Luria lurida*	•			
		Luria sp.	•		•	
	Naticidae	*Euspira macilenta*	• x			
		Naticarius hebraeus (syn: *Natica hebraea*)				•
		Euspira intricata		• x		
		Euspira sp.	• x			
		Unidentified genus	•		•	•
	Cassidae	*Semicassis saburon* (syn: *Phalium saburon*)				•
	Muricidae	*Ocenebra edwardsii*	• x	• x	• x	
		Ocinebrina sp.	•			
		Unidentified genus	•			
	Mitridae	*Episcomitra cornicula* (syn: *Mitra cornicula*)	• x			•
		Unidentified genus				•
	Buccinidae	*Aplus* sp.	•			
		Unidentified genus	•			
	Pisaniidae	*Gemophos viverratoides* (syn: *Pollia viverratoides*)				•
	Nassaridae	*Nassarius circumcinctus*	• x	•		•
		Tritia corniculum (syn: *Nassarius corniculum*)	• x			
		Nassarius gibbosulus		• x		
		Tritia cuvierii (syn: *Nassarius costulatus cuvierii*)				•
		Tritia incrassata (syn: *Nassarius incrassatus*)	• x	• x		• x
		Tritia mutabilis (syn: *Nassarius mutabilis*)	• x		•	• x
		*Tritia neritea (*syn: *Cyclope neritea)*	• x	• x		• x
		Tritia nitida (syn: *Nassarius nitidus*)		• x		
		*Tritia pellucida (*syn: *Tritia pellucida)*	• x	• x		• x
		Tritia reticulata (syn: *Nassarius reticulatus*)	• x	•		
		Tritia sp. (syn: *Cyclope* sp.)	• x	•	• x	•
		Nassarius sp.			• x	•
	Columbellidae	*Columbella rustica*		• x		•
		Mitrella gervilii				•
		Mitrella scripta			• x	
	Cancellariidae	*Bivetiella cancellata* (syn: *Cancellaria cancellata*)		•		

	Conidae	*Conus ventricosus* (syn: *C. mediterraneus*)		• x	• x	
	Neritidae (Freshwater)	*Theodoxus* cfr. *danubialis*	•			
	Unidentified		•		•	
Bivalvia	Noetidae	*Striarca lactea*			•	
	Glycymerididae	*Glycymeris glycymeris*	•		•	• x
		Glycymeris nummaria (syn: *G. insubrica/ G. violacescens*)	• x		• x	
		Glycymeris sp.	•		•	
	Mytilidae	*Mytilus galloprovencialis*	•			
		Mytilus sp.			•	
	Ostreidae	Unidentified genus	•			
	Pectinidae	*Pecten jacobeus*			•	•
		Chlamys sp.		• x		
		Unidentified genus			•	
	Cardiidae	*Acanthocardia tuberculata*			•	
		Cerastoderma glaucum	• x		•	
		Cerastoerma cfr. *edule*	•			
		Cerastoderma sp.	•			
		Papillicardium papillosum	•			
		Unidentified genus			•	
	Veneridae	*Callista chione*			•	
	Unidentified				•	•
Scaphopoda	Dentaliidae	*Antalis inaequicostatum*	• x	• x	• x	
	Fustiariidae	*Fustiaria rubescens*			• x	

4. Discussion

4.1 *Bone artefacts*

4.1.1 The Italian record

In the Mousterian world, bone was, indeed, an optional raw material that was opportunistically used for tools that do not result from a planned sequence of actions. These tools mainly consist of unmodified long bone fragments of medium or large ungulates (occasionally bear) used as retouchers (Malerba and Giacobini, 1996; Jéquier et al., 2012; Thun Hohenstein and Bertolini, 2012; Peresani et al., 2014a; Jéquier et al., 2016; Jéquier et al., 2018; Romandini et al., 2018; Thun Hohenstein et al., 2018). It is reasonable to expect that bones were primarily broken to extract the marrow for food purpose, rather than to obtain blanks from which to produce tools (Boscato and Crezzini, 2006 and 2012).

Specific studies on the function of Middle Palaeolithic retouchers have demonstrated their main use in sharpening, blunting, shaping, and crushing cutting-edges of stone tools (Siret, 1925; Vincent, 1993; Armand and Delagnes, 1998; Daujear et al., 2014), thus confirming the “retoucher” nomenclature. Nevertheless, their use in other stages of the lithic production (therefore described as

hammers or anvils) is also documented by specific experimental tests (Armand and Delagnes, 1998; Rigaud, 2007; Daujeard et al., 2014; David and Pelegrin, 2009).
The longevity of bone retouchers as an artefact class, which are documented well before MIS 3 (Bertola et al., 1999; Jéquier et al., 2015; Thun Hohenstein et al., 2018), attests to a continuity of this technological tradition over several tens of millennia which extends into the Early Upper Palaeolithic based on the Fumane sequence, where similar items have been recovered in the Protoaurignacian assemblages (Jéquier et al., 2018).

The situation changes dramatically with the Uluzzian technocomplex, where different sites have yielded awls and cylinder-conical elements. Both are typical formal tools, namely functionally-specific implements (usually for piercing soft materials) within the site economy. Even if the technical scheme used to manufacture these tools remained relatively simple, the whole multi-step procedure involved in their production implies a distinct investment in time and energy for the selection and processing (i.e. disarticulating and defleshing) of suitable anatomical parts (whatever they were) from specific taxa. This selection of specific anatomical parts to be used as blanks is a fundamental step in the *chaine opératoire*, and is indeed more challenging than the production of bone blanks by other methods (e.g., percussion).

The Protoaurignacian bone technology aligns itself substantively in continuity with that of the Uluzzian except, perhaps, as concerns the selected skeletal portions. In most cases, and notably at Fumane, the bone tools in Protoaurignacian contexts imply manufacturing strategies mainly aimed at shaping an active part from bone fragments. At Riparo Bombrini, there is evidence that blanks were produced through both indirect and direct percussion. Although Protoaurignacian implements are typologically more variable (also including points and needles), we cannot identify a genuine break between the bone industry of this techno-complex and that of the Uluzzian. The occurrence of a real distinction, marked by significant innovations in bone technology and typology, has been postulated by some authors for the Early Aurignacian, when the use of antler is introduced, and bone is also used to produce hunting weapons like split-based points (Tejero, 2014; Tejero and Grimaldi, 2015). Conversely, bone tool manufacturing has been interpreted as a subsistence activity probably related to activities others than hunting, both in the Uluzzian and in the Protoaurignacian (d'Errico et al., 2012b; Bertola et al., 2013; Peresani et al., 2016). Despite this functional homogeneity, we note that the northern Protoaurignacian displays a preference for blanks from generic diaphyseal parts, in contrast to the Uluzzian which is usually more selective and oriented to exploit specific anatomical portions. In the south the near absence of bone tools in Protoaurignacian contexts (with rare tools from Grotta di Castelcivita, Grotta della Cala, Paglicci and Serra Cicora) does not allow us to discuss possible differences with the Uluzzian.

4.1.2 The European framework

As attested in Italy, in the rest of Europe, Middle Palaeolithic bone tools are mainly retouchers, and their use has been ascertained since the Lower Palaeolithic (Blasco et al., 2013; Serangeli et al., 2015; van Kolfschoten et al., 2015; Moigne et al., 2016). Likewise, they are usually made on ungulate bone fragments, or occasionally bones of other taxa, including humans (Verna and d'Errico, 2011; Daujear et al., 2014; Rougier et al., 2016).

During the Middle Palaeolithic Neandertals also produced rare bone scrapers and denticulates (see for example Hahn, 1976; Tromnau, 1983; Freund, 1987; Hardy et al., 2014), and shell scrapers

(Douka and Spinapolice, 2012; Romagnoli et al., 2014; Romagnoli et al., 2016). However, techniques used in the making of these implements appear to largely have been transposed *en bloc* from stone working and were not conceived specifically for these kinds of raw materials.

The occurrence of formal bone tools in the Mousterian is a matter of debate since decades (Villa and d'Errico, 2001). However recent excavations in two Mousterian of Acheulian Tradition sites, Pech-de-l'Azé I and Abri Peyrony (Soressi et al., 2013), have brought to light four smoothers (or *lissoirs*) intentionally shaped by polishing. This has generated renewed interest on this topic. The discovery of these objects, although representing an exception in the repetitive world of Mousterian retouchers, indicates that the use of a technology like polishing in bone processing was not foreign to Neandertals. Further confirmation of this is provided by the description of what may be basic shaping or preparation for some bone tools from the Lower Palaeolithic site of Schöningen (Julien et al., 2015).

As documented in the Italian Uluzzian, also in the other European transitional technocomplexes formal bone tools are attested, even if their presence in some cases is debated. The most abundant evidence of osseous tool production is claimed at the Châtelperronian site of Grotte du Renne. More than 100 items, including projectile points, awls, pins, "burnishing tools," ivory baguettes, and by-products of bone and ivory manufacturing have been ascribed to the Châtelperronian layers of the cave (d'Errico et al., 1998). Unfortunately, the integrity of the stratigraphic sequence of the site is very controversial and it does not allow to understand the role of such implements in this technocomplex. A part of bone tools from Grotte du Renne, as well as a part of ornaments, have been claimed to be an intrusion from the overlying Aurignacian layers, on the basis of the homogeneity between the Châtelperronian and the Aurignacian remains (White, 2001). In addition, a series of dates on human-modified bone and antler materials from layers V to XII (Gravettian/Mousterian) suggests a mixing of the materials (Higham et al., 2010).
The validity of the stratigraphic sequence of Grotte du Renne has been instead stressed by other authors (Caron et al., 2011; Hublin et al., 2012), that after a re-assessment of the distribution of the archaeological findings by means of statistical analyses and new radiocarbon dating affirm that any disturbance affects the site and the incoherent dates are due to an incomplete cleaning of the samples used.

The great abundance of bone tools from Grotte du Renne stands out if compared with the paucity of comparable materials in other Châtelperronian assemblages. Some awls and ornaments have been claimed at the site of Quinçay (d'Errico et al., 2003), but these items have never been published.

The presence of bone tools in transitional assemblages of Central Europe is troubled. Only one bone point from Ranis 2 was probably retrieved in Lincombian-Ranisian-Jermanowician (LRJ) techno-complex, but it has been lost (Flas, 2007). Other possible bone tools have been claimed in other LRJ sites, but their stratigraphic provenance is uncertain (Flas, 2007). Furthermore, some Szletian sites yielded bone points, but probably from layers mixed with Aurignacian materials (Svoboda, 2001).

The systematic and sometimes abundant production of bone tools that has been reported from several Protoaurignacian sites all over Europe (mainly from France and Spain), like Trou de la mère Clochette, Grotte du Renne and Isturitz (Julien et al., 2002; Soulier et al., 2014; Tartar, 2015), can be compared with the sites of Northern Italy. The sporadic presence in Protoaurignacian assemblages such as those from Trou de la mère Clochette and Arbreda of split-based points characteristic of the Aurignacian (Ortega Cobos et al., 2005; Tartar, 2015), has been interpreted by some authors as being symptomatic of a gradual process leading from the Protoaurignacian to the Aurignacian (Teyssandier and Liolios, 2008; Tartar, 2015).

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4.2 *Ornaments and other non-utilitarian evidence*

4.2.1 The Italian record

The Late Mousterian provides only sporadic evidence of activities which do not seem directly related to subsistence needs. They are documented only in two northern sites (Fumane and Rio Secco) and attest the use of raptor claws, feathers and a shell for ornamental purpose (Peresani et al., 2011; Peresani et al., 2013; Romandini et al., 2014b). The presence of some engraved bones or stones in different Mousterian sites is not enough to assign them a symbolic or non-utilitarian value (Peresani et al., 2014b).

In contrast, potential symbolic artefacts are well documented in Italy in the Uluzzian technocomplex that has yielded, mainly as ornaments. These mostly consist of tusk shells and are distributed from northern to southern Italy and even as far as Greece (Stiner, 2010), attesting to possible close cultural affinities among groups even over long distances. This pattern probably stems from a common origin or a sustained social interaction (or both) among makers of the Uluzzian. In other words, early MHs who arrived in Italy and in the Balkans had common technological and cultural traditions (see also Marciani et al., in this special issue) and were able to widely diffuse this identity. In this light tusk shells could play the role of a cultural and social marker, similarly to other kinds of body modifications (tattoos, scarifications, piercings, lip and neck stretching etc. for which at this point there is no evidence). It is thus conceivable that their use was directly tied to the mental model the individual and the group used to represent themselves *vs* other individuals and/or groups (Boyd and Richerson, 1987; Newell et al.,1990; Nettle and Dunbar, 1997; McElreath et al., 2003; Vanhaeren and d'Errico, 2006; Kuhn 2014).

The uniqueness of tusk shell phenomenon is underlined by the absence of this kind of ornaments in the IUP assemblages in general (Stiner et al., 2002; Campbell, 2017). Among the transitional techno-complexes, the occurrence of tusk shells in the Châtelperronian of Saint Césaire (d'Errico et al., 1998), is, so far, a singular exception.

The presence of colouring substances is documented in some Uluzzian sites, even with decorative purposes as shown by the ochred tusk beads from Riparo Broion (Peresani et al., 2019a). This site has also yielded a schematically engraved stone, that is the only evidence of this kind in the Uluzzian.

In the Protoaurignacian there is a vast assortment of ornamental taxa (mostly small size gastropods) in the composition of personal adornments that stands in evident contrast with respect to the Uluzzian. A significant role is played by *Homalopoma sanguineum*, possibly for its typical red colouration. A preference towards shells with red or yellow colourations has been noted for the Upper Palaeolithic in general, maybe because these colours had a peculiar symbolic significance or high visibility (Álvarez-Fernández, 2006). Concomitantly, the utilisation of tusk shells notably decreases since only a few specimens are recorded in Italian and European sites (Fiocchi, 1998; Zilhão, 2007; Bertola et al., 2013; Peresani et al., 2019b). This diversity between the Uluzzian and the Protoaurignacian ornamental suite could be traced back to their distinct ethnic identities, which could suggest different origins for these two technocomplexes. The geographical distribution displayed by Protoaurignacian ornaments seems to mirror the pattern shown by bone implements, in that both are very well documented and quite diverse in northern sites, where bone and stone pendants are also recorded, unlike the southern ornament assemblages, which are usually very poor and composed only by shells.

4.2.2 The European framework

Probable evidence of non-utilitarian activities, such as the occurrence of unusual objects most likely intentionally collected by hominids, has been recognized in Europe since the Lower Palaeolithic. It is difficult to evaluate the meaning of such collecting, but hominins' curiosity for unfamiliar and bizarre objects may have played an important role (Leroi-Gourhan, 1961 and 1964). In Europe the earliest records interpreted as possible "symbolic" evidence are the grooved bones from Bilzingsleben (Germany) dated to 350-220,000 years ago (Mania and Mania, 1988). Engraved stones and bones have been found in Europe both in Lower and Middle Palaeolithic sites (see Majkić et al., 2018a and 2018b and references therein). Some Authors (Marshack, 1976; Bednarik, 1995; Bahn, 1996) have interpreted these objects as non-utilitarian expressions by Neandertals or Pre-Neandertal hominids, whereas other scholars suggest a more prosaic function, at least for some of them, assuming that they might be related to butchering practices, or even to carnivore activities or other taphonomic phenomena (Bordes, 1969; Raynal, Séguy, 1986; Crémades, 1996; Wolpoff, 1996; d'Errico and Villa, 1997; Majkić et al., 2017). Pigments are also frequently recorded in Middle Palaeolithic sites (as for example Pech-de l'Azé I) (Soressi and d'Errico, 2007); however, their exploitation for non-subsistence activities has been questioned both in South African Middle Stone age and in European Mousterian (Wadley, 2003 and 2005; Roebroeks et al., 2012; Dayet et al., 2015; Heyes et al., 2016; Dayet et al., 2019).

During the Late Mousterian, objects interpreted as non-utilitarian are more frequent, even if they are not systematic and widespread. Some of these mirror the Italian evidence, such as the use of raptor claws as ornaments documented in France (Morin and Laroulandie, 2012) and in Croatia (here dated to 130 ka BP) (Radovčić et al., 2015) or the probable use of naturally pierced bivalves as ornaments and the use of pigments documented in two Mousterian sites in Spain, Cueva Antón and Cueva de los Aviones (Zilhão et al., 2010) recently re-dated to120-115 ka (Hoffmann et al., 2018a).

The Late Mousterian offers also other potential evidence of non-utilitarian artefacts. Bones showing notches and incisions are documented in Europe, as, for example, a schematically engraved bone

found in the Final Mousterian layer of Bacho Kiro (Bulgaria) (Kozlowsky, 1982), a raven bone with notches retrieved in the Micoquian layer of Zaskalnaya VI (Crimea) (Tsvelykh et al., 2014; Majkić et al., 2017) and a hyena femur with a set of incisions and a cave bear cervical vertebra showing subparallel marks respectively recovered in the Mousterian sites of Les Pradelles (France) (d'Errico et al., 2018) and Pešturina Cave (Serbia) (Majkić et al., 2018b). Furthermore, some cave paintings in Spain (La Pasiega, Maltravieso, Ardales) have been re-dated to between 65-47 ka (Hoffmann et al., 2018b; Slimak et al., 2018; but cf. Pearce and Bonneau, 2018) possibly assigning them to Neandertals like the deeply engraved lines in a cross-hatched pattern on the bedrock of Gorham's Cave at Gibraltar (Rodríguez-Vidal et al., 2014).

European transitional technocomplexes exhibit evidence of symbolic behaviour, mostly composed by bone and teeth pendants, unlike the Uluzzian that is only associated with shell beads. The Châtelperronian, for instance, has yielded ornaments, mostly perforated bones and pierced teeth (Taborin, 1993; Granger and Lévêque, 1997; d'Errrico et al., 1998; Zilhão, 2007; Caron et al., 2011). Once again, the debate involving Grotte du Renne (which has yielded the most substantial assemblage of ornaments) and the questioned stratigraphic integrity of some sites and/or cultural attribution of some findings (e.g. Grotte des Fées and Roche au Loup) do not allow us to reconstruct an effective scenario to evaluate the real extent of this phenomenon in the Châtelperronian (Rigaud 2001; White, 2001; Mellars et al., 2007; Zilhão et al., 2007; Riel-Salvatore et al., 2008; Higham et al., 2010 and 2011; Caron et al., 2011; Hublin et al., 2012;). Further evidence of possible symbolic behaviour could be the engraved motifs adorning some bone implements from Grotte du Renne (d'Errico et al., 1998), but, as said above, the reliability of this evidence is affected by the stratigraphic issues of the site. Nevertheless, colouring substances were frequently used in order to obtain pigment powder at several Châtelperronian sites (Dayet et al., 2014).

In Central Europe, Early Upper Palaeolithic ornaments are curiously uncommon and limited to just a few cases, among which a bone pendant and two pierced teeth retrieved at Bacho Kiro (Bulgaria) (Kozlowski, 1982), a perforated fossil gastropod from Willendorf II (Austria) (Felgenhauer,1956-1959; Hahn,1993), and an ivory disc with a central hole, maybe a pendant, found at Ilsenhöhle (Germany) (Hülle, 1977).

As in Italy, ornaments, as well as other records of non-utilitarian activity, are common in the Protoaurignacian. In France and Spain, several sites have yielded shell ornaments, notably La Laouza (Taborin, 1993), Isturitz (Normand and Turq, 2005), L'Arbreda (Maroto et al., 1996; Soler Sublis et al., 2008) and Rothschild (where fossil shells were also used; Taborin, 1993; Sacchi, 1996; Bon, 2002). The preference for basket-shaped beads is considered a distinctive feature of both the Protoaurignacian and the Aurignacian technocomplexes (Taborin, 1993; Zilhão, 2007 and 2011). This characteristic is reminiscent of the shell ornaments of the Early Ahmarian (Kuhn et al., 2001). Pierced teeth (frequently fox and red-deer) are also recorded in the assemblages from Rothschild (Taborin, 1993; Sacchi, 1996; Bon, 2002) and Isturitz (Normand and Turq, 2005) in France and from Cueva Morin, in Spain (González Echegaray and Freeman, 1971).

5 Conclusions

The picture that emerges for the interval 50-36 ka cal. BP in Italy is that of a period during which considerable biological, cultural and technological innovations first manifest themselves, sometimes

in apparently revolutionary ways. When considering this scenario in light of the topics discussed above, some interesting interpretations are possible. Firstly, we can note that the patchy evidence regarded as symptomatic of behavioural modernity in the Late Mousterian seems to be mostly related to the "symbolic" sphere rather than to the technological field. The Late Mousterian actually displays some activities that do not seem directly related to subsistence needs. However, these appear to have been largely anecdotal experiments, that ultimately were not shared by most Neandertal groups. It is possible that the punctuated nature of this evidence indicates the presence of distinct social, economic or cognitive structures to generate and transmit behavioural innovations across time and space among Neandertals, which could have limited the diffusion of these acquisitions. In other words, the occurrence of formal bone tools, ornamental items, colouring substances and other "non-utilitarian" elements in the Late Mousterian appears to be occasional. This would suggest that those behaviours, which were systematic and widespread in Early Upper Palaeolithic MH societies, were instead episodic among Neandertals.

The Uluzzian, in contrast, is characterized by innovations in the main hallmarks of "modern human behaviour": from lithic technology (see Marciani et al., in this special issue) to bone technology and ornaments. Among personal ornaments, exclusively made on shells, tusks appear to be a sort of distinctive features of the Uluzzian because of their frequency and distribution. The same uniformity is suggested by bone tools.

The Protoaurignacian differs from the Uluzzian especially in the domain of personal ornaments and displays, even internally, some geographical differentiation in the amount and assortment of both ornaments and bone tools. Going south, the depletion of some typical features usually connected to ethnic identity could be anthropologically consistent with the notion of a spread from the north of this techno-complex.

Interpretations proposed in our state of art account on bone tools, ornaments, and other non-utilitarian objects are mainly working hypotheses that we planned to investigate more in depth in further studies that are going to include newly discovered materials from ongoing excavations in the most important transitional sites in Italy.

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Figures

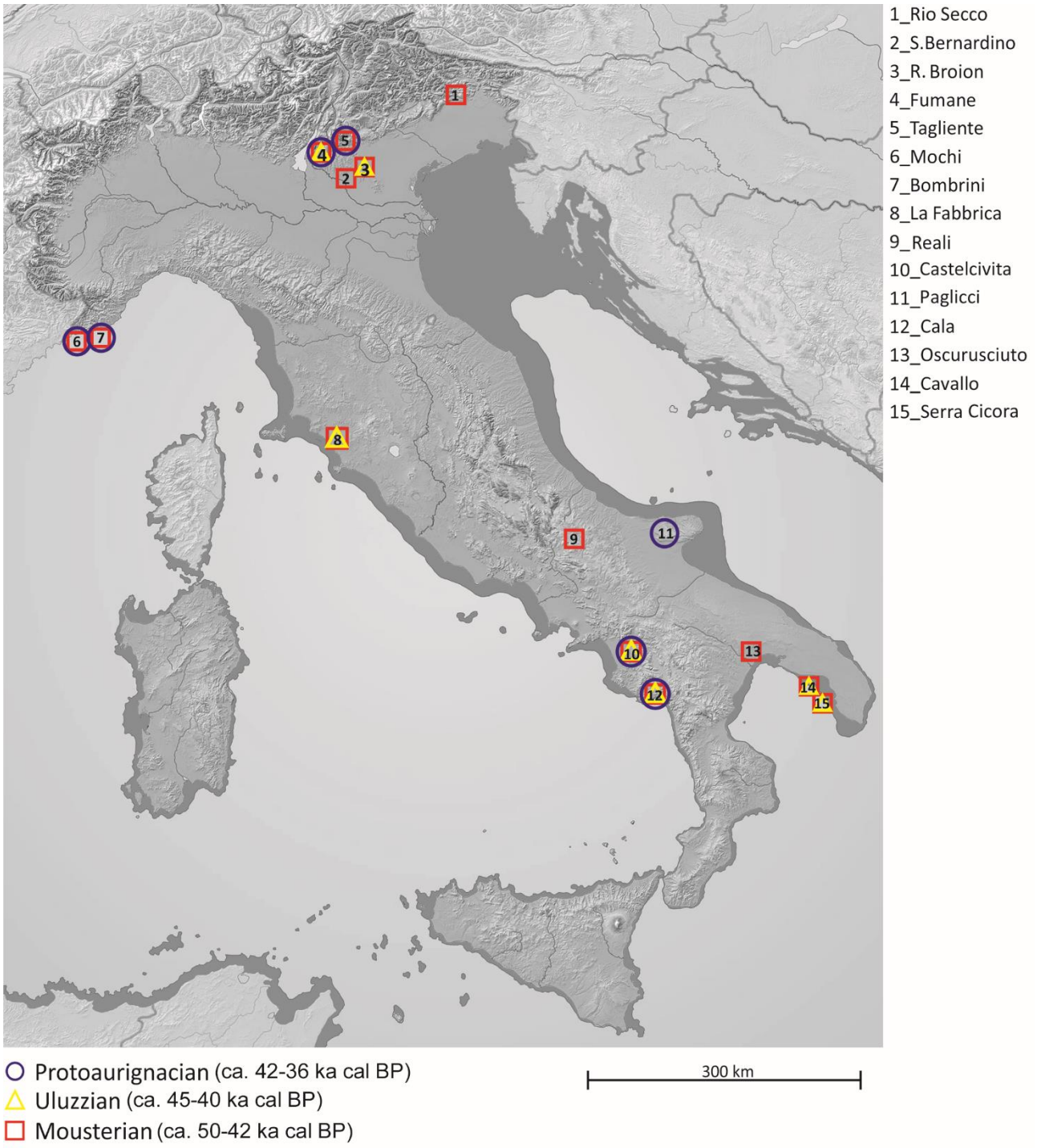

Fig.1 Localization of the MIS3 Italian sites yielding bone tools and/or ornaments and other non-utilitarian items. The Italian Peninsula shows a sea level of 70 m below the present-day coastline, based on the global sea-level curve (Benjamin et al., 2017) but lacking the estimation of post-MIS3 sedimentary thickness and eustatic magnitude (sketch map courtesy by S. Ricci, University of Siena).

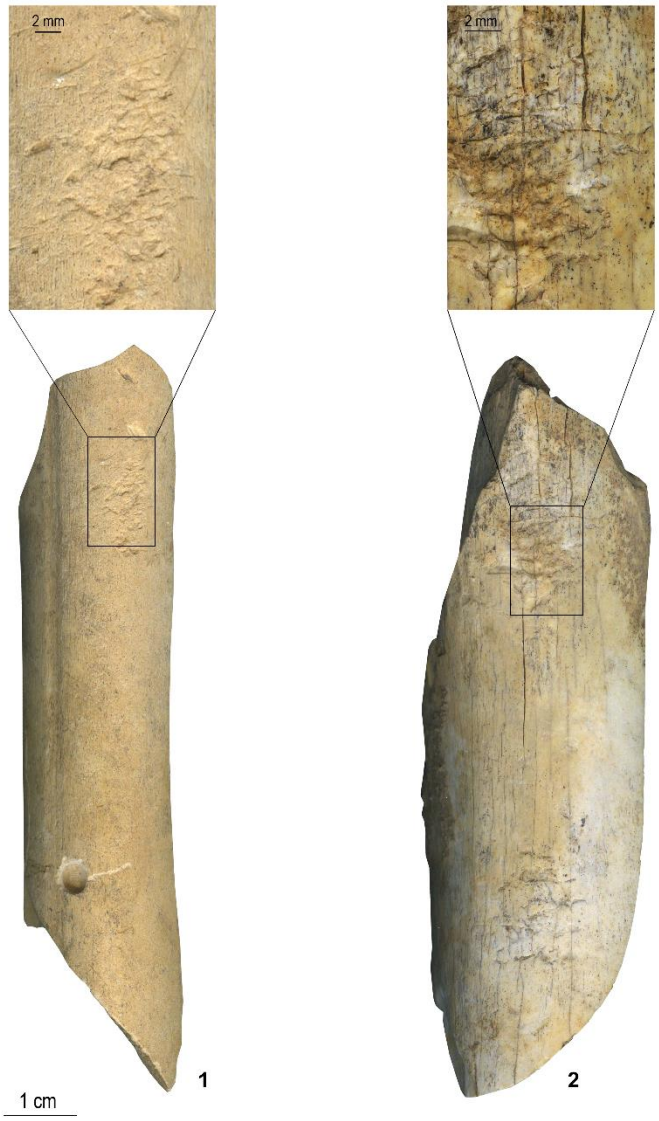

Fig. 2 Mousterian bone retouchers from Grotta di Fumane showing percussion traces: *Cervus elaphus* metacarpal and close-up of the percussion traces (layer A6) (1). Double retoucher made from *Alces* or *Megaloceros* tibia and close-up of the percussion traces (layers A5+A6) (2).

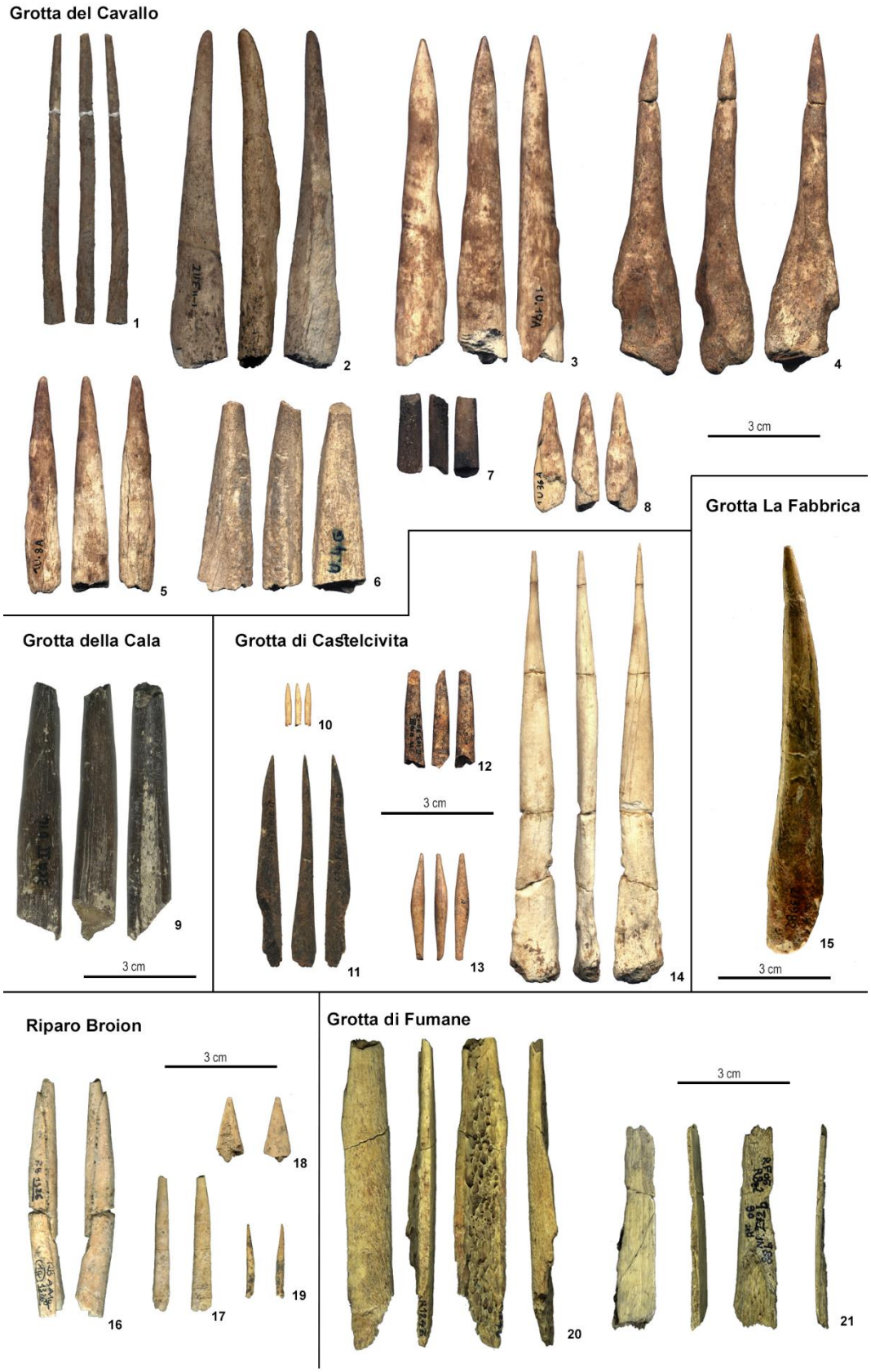

Fig. 3 Uluzzian bone tools. Grotta del Cavallo (layers EIII, EII-I, D) (1-8). Grotta della Cala (layer D14) (9). Grotta di Castelcivita (layers upper rsi, rpi, rsa") (10-14). Grotta La Fabbrica (layer 2) (15). Riparo Broion (layer 1g) (16-19). Grotta di Fumane (layer A3) (20-21) (Modified after d'Errico et al., 2012b; Peresani et al., 2016, Villa et al., 2018; Peresani et al., 2019a).

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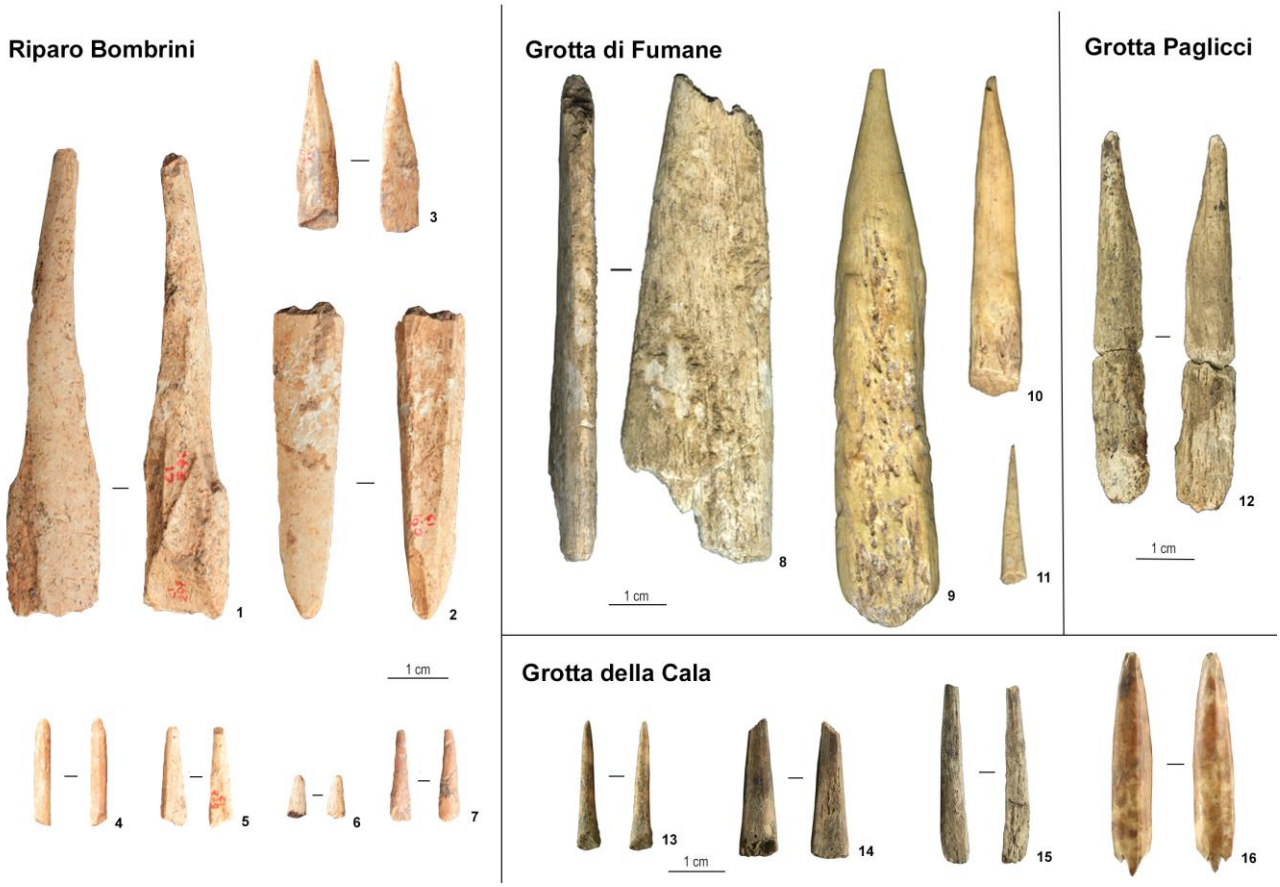

ig. 4 Protoaurignacian bone tools. Riparo Bombrini (layers A3-A1): pointed tool (1), fragmentary tool (2) needle (4) and awls fragments (3, 5-7); Grotta di Fumane (layers A2-A1): split based point recovered at the interface between layers A1 (Protoaurignacian) and D3 (Aurignacian *sensu lato*) (8), awls (9-10) and distal portion of a needle or a awl (11); Grotta Paglicci (layer 24): awl (12); Grotta della Cala (layers 12-13) fragmentary bone points (13-14).

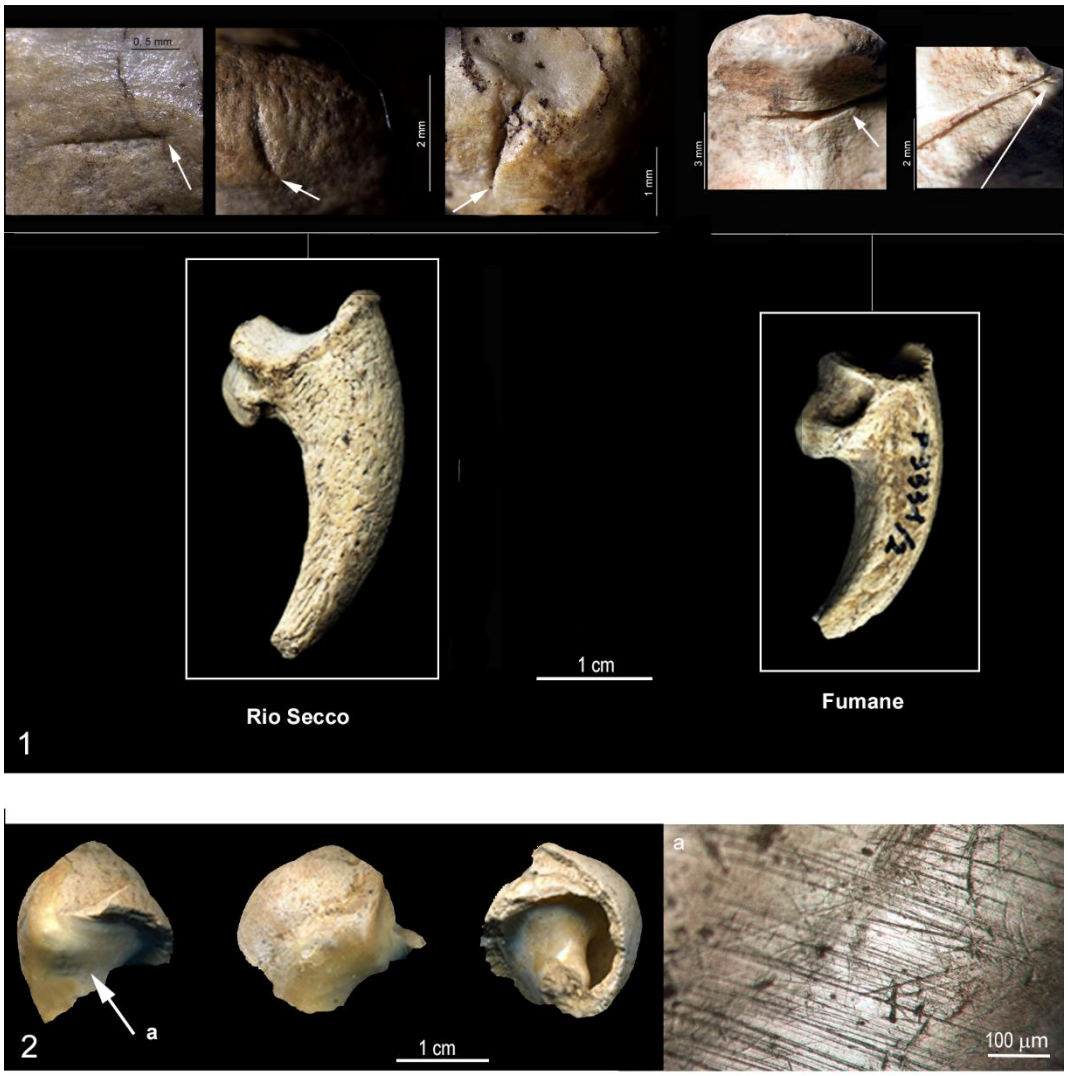

Fig.5 Eagle claws with cut marks from Riosecco and Fumane and close-up of the anthropic signs indicating their intentional removal (1). The *Aspa marginata* recovered at Grotta Fumane (layer A9) and zoom on the striations on the inner lip. The striations are consistent with the presence of a thread, attesting the use of the shell as a pendant (2) (Modified after Peresani et al., 2013).

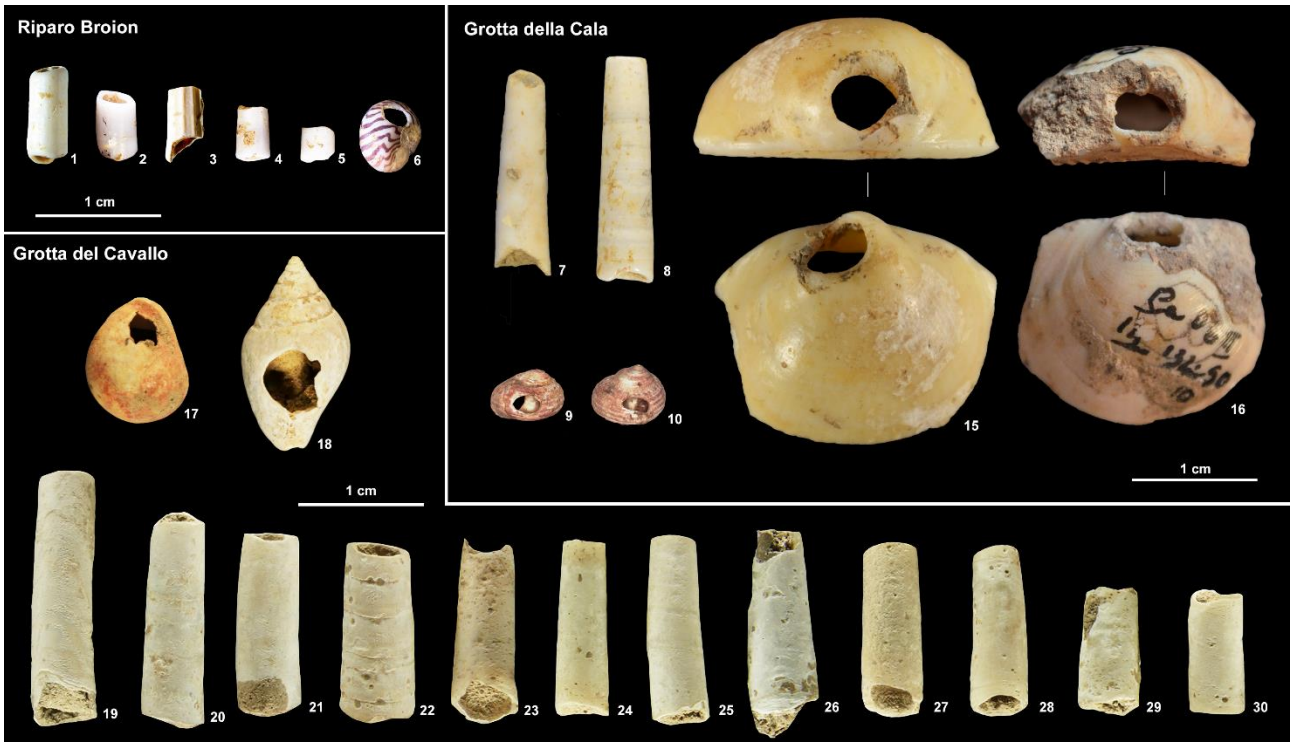

Fig. 6 Uluzzian ornamental assemblages. Riparo Broion: *Antalis vulgaris* (1-2 and 4-5), *Antalis inaequicostata* (3), *Theodoxus danubialis* (6). Grotta della Cala: *Antalis vulgaris* (7-8), *Glycymeris nummaria* (15-16), *Homalopoma sanguineum* (9), *Clanculus corallinus* (10). Grotta del Cavallo: *Tritia neritea* (17), *Columbella rustica* (18), *Antalis* sp. (19-30).

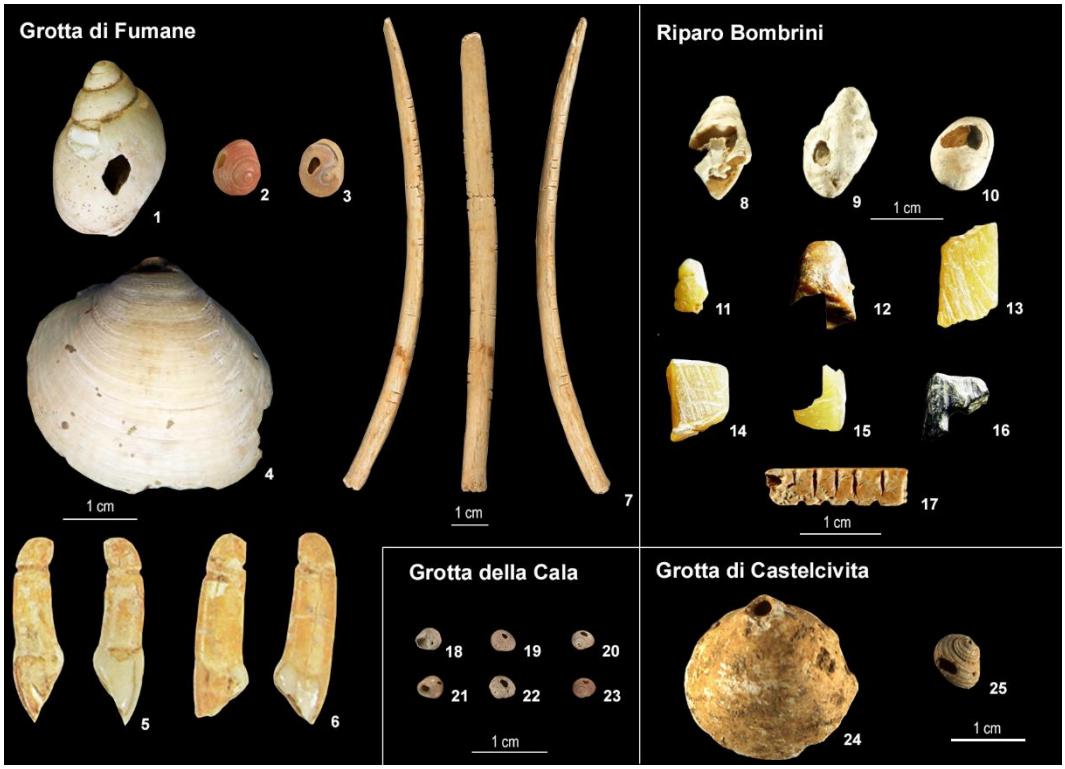

Fig.7 Ornaments and other non-utilitarian items from Italian Portoaurignacian sites. Grotta di Fumane: sample of the ornamental shells, *Tritia mutabilis* (1), *Homalopoma sanguineum* (2), *Tritia*

pellucida (3), *Glycymeris nummaria* (4), teeth pendants (5-6), engraved rib from a medium-sized ungulate (7). Riparo Bombrini: sample of the ornamental shells (8-10), worked steatite fragments (11-15), fragmentary steatite pendant (16), bird bone with notches and incisions (17). Grotta della Cala: sample of ornamental shells, *Homalopoma sanguineum* (18-23). Grotta di Castelcivita: sample of ornamental shells, *Pecten jacobeus* (24) *Homalopoma sanguineum* (25).