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ON THE MORPHOLOGY, CHRONOLOGY, AND PHYLOGENY OF TRIANGULAR LITHIC INSETS BETWEEN 20 AND 14 KA CALBP IN WESTERN AND CENTRAL EUROPE

ABSTRACT: There is a long-standing debate about triangular lithic implements – particularly those referred to as scalene bladelets and scalene triangles – occurring in Western and Central European assemblages roughly between 20 and 14 ka calBP. By and large, the debate revolves around three key questions, namely the morphological distinctiveness, chronological significance, and phylogenetic relation of these two groups of objects. Within this triangle of dissent, most discrepancies seem to spring from an amalgamation of inappropriate analytical categories, poor chronological control, and untested assumptions on the evolution of material culture. This paper reviews the available evidence from assemblages with triangular lithic implements to strengthen their morphological distinction, sharpen the chronological resolution, and test ideas about the cultural evolution of triangular lithic insets during the period in question. It is found that scalene bladelets predominantly occur between 19 and 16 ka calBP. There also seems to be a microlithic variant occurring between 16 and 15.5 ka calBP. Scalene triangles, on the other hand, seem to be much more chronologically restricted and to have been in us for a rather short period of time at around 16 ka calBP. Scalene triangles are found to be most likely phylogenetically unrelated to scalene bladelets. While the former probably served as lateral insets, the latter seem to be more convincingly interpreted as frontal insets. As such, they can be seen as a variant of shouldered points, which bridges the gap between the shouldered points of the Badegoulian and early Upper Magdalenian.

KEY WORDS: Scalene bladelets – Scalene triangles – Shouldered points – Radiocarbon dates – Phylogenetic relation

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1. INTRODUCTION - TRADITIONAL VIEWS AND CURRENT QUESTIONS

The history of research on triangular lithic implements in Upper Palaeolithic assemblages starts with a nomenclatorial confusion. In 1934, J. Bouyssonie, L. Lejeune, and J.-F. Perol presented short and stout scalene triangles from Puy de Lacan at the Congrès préhistorique de Périgeux (Bouyssonie *et al.* 1935, Demars, Laurent 1989). In the same year, D. Peyrony proposed a new archaeostratigraphic unit at the Congrès des Sociétés savants de Paris named "*Magdalénien à triangles scalène*" (Peyrony 1936). However, the eponymous artefacts Peyrony showed were morphologically different, i.e. more slender and elongated than those presented by Bouyssonie and his colleagues. Despite some efforts to the contrary (e.g. Cheynier 1951), the thus introduced definitional fuzziness was still plaguing analyses more than 20 years later, when terms such as (triangular) bevelled bladelets, obliquely truncated blade(let), or (typical) scalene triangles were in use. Here the same words have been applied to different morphologies, just as much as similar morphologies were named differently (Couchard 1960). In the typological lists for the Upper Palaeolithic, no distinction was made and only "triangles" (Nr. 79) are listed (Sonneville-Bordes, Perrot 1956: 552). In 1965, Cheynier tried to solve this issue by proposing Kidder's unofficial label "pike heads" (*têtes de brochet*) as a new term for slender and elongated backed bladelets with an oblique distal truncation. Cheynier stressed that when put on the ventral face, the retouched side is usually situated left and the back can show a clear concave bending before transitioning into the truncation (Cheynier 1965: 318). Today, these pieces are usually referred to as scalene bladelets, whereas the short and stout triangles are called scalene triangles (Demars, Laurent 1989). But then again, terms such as "elongated scalene triangles" (*triangles scalènes allongés*, Langlais 2007), which morphologically seem to be smaller variants of scalene bladelets, or "points with obliquely truncated base" (*pointes à base tronquée oblique*, ibid.), which can be an upside-down reading of scalene bladelets, appear to complicate a systematics for triangular lithic implements.

As for the chronology of these triangular pieces, the confusion set in later, presumable partly also due to nomenclatorial misunderstandings. With no claim to completeness, the following overview shall highlight the debate in exemplary fashion. Peyrony (1936), who apparently did not distinguish between different triangular morphologies, considered his "*Magdalénien à triangles scalène*" to be contemporaneous with Breuil's "*Magdalénien II*" based on his observations at the rock shelter of Laugerie-Haute. At Puy-de-Lacan, L. and H. Kidder (1936: 23) observed that slender scalene bladelets (which they referred to as scalene triangles) were only found in the lower part of the stratigraphy, whereas short scalene triangles occurred in the upper part. The thus established posteriority of scalene triangles to scalene bladelets did not go unchallenged. D. de Sonneville-Bordes (1960) stated that scalene bladelets are older than scalene triangles but saw an insecure chronological position for the latter. She also stressed a later re-appearance at the end of the Magdalenian and concluded that lithic triangles are a normal part of the Magdalenian tool kit with diachronically strongly varying quantities. Höck (2000), who did not distinguish between different morphologies, found that triangles have no chronological significance whatsoever. Recently, Langlais *et al.* (2016) have suggested an age of 19–17.5(16) ka calBP for scalene bladelets and 16.5–14 ka calBP for scalene triangles.

Assuming a posteriority of scalene triangles to scalene bladelets and presumably led by superficial morphological similarities, Cheynier (1965: 320) proposed that scalene triangles directly evolved from scalene bladelets, which was reinforced by Demars and Laurent (1989: 108). This hypothesis was readily accepted, but has never been put to test. Morphological similarity and chronological consecutiveness alone, however, are not sufficient to establish phylogenetic relation in the evolution of material culture.

To contribute to the debate, this paper presents a critical review of the available evidence from assemblages with triangular lithic implements to strengthen the morphological distinction, sharpen the chronological resolution, and test ideas about the cultural evolution of triangular lithic insets between 20 and 14 ka calBP. To this end, a three-step approach is taken. First, current definitions of scalene bladelets and scalene triangles are reviewed to aim for a mutually exclusive set of properties. Second, a critical review of available ^{14}C-dates for assemblages with triangular insets is performed. Third, criteria considered necessary to claim a phylogenetic relation are put forward and used to test the hypothesis of a direct evolution from scalene bladelets to scalene triangles.

2. MATERIAL AND METHOD

The following analyses are based on 80 assemblages with triangular lithic implements that show an obtuse angle between two retouched edges. There is a number of other triangular forms occasionally reported from assemblages between 20 and 14 ka calBP. These forms show a right or acute angle between the retouched edges. These pieces are excluded from discussion for two reasons. First, these artefacts likely have a different function than scalene bladelets and scalene triangles (see discussion in 3.1). Second, these forms become particularly numerous during the Mesolithic. When they occur in longer stratigraphies, an admixture often cannot be excluded with certainty.

2.1 Strengthening the morphological and functional distinction between scalene bladelets and scalene triangles

The systematics for triangular lithic implements is, in its current state, not suitable to properly capture and describe the morphological variability of this group of objects in an orderly fashion. As an attempt to reduce and structure the still confusion pluralism of overlapping and redundant terms, a first distinction is based on morphological observations. To further include functional arguments, the suitability of scalene bladelets and scalene triangles for either lateral or frontal hafting will be evaluated.

2.2 Sharpening the chronological resolution

The chronological analysis is based on 167 ^{14}C-dates from 42 assemblages. Here, the majority relates to assemblages with scalene bladelets (137 dates from 39 assemblages), whereas for scalene triangles only 20 dates from 3 assemblages are available. For the earliest occurrence of barbed points, the assumed successors of composite points with triangualr insets, 10 diretly directly dated specimens from 7 assemblages have been selected. Since it is the aim of the following review to sharpen the chronological position of scalene bladelets and scalene triangles, it is crucial to rigorously eliminate all potential noise and stray signals in order to obtain a clear picture that is diagnostically conclusive (cf. Maier *et al.* 2020). Thus every date is assessed singly and excluded from further consideration if it shows:

1 a standard deviation larger than 1.5% of the measured ^{14}C-age
2 conflict with AMS date(s); when conventional dates are in conflict with AMS dates, AMS dates are being preferred
3 conflict with date(s) on humanly modified pieces from same layer; when dates on non-modified material are in conflict with dates from humanly modified material, the latter are being preferred. Being humanly modified, however, does not constitute in itself a reliable argument that the dated material is truly related to the occupation of interest but excludes non-human agency
4 poor sample quality; e.g. low CO_2 or collagen content, bulk sample, unfortunately not always stated
5 a contradictory value with other date(s) from the same layer or with regard to the overall dating throughout the stratigraphy. In case of two contradictory values from the same layer, both were excluded if there were no other arguments (see 1–4) against one of the dates. Otherwise, single dates would be given too much weight, because the possibility for contradiction is not given (see point 6)
6 to be a single date. To be sure, single dates can give reliable age estimates of the event in question. However, single dates from potential palimpsest assemblages or sites with long stratigraphies are also difficult to assess in terms of their reliability and relation to the event in question. In order to warrant a maximum chronological control, single dates are excluded for the construction of a chronological framework
7 a context with strong signs of stratigraphic mixing; i.e. artefacts characteristic of older and younger phases occurring together in the same assemblages. 7a admixture with younger material, 7b admixture with older material
8 questionable relations to the specific occupation with items to be dated; i.e. if it is unclear if the dated object relates to the occupation during which the items of interest have been discarded
9 a slight offset to the younger in comparison to other dates from the same layer that cannot be averaged. If two dates do not differ strongly and are not different with regard to points 1–4, the older value is given preference, since contamination to the younger is much more likely than to the older.
10 to be outside the range of all other dates of artefacts with the same morphological traits
11 to be an outlier with regard to the entire set of dates for the item in question after review

Of the remaining dates, we calculate weighted averages when possible, using CalPal-2014 (Weninger

et al. 2014) to assess the length of the periods during which scalene bladelets and scalene triangles have been in use. In order to assess the duration of the phenomena under study in calendar years, we only use calibrated dates before present throughout the text (for the uncalibrated measurements see *Table 2*). All dates are calibrated using the IntCal13 calibration curve (Reimer *et al.* 2013) as implemented in CalPal-2014 (Weninger *et al.* 2014).

To be sure, an exclusion of dates by this review protocol does not automatically imply that these dates must be dismissed completely. Dates with a large standard deviation, for instance, can cover the period of interest somewhere in their range. They are, however, unsuited to build up a chronological framework.

2.3 Testing phylogenetic relation

Phylogenetic relation is established by showing that two traits in two different objects are homologous. However, to date it is impossible to give a sufficient condition which unequivocally establishes a homologous relation between two artefacts. For the moment, the approach thus aims at minimizing the possibility that two traits are analogous. Therefore, it is necessary to formulate a number of conditions that must be met to consider two traits non-analogous. It needs to be stressed that the following conditions are neither all singly necessary nor jointly sufficient to state a homologous relation between two artefacts. Nevertheless, violating one of them should result in dismissing the hypothesis of phylogenetic relation in order to warrant a conservative approach.

1. Morphological and structural similarity

Two homologous traits are not necessarily morphologically similar. However, in the absence of an independent source of information on descent (e.g. genetic analysis), morphological similarity is prerequisite to assume a phylogenetic relation, much as in Palaeontological research. This is based on the assumption that evolution takes place in small-scale, incremental steps, because when faced with change in one part, the functionality of the whole system has to be warranted (Simpson 1944). Changes in organs must not hamper the functionality of the entire organism and changes in projectiles must not hamper the functionality of the entire hunting strategy. In the same logic, it has to be assumed that morphological changes within a class of objects (e.g. lithic points) are much more common than the loss and subsequent re-invention of this object class.

2. Functional similarity

Objects in a homologous relation should be found in very similar functional contexts to prevent the functionality of the larger system from failure. As morphological similarity, functional similarity is not necessary for a homologous relation, but it helps making analogous relations unlikely. Morphologically very similar objects can have very different functions, such as specific bladelet cores and tools for grooving, which are both labelled burins and whose similarity is likely of rather analogous nature.

3. Temporal proximity

In order to assume a homologous relation between two traits, they should follow one another closely in time. This is because phylogenetic relation requires a continuous chain of succession. The larger the temporal gap between two similar observations, the more likely is an analogous relation. Solutrean and Clovis bifacial points, for instance, are separated by roughly 10 ka and therefore are most probably analogous to one another.

4. Spatial proximity

Much as temporal proximity, spatial proximity is a condition to assume a phylogenetic relation. This is because growing distances renders continuous succession increasingly unlikely. The occurrence of pyramids in Africa and America is an example of similar objects which occur far from each other and are most probably analogous phenomena.

3. RESULTS

3.1 Morphological and functional distinction

Scalene bladelets and scalene triangles differ by a number of properties (*Figure 1*, *Table 1*). Scalene bladelets regularly show a straight to slightly concave retouched longer leg transitioning into a likewise retouched shorter leg at an angle usually around 140° ±10°. The length ratio between the long and the short leg is usually 3 : 1 or higher. The short leg is straight or slightly convex but usually never concave. The third and usually unretouched edge meets the short leg in a point which is often located towards the longitudinal axis of the piece. This is either achieved by a short, slight retouch or given by the initial shape of the unretouched edge. The long leg converges with the unretouched edge either in a point or in a blunt end. Scalene triangles, on the other hand, regularly show a straight to slightly concave retouched longer leg transitioning into the shorter leg at an angle usually

around 120° ±10°. The length ratio between the long and the short leg is usually 2 : 1. The short leg is usually clearly concave and sometimes straight but not convex. The third edge regularly shows a denticulation and meets the short and the long leg in a point. The point with the short leg is often designed in a way that amplifies its position away from the longitudinal axis of the piece. Scalene triangles usually occur in considerably higher numbers than scalene bladelets in their respective assemblages.

Within the group of scalene bladelets, a microlithic variant with lengths at around and below 20 mm can be distinguished. It is mainly found in the Cantabrian area and seems to represent a late development (see 3.2).

How do these observations conform to expectations towards frontally and laterally hafted insets, i.e. points and barbs? Frontally hafted, pointed projectiles receive most of the impact energy via the point. The point, therefore, has to be rather stable to avoid breakage at impact without penetration. The short leg forming one side of the point should thus be straight or slightly convex. It should, however, not be concave, since the material reduction of a concave retouch reduces the stability of the point. For barbs, on the other hand, the shorter leg should preferentially be concave, since this enhances its function. A convex shape, in contrast, impedes it. For points, the angle between the short and the long leg should allow for the short leg to form a point with the unretouched edge more or less on-axis with the longitudinal axis of the piece. Therefore, the angle should be obtuse. However, the obtuser the angle gets, the longer the short leg becomes, and the more pointed and fragile the tip will be. A compromise between off-axis avoidance and a robust tip seems to be achieved with an angle at around 140°. A too pronounced lengthening of the tip can also be avoided by a slight curvature of the unretouched edge. Such

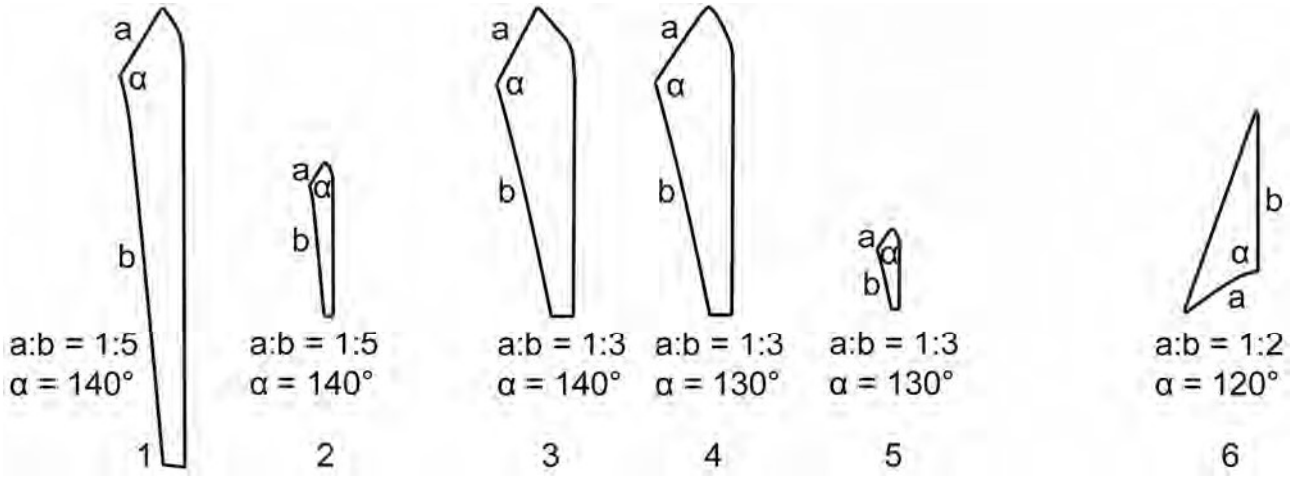

FIGURE 1: Morphological properties of scalene bladelets (1–5, 2 and 5 are microlithic variants) and scalene triangles (6). a: short leg, b: long leg, α: angle long/short leg, opposite of α: third edge.

TABLE 1: Morphological differences of scalene bladelets and scalene triangles in relation to expectations of frontally and laterally hafted tools. For nomenclature compare Figure 1.

	Scalene bladelets	Scalene triangles	Frontal hafting	Lateral hafting
Angle long/short leg	140° ±10°	120° ±10°	130–150°	110–130°
Short leg	straight/convex	concave/straight	straight/convex	concave/straight
Point third edge/short leg	towards longitudinal axis	off-axis	towards longitudinal axis	off-axis
Contact third edge/long leg	variable	point	variable	point
Ratio long to short leg	≥ 3:1	2:1	long	short
Numbers per assemblage	lower	higher	lower	higher

a curvature, either by retouch or by the natural shape of the blank, can regularly be observed for scalene bladelets. For barbs, the angle between the long and the short leg should be larger than 90° to assure its functionality. However, increasing this angle and keeping a length ration of 2 : 1 between the legs results in a decrease of the distance between the vertex between the short and long leg and the opposite, unretouched side. Such a decrease will make the barb narrower and more slender. This effect eventually decreases both the mechanical robustness and the distance with which the barb can protrude from the shaft. Given that hafting with birch tar or other adhesives seems likely, a certain protrusion of the barb is, however, necessary to warrant its functionality. To mediate between both requirements, an angle between 110° and 130° seems optimal. A concave retouch of the smaller leg further optimizes function at less obtuse angles. While a projectile usually has a single frontal inset, it can carry several lateral insets. To allow for more barbs per centimetre shaft, the long leg should be as short as possible, while still providing enough contact area for hafting. Laterally hafted pieces are thus expected to show a rather low long to short leg ratio. A high long to short leg ratio, to the contrary, is advantageous for frontally hafted pieces to prevent the inset from breaking away laterally at impact. If attached laterally, the convergence of the long leg and the unretouched edge should take the form of a point to avoid unwanted protruding. If inserted frontally, the morphology of this convergence is of lesser importance and can be pointed or blunt.

Eventually, it seems that the morphological properties of scalene bladelets indicate frontal hafting, whereas those of scalene triangles rather speak in favour of lateral hafting. The fact that scalene triangles usually occur in considerably higher numbers compared to scalene bladelets signals lateral hafting and thus corroborates this notion. The microlithic variant of scalene bladelets seems only functional when hafted frontally, probably on very light projectiles. Due to their extremely reduced width, they would vanish into the hafting adhesive making a lateral hafting rather unlikely. However, their considerably higher numbers compared to larger scalene bladelets may also indicate an entirely different use.

3.2 Chronology

When plotting all available radiocarbon dates for assemblages with scalene bladelets, scalene triangles, and barbed points (*Figure 2a*), it seems that scalene bladelets occur throughout a period of roughly 9000 years between 22 and 13 ka calBP. Scalene triangles appear a little later between 18.5 and 15.5 ka calBP and reappear between 14 and 13.5 ka calBP. Directly dated barbed points occur from about 15.8 ka calBP onwards. After reviewing the available radiocarbon data according to the criteria listed in 2.2 (see *Table 2*), the chronological pattern changes significantly (*Figure 2b*). The occurrence of scalene bladelets now appears to be limited to the period between 19 and 16 ka calBP. For scalene triangles, only the dates from Kniegrotte and Dzierżysław 35 withstand a critical evaluation and can be further aggregated to weighted averages. Admittedly, the data basis for scalene triangles is rather weak and it is well possible that future research will alter the picture significantly. However, based on the currently available dates, it seems that scalene triangles are a rather short-lived phenomenon at around 16 ka calBP. Moreover, they seem to overlap only briefly with scalene bladelets and disappear with the advent of barbed points. For the latter, the picture does not change. The above-mentioned microlithic variant of scalene bladelets can be separated also chronologically from the larger variant(s) and seems to occur between 16 and 15.5 ka calBP. They thus seem to post-date the use-period of their larger counterparts.

3.3 Phylogenetic relations

The assessment of a potential phylogenetic relation between scalene bladelets and scalene triangles according to the criteria stated above (see 2.3) gives the following results.

With regard to the revised radiocarbon dates, it can be stated that scalene triangles follow close upon scalene bladelets. From a chronological point of view, a phylogenetic relation thus seems possible. Moreover, scalene bladelets are morphologically similar to scalene triangles and it is their temporal succession and morphological resemblance which is probably at the root of their assumed phylogenetic relation. However, upon a closer look, the morphological similarity seems rather superficial. Without repeating the arguments given above (for details see 3.1), it has to be concluded that scalene bladelets are morphologically and functionally different from scalene triangles. It thus seems that their similarity is of analogous rather than homologous nature. The amount of scalene bladelets and scalene triangles of 81 assemblages is mapped in *Figure 3*. It becomes clear that scalene bladelets in both their large and microlithic variant have a clear focus in

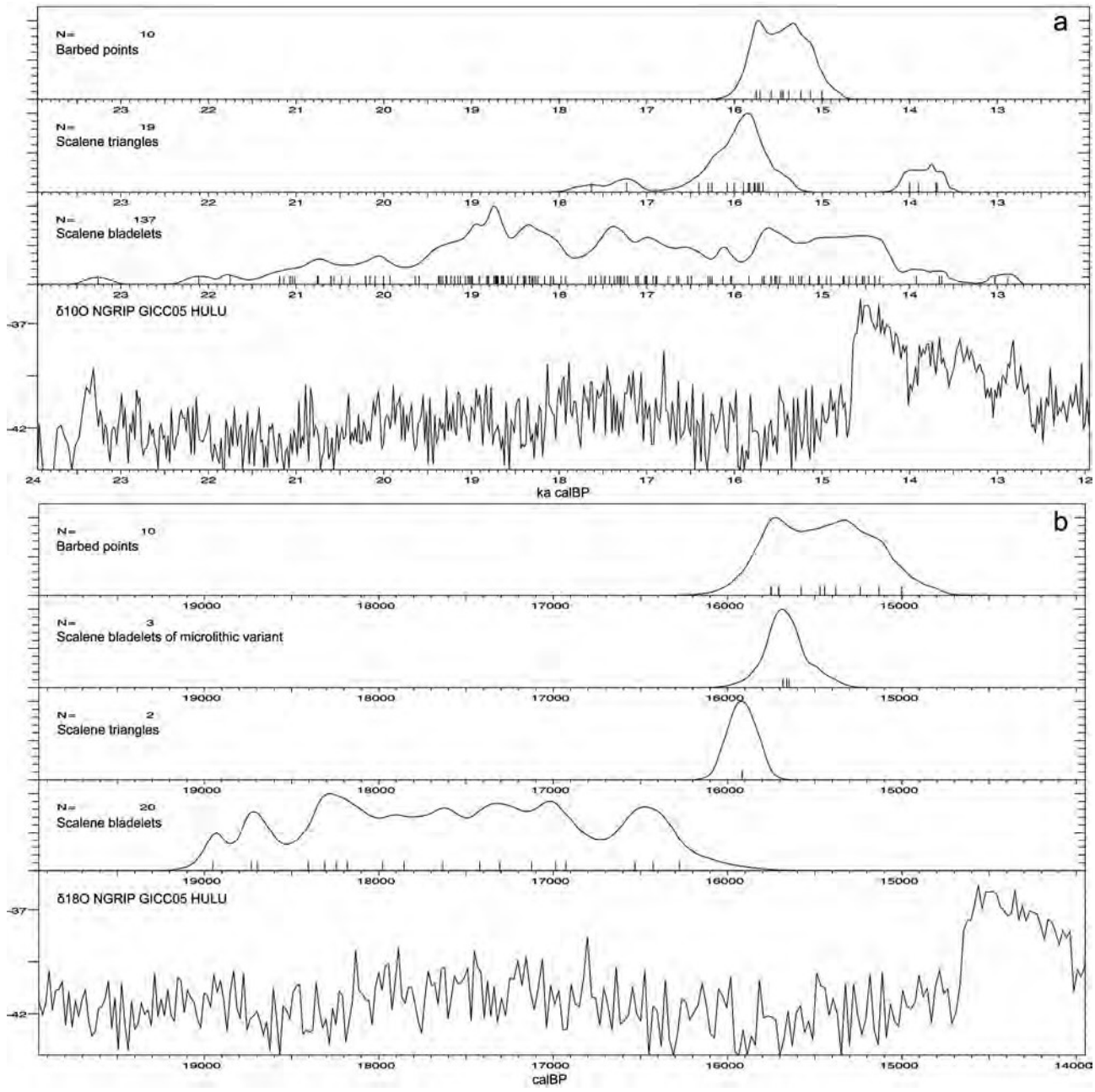

FIGURE 2: Radiocarbon dates for scalene bladelets, scalene triangle and barbed points before (a) and after (b) review (for uncalibrated dates and references see *Table 2*). Calibration with IntCal13 as implemented in CalPal-2014 (Weninger *et al.* 2014).

the Franco-Cantabrian region. The distribution pattern of scalene triangles, however, differs strongly. Virtually all sites are located north-east of the Tarn and Garonne rivers and in comparison to scalene bladelets, there is a significant occurrence in Central Europe. This spatial pattern indicates only weak overlap between the distribution areas of scalene bladelets and scalene triangles. Basically, the criterion of spatial proximity is thus met. However, the pronounced differences in the spatial distribution, which rather highlights segregation, cast doubts about a continuous succession between the two kinds of triangular insets.

TABLE 2: Radiocarbon dates of assemblages with scalene bladelets, scalene triangles, and directly dated barbed points as discussed in this study. Abbreviations: Pos : Position, layer, or other site unit; M: Material (a: antler; b: bone; bb: burnt bone; ch: charcoal; i: ivory; ns: not specified; so: soil; t: tooth; *: humanly modified); Sp/Ob: Species or object: (Ax: Alopex; B/B: Bos/Bison; BRP: barbed point; Ce: Cervus; d.s.: decorated spatula; E: Equus; Ho: Homo; Ma: Mammuthus; ns: not specified; R: Rangifer; SO: Snowy Owl; St: Saiga tatarica); A/C: AMS or conventional date (AMS: AMS-date; CON: conventional date); Lab.-Nr.: Laboratory Number; BP: uncalibrated ^{14}C-date before present; Std: standard deviation; Std%: percentage of Std from BP; calBP: calibrated date BP; P%: Probability for dates indicated by *, a, or b of being statistically identical; WA: weighted average for dates indicated by *, a, or b; R: reason for exclusion of date. For number code see list in section 2.2. Calibration with IntCal13 as implemented in CalPal-2014 (Weninger *et al.* 2014).

Site	Pos	M	Sp	A/C	Lab. Nr.	BP	Std	Std%	calBP	Std		P%	WA	Std	calBP	Std	A	Reference
Scalene bladelets																		
Abauntz	**e**	**b**	**d.s.**	**AMS**	**OxA-5983**	**13500**	**160**	**1,2**	**16280**	**230**								**Mazo, Utrilla 1996**
Abauntz	e-e1	b	ns	AMS	Beta-67949	14470	480	3,3	17520	620							1	Mazo, Utrilla 1996
Abauntz	e	b	ns	CON	GrN-16316	15460	130	0,8	18720	130							2	Mazo, Utrilla 1996
Abauntz	e	b	ns	CON	Ly-1965	15800	350	2,2	19130	390							1	Mazo, Utrilla 1996
Alonsé, Cova		**ch**	**ns**	**AMS**	**GrA-21537**	**14840**	**90**	**0,6**	**18070**	**120**	*							**Utrilla, Montes 2007**
Alonsé, Cova		**ch**	**ns**	**AMS**	**GrA-21536**	**15069**	**90**	**0,6**	**18310**	**130**	*							**Utrilla, Montes 2007**
												7,2	**14955**	**64**	**18180**	**100**		
Canecaude I	2	b	ns	CON	Gif-2708	14230	160	1,1	17310	220							6	Sacchi 1986
Caldas, Las	**11**	**n**	**ns**	**AMS**	**Ua-2734**	**13755**	**120**	**0,9**	**16630**	**200**								**Corchón Rodríguez *et al.* 2015**
Caldas, Las	**12**	**ns**	**ns**	**AMS**	**Ua-2735**	**14495**	**140**	**1,0**	**17660**	**170**	*							**Corchón Rodríguez *et al.* 2015**
Caldas, Las	**12**	**ns**	**ns**	**AMS**	**Ua-4300**	**14835**	**130**	**0,9**	**18060**	**160**	*							**Corchón Rodríguez *et al.* 2015**
												7,5	**14678**	**95**	**17860**	**120**		
Caldas, Las	**13**	**ns**	**ns**	**AMS**	**Ua-4301**	**15165**	**160**	**1,1**	**18400**	**190**								**Corchón Rodríguez *et al.* 2015**
Chair-à-Calvin	F, 6	b	ns	CON	Ly-1998	15440	440	2,8	18710	500							1	Dujardin, Tymula 2005
Chair-à-Calvin	6 (Bouvier)	b	St	AMS	OxA-12053	16020	80	0,5	19330	130							11	Dujardin, Tymula 2005
Combe Cullier	**10 base**	**b**	**ns**	**CON**	**Ly-978**	**15030**	**330**	**2,2**	**18240**	**360**								**Secher 2017**
Combe Cullier	**11**	**b**	**R**	**AMS**	**OxA-34936**	**15430**	**70**	**0,5**	**18700**	**80**								**Langlais *et al.* 2018**
Cueva Rascaño	4	b	ns	CON	BM-1453	15988	193	1,2	19290	240							6	Utrilla 1981
Duruthy	4 upper	b	ns	CON	Ly-859	13510	220	1,6	16300	320							1,2	Langlais 2007
Duruthy	**4 base**	**b**	**ns**	**CON**	**Ly-860**	**13840**	**210**	**1,5**	**16750**	**310**	*							**Langlais 2007**
Duruthy	**4**	**b**	**R**	**AMS**	**OxA-28118**	**14005**	**65**	**0,5**	**17010**	**120**	*							**Barshay-Szmidt *et al.* 2016**
Duruthy	4 base	ns	ns	CON	BOR7	14500	1450	10,0	17290	1890							1	Miller 2012
												45,3	**13991**	**62**	**16990**	**120**		
Duruthy	5	ns	ns	CON	Ly-861	14180	220	1,6	17220	310							1	Höck 2000
Ekain	VII	ns	ns	CON	I-13005	20900	450	2,2	25080	520							1	Altuna, Merino Eds. 1984
Ekain	VII B	ns	ns	CON	I-12224	16030	240	1,5	19350	290							5,7	Altuna, Merino Eds. 1984
Ekain	VII B	ns	ns	CON	I-12020	16510	270	1,6	19930	330							1	Altuna, Merino Eds. 1984
Ekain	VII c	ns	ns	CON	I-12225	15970	240	1,5	19280	280							5,7	Altuna, Merino Eds. 1984
Ekain	VII D	ns	ns	CON	I-12226	15400	240	1,6	18640	250							1	Altuna, Merino Eds. 1984
Ekain	VII F	ns	ns	CON	I-12566	16250	500	3,1	19640	580							1	Altuna, Merino Eds. 1984
Ekain	VII inf.	ns	ns	CON	I-10931	13950	330	2,4	16900	470							1	Altuna, Merino Eds. 1984
Faurélie II	4	b	ns	AMS	Lyon-5368(SacA-12061)	11010	60	0,5	12880	90							7a	Costamagno *et al.* 2016
Faurélie II	4	b	ns	AMS	Ly-on5367(SacA-12060)	11180	70	0,6	13030	80							7a	Collins 2012
Faurélie II	4	b	ns	AMS	Lyon-5366(SacA-12059)	11850	70	0,6	13660	80							7a	Costamagno *et al.* 2016
Faurélie II	5	ch	ns	CON	Gif-3649	11780	180	1,5	13630	190							7a	Langlais 2007
Faurélie II	5	b	R	AMS	Lyon-5370(SacA-12063)	12070	70	0,6	13920	100							7a	Collins 2012
Faurélie II	5	b	ns	AMS	Lyon-5369(SacA-12062)	12980	80	0,6	15520	150							7a	Collins 2012
Faustin	M/b	b	ns	CON	Ly-2700	12370	220	1,8	14520	400							1,6	Lenoir 1983

Flageolet II	IX top	b	ns	CON	Ly-917	14110	690	4,9	17000	910							1	Cattelain 2005
Flageolet II	IX whole	b	ns	CON	Ly-1182	14250	400	2,8	17260	540							1	Cattelain 2005
Flageolet II	IX base	b	ns	CON	Ly-918	15250	320	2,1	18470	340							1	Cattelain 2005
Gandil	2	ch	ns	AMS	GifA-93238	16070	160	1,0	19380	210							5	Djindjian 2000
Gandil	5	b	ns	AMS	GifA-96350	16580	160	1,0	20000	220							5	Djindjian 2000
Gandil	14	b	ns	AMS	GifA 96351	16700	160	1,0	20160	210							5	Djindjian 2000
Gandil	**20**	**ns**	**ns**	**AMS**	**Ly-2483 (Poz)**	**15033**	**120**	**0,8**	**18270**	**160**	*							**Djindjian 2000**
Gandil	**20**	**ns**	**ns**	**CON**	**Gif-9176**	**15380**	**140**	**0,9**	**18630**	**150**	*							**Djindjian 2000**
												6,0	**15180**	**91**	**18440**	**120**		
Gandil	20	b	ns	AMS	GifA-96416	16980	170	1,0	20480	220							5,7b	Djindjian 2000
Gare de Couze	H	b	ns	CON	Ly-975	12430	320	2,6	14610	520							1	Evin *et al.* 1976
Gare de Couze	G0	ns	ns	AMS	GrA-43937	12490	50	0,4	14690	200							6	Costamagno *et al.* 2016
Gare de Couze	H	b	R	AMS	GrA-45456	12630	120	1,0	14900	260	*						7a	Costamagno *et al.* 2016
Gare de Couze	H	b	R	AMS	GrA-45461	12800	60	0,5	15260	90	*						7a	Costamagno *et al.* 2016
												20,5	12766	54	15210	70		
Grande Bize	3	b	ns	CON	Ly-1232	14530	510	3,5	17590	650							1	Sacchi 1986
Grande Bize	**3**	**ch**	**ns**	**CON**	**Ly-1675**	**14770**	**160**	**1,1**	**17980**	**200**								**Sacchi 1986**
Gazel, Grotte	**7 sec F**	**ch**	**ns**	**AMS**	**KIA-22855**	**14213**	**60**	**0,4**	**17310**	**110**								**Langlais 2007**
Gazel, Grotte	**7 sec F**	**ch**	**ns**	**AMS**	**KIA-22856**	**14462**	**62**	**0,4**	**17630**	**100**								**Langlais 2007**
Gazel, Grotte	7 sec F	ch	ns	CON	Gif-2655	15070	270	1,8	18300	290							1	Langlais 2007
La Vache	**ns**	**b**	**ns**	**AMS**	**GifA-96478**	**13490**	**120**	**0,9**	**16250**	**170**	*							**Langlais 2007**
La Vache	**ns**	**b**	**ns**	**AMS**	**GifA-96480**	**13650**	**130**	**1,0**	**16490**	**200**	*							**Langlais 2007**
La Vache	**ns**	**b**	**ns**	**AMS**	**GifA-96479**	**13770**	**140**	**1,0**	**16660**	**230**	*							**Langlais 2007**
												30,5	**13622**	**75**	**16430**	**120**		
La Vache	Tr2	ch	ns	CON	GrN-2025	12540	105	0,8	14750	270							2	Langlais 2007
La Vache	Tr4	ch	ns	CON	GrN-2026	12850	140	1,1	15360	220							2	Langlais 2007
Lafaye, Abri		b	Ho	AMS	GifA-95047	15290	150	1,0	18540	170							1	Secher 2017
Lascaux	/c	ch	ns	AMS	GrN-1632	17190	140	0,8	20750	190							8	Leroi-Gourhan, Evin 1979
Lascaux	/c	ns	ns	CON	SA-102	16000	500	3,1	19370	560							1,8	Leroi-Gourhan, Evin 1979
Lassac		ch	ns	AMS	KIA-25340	13335	45	0,3	16040	90							5	Petillon, Ducasse 2012
Lassac		a	ns	AMS	Ly-6420/SacA-17497	16230	100	0,6	19600	150							5,11	Petillon, Ducasse 2012
Lassac		ns	ns	AMS	GrA-18488/Ly-1548	16580	80	0,5	20000	120	*						5,11	Petillon, Ducasse 2012
Lassac		a	ns	AMS	Ly-6421/SacA-17498	16650	100	0,6	20100	140	*						5,11	Petillon, Ducasse 2012
Lassac		b	ns	CON	Gif-2981	16750	250	1,5	20210	310	*						5,11	Petillon, Ducasse 2012
												73,9	16616	61	20050	100		
Lassac		a	ns	AMS	Ly-6417/SacA-17494	17400	110	0,6	21020	180	*						5,11	Petillon, Ducasse 2012
Lassac		a	ns	AMS	Ly-6418/SacA-17495	17530	100	0,6	21190	170	*						5,11	Petillon, Ducasse 2012
												38,2	17471	74	21110	150		
Laugerie-Haute	I''' 2,3/?	ns	ns	CON	Ly-974	13970	480	3,4	16890	640							1	Délibras, Evin 1976
Laugerie-Hte Est	**II**	**ns**	**R**	**AMS**	**OxA-761**	**14320**	**180**	**1,3**	**17420**	**240**								**Gowlett *et al.* 1986**
Laugerie-Hte Est	**II**	**ns**	**R**	**AMS**	**OxA-759**	**14320**	**180**	**1,3**	**17420**	**240**								**Gowlett *et al.* 1986**
Laugerie-Hte Est	II	ns	R	AMS	OxA-760	15730	200	1,3	19040	230							5	Gowlett *et al.* 1986
Laugerie-Hte Est	I'' X8/?	ns	ns	CON	Ly-973	17040	440	2,6	20600	560							1	Délibras, Evin 1976
Laugerie-Hte Est	**Mag3, IIIb, IIIs**	**ns**	**R**	**AMS**	**OxA-762**	**14100**	**180**	**1,3**	**17120**	**270**								**Gowlett *et al.* 1986**
Laugerie-Hte Est	Mag3, IIIb, IIIs	ns	R	AMS	OxA-480	14730	250	1,7	17930	300							1	Gowlett *et al.* 1986
Laugerie-Hte Est	**Mag3, IIIb, IIIs**	**ns**	**R**	**AMS**	**OxA-492**	**14770**	**180**	**1,2**	**17980**	**220**								**Gowlett *et al.* 1986**
Le Martinet	IV	b	ns	CON	Ly-1605	12600	1100	8,7	15040	1460	*						1	Le Tensorer 1981
Le Martinet	IV	b	ns	CON	Ly-5069	14098	239	1,7	17100	350	*						1	Djindjian 2000
												18,3	14030	234	17010	350		

TABLE 2: Continued.

Les Conques	2	b	ns	CON	Ly-8778	13335	140	1,0	16030	190							6	Langlais 2007
Legintxiki	1a	n	ns	AMS	Ua-3397	14865	130	0,9	18100	160							6	Cabello 1993
Mirón	504	ns	ns	AMS	MAMS-14585	15460	40	0,3	18730	60							5	Straus *et al.* 2015
Mirón	**504**	**ns**	**ns**	**AMS**	**UGAMS-7217**	**15740**	**40**	**0,3**	**18990**	**80**	*							**Straus *et al.* 2015**
Mirón	**505**	**ns**	**ns**	**AMS**	**UGAMS-15183**	**15670**	**40**	**0,3**	**18910**	**70**	*							**Straus *et al.* 2015**
Mirón	**312**	**ns**	**ns**	**CON**	**GX-31932**	**15850**	**170**	**1,1**	**19150**	**210**	*							**Straus, Gonzales Morales 2007**
												32,6	**15709**	**28**	**18950**	**60**		
Montlleó	**C**	**ns**	**ns**	**AMS**	**OxA-9017**	**15440**	**80**	**0,5**	**18700**	**90**	*							**Mangado *et al.* 2009**
Montlleó	**C**	**ns**	**ns**	**AMS**	**OxA-14034**	**15550**	**140**	**0,9**	**18810**	**140**	*							**Mangado *et al.* 2009**
												49,5	**15467**	**69**	**18730**	**80**		
Pégourié	8A2	b	ns	CON	Ly-5257	16890	300	1,8	20390	370	*						1	Miller 2012
Pégourié	8 a	b	ns	CON	Ly-1834	17400	460	2,6	21040	580	*						1	Miller 2012
Pégourié	8b	b	ns	CON	Ly-1394	17490	520	3,0	21140	640	*						1	Miller 2012
												48,1	17127	226	20680	290		
Pégourié	9a	b	ns	CON	Ly-1836	17420	390	2,2	21070	500							1	Miller 2012
Peyrugues	3	b	ns	CON	Gif-7592	13020	140	1,1	15580	220							2,5	Drucker *et al.* 2003
Peyrugues	**3**	**b**	**ns**	**AMS**	**LYON-3599 (SacA-5537)**	**13700**	**60**	**0,4**	**16530**	**120**								**Langlais 2007**
Peyrugues	**3**	**b**	**ns**	**AMS**	**LYON-3600(SacA-5538)**	**13960**	**100**	**0,7**	**16930**	**170**								**Langlais 2007**
Plantade	c. noire inf.	b	Ho	AMS	GifA-96326	12740	120	0,9	15140	210							5	Gambier *et al.* 2000
Plantade	c. noire inf.	b	ns	AMS	GifA-94184	14020	140	1,0	17020	230							5	Gambier *et al.* 2000
Plantade	c. noire inf.	b	Ho	AMS	GifA-94185	15890	160	1,0	19190	210							5	Gambier *et al.* 2000
Roc-de-Marcamps2	**2a**	**b**	**St**	**AMS**	**OxA-28091**	**15570**	**75**	**0,5**	**18820**	**80**	*							**Secher 2017**
Roc-de-Marcamps2	**2b**	**ns**	**R**	**AMS**	**OxA-28092**	**15480**	**75**	**0,5**	**18740**	**90**	*							**Secher 2017**
Roc-de-Marcamps2	**3**	**b**	**ns**	**CON**	**Ly-4222**	**15070**	**270**	**1,8**	**18300**	**290**	*							**Secher 2017**
Roc-de-Marcamps2	**3**	**b**	**St**	**AMS**	**OxA-28089**	**15460**	**70**	**0,5**	**18720**	**80**	*							**Secher 2017**
Roc-de-Marcamps2	**3**	**ns**	**R**	**AMS**	**OxA-18090**	**15550**	**75**	**0,5**	**18810**	**80**	*							**Secher 2017**
Roc-de-Marcamps2	**3**	**b**	**ns**	**AMS**	**Ly-2681**	**15700**	**430**	**2,7**	**19020**	**480**	*							**Secher 2017**
												48,9	**15506**	**36**	**18770**	**60**		
Rond du Barry	D	a	R	AMS	Beta-223278	14230	25	0,2	17330	90							5	Raynal *et al.* 2014
Rond du Barry	E	so	ns	CON	Gif-2671	12380	280	2,3	14540	470							1,2,5	Raynal *et al.* 2014
Rond du Barry	E	a*	R	AMS	Beta-306186	12400	25	0,2	14470	150							5	Raynal *et al.* 2014
Rond du Barry	E	a*	R	AMS	Beta-306187	17210	40	0,2	20760	100							5	Raynal *et al.* 2014
Rond du Barry	E	a*	R	AMS	Beta-297897	17960	35	0,2	21750	100							5	Raynal *et al.* 2014
Rond du Barry	E	a	R	AMS	Beta-297896	18240	45	0,2	22110	120							5	Raynal *et al.* 2014
Rond du Barry	E	a	R	AMS	Beta-297894	19310	40	0,2	23260	120							5	Raynal *et al.* 2014
Rond du Barry	E1	b	ns	CON	Gif-3492	12800	170	1,3	15240	300							2,5	Raynal *et al.* 2014
Rond du Barry	E1	so	ns	CON	Gif-2672	15400	400	2,6	18660	450							1,2,5	Raynal *et al.* 2014
Rond du Barry	E3	b	R	AMS	Beta-223276	13400	25	0,2	16130	60							5	Raynal *et al.* 2014
Rond du Barry	E3	a	R	AMS	Beta-297899	14340	30	0,2	17480	70							5	Raynal *et al.* 2014
Rond du Barry	E3	a*	R	AMS	Beta-297898	15120	60	0,4	18380	100							5	Raynal *et al.* 2014
Rond du Barry	E3	a*	R	AMS	Beta-297893	15750	30	0,2	19000	80							5	Raynal *et al.* 2014
St-G.-la-Rivière	**ens. Sup./C1**	**b**	**R**	**AMS**	**Poz-52970**	**14940**	**70**	**0,5**	**18170**	**110**	*							**Barshay-Szmidt *et al.* 2016**
St-G.-la-Rivière	**ens. Sup./C1**	**b**	**B/B**	**AMS**	**OxA-26655**	**15090**	**75**	**0,5**	**18340**	**120**	*							**Barshay-Szmidt *et al.* 2016**
St-G.-la-Rivière	**ens. Sup./C1**	**a**	**R**	**AMS**	**OxA-26486**	**15140**	**90**	**0,6**	**18400**	**120**	*							**Barshay-Szmidt *et al.* 2016**
St-G.-la-Rivière	**ens. Sup./C1**	**b**	**ns**	**AMS**	**OxA-7345/Ly-615**	**15330**	**150**	**1,0**	**18580**	**160**	*							**Lenoir 2000**
												6,8	**15065**	**43**	**18310**	**90**		
St-G.-la-Rivière	ens. Sup./C1	b	SO	AMS	OxA-X-2503-18	15940	80	0,5	19230	140							5	Barshay-Szmidt *et al.* 2016

Tastet	US205	b	R	AMS	Ly-10027 (SacA-32392)	14270	80	0,6	17370	130						5	Petillon *et al.* 2015
Tastet	US207	b	Ce	AMS	Ly-10028 (SacA-32393)	15800	90	0,6	19070	120						5	Petillon *et al.* 2015
Tastet	US305	b	E	AMS	Ly-10029 (SacA-32394)	13930	70	0,5	16890	130						5	Petillon *et al.* 2015
Urtiaga	F	ch	ns	CON	GrN-5817	17050	140	0,8	20570	190						6	Utrilla 1981
Scalene bladelets, microlithic variant																	
Bora Gran	ns	t	R	AMS	Ox BGA-2222	12830	80	0,6	15330	140						9	Langlais 2007
Bora Gran	**ns**	**t**	**R**	**AMS**	**Ox BGA-2153**	**13080**	**90**	**0,7**	**15660**	**170**							**Langlais 2007**
C. d. Belvis	3	b	ns	CON	Gif-2950	12270	280	2,3	14400	480						1	Sacchi 1986
C. d. Belvis	3	b	ns	AMS	SacA-6971	12330	50	0,4	14350	160						5	Miller 2012
C. d. Belvis	**3**	**b**	**ns**	**AMS**	**SacA-6973**	**13080**	**50**	**0,4**	**15680**	**100**							**Miller 2012**
Chaves	2b	bb	ns	CON	GrN-14561	12660	70	0,6	15030	140						5	Langlais 2007
Chaves	2b	bb	ns	CON	GrN-15635	12950	70	0,5	15480	130						5	Langlais 2007
Parco	II; -269	ch	ns	AMS	OxA-10797	12460	60	0,5	14610	220						5	Mangado *et al.* 2006/2007
Parco	II; -271	ch	ns	AMS	OxA-10835	12560	130	1,0	14760	300						5	Mangado *et al.* 2006/2007
Parco	II; -230–240	ch	ns	AMS	OxA-10796	12605	60	0,5	14950	140	*					5	Mangado *et al.* 2006/2007
												22,8	12535	40	14840	140	
Parco	**II; -285**	**ch**	**ns**	**AMS**	**OxA-13597**	**12995**	**50**	**0,4**	**15540**	**120**	*						**Mangado *et al.* 2006/2007**
Parco	**II; -280**	**ch**	**ns**	**AMS**	**OxA-13596**	**13025**	**50**	**0,4**	**15580**	**120**	*						**Mangado *et al.* 2006/2007**
Parco	**II; -273**	**ch**	**ns**	**AMS**	**OxA-10798**	**13175**	**60**	**0,5**	**15840**	**100**	*						**Mangado *et al.* 2006/2007**
												5,5	**13053**	**30**	**15650**	**80**	
Scalene triangles																	
Birsek	M/b	b	ns	CON	B-4261	12040	80	0,7	13900	100	*					7,10	Le Tensorer 1998
Birsek	M/b	b	ns	CON	B-4260	11860	100	0,8	13680	110	*					7,10	Le Tensorer 1998
Birsek	lower	b	R	AMS	ETH-43307	11900	55	0,5	13700	80	*					7,10	Leesch *et al.* 2012
												26,2	11930	41	13740	70	
Dzierżysław 35	1a; -35–58	ns	ns	AMS	Poz-7318	12150	70	0,6	14000	110						5	Wisniewski *et al.* 2017
Dzierżysław 35	**1a; -35–55**	**b**	**Ma**	**AMS**	**Poz-10135**	**13180**	**60**	**0,5**	**15840**	**100**	**a/b**						**Wisniewski *et al.* 2017**
Dzierżysław 35	**1a; -35–59**	**b**	**Ma**	**AMS**	**GdA-70**	**13220**	**70**	**0,5**	**15890**	**110**	**a/b**						**Wisniewski *et al.* 2017**
Dzierżysław 35	**1a; -35–60**	**b**	**ns**	**AMS**	**GdA-193**	**13370**	**80**	**0,6**	**16080**	**120**	**a/b**						**Wisniewski *et al.* 2017**
											a: 15.6	**13239**	**40**	**15920**	**80**		
Dzierżysław 35	**1a; -35–61**	**ns**	**ns**	**AMS**	**GdA-69**	**13500**	**80**	**0,6**	**16260**	**120**	**b**						**Wisniewski *et al.* 2017**
											b: 0.7	**13291**	**35**	**15980**	**80**		
Dzierżysław 35	1a; -35–57	b	Ma	AMS	Poz-10136	14150	70	0,5	17230	120						5	Wisniewski *et al.* 2017
Kniegrotte	**VIII lower**	**b**	**St**	**AMS**	**OxA-4853**	**13090**	**130**	**1,0**	**15670**	**220**	*						**Hedges *et al.* 1992**
Kniegrotte	**VIII upper**	**b**	**R**	**AMS**	**OxA-4845**	**13120**	**130**	**1,0**	**15720**	**220**	*						**Hedges *et al.* 1992**
Kniegrotte	**VIII middle**	**b**	**St**	**AMS**	**OxA-4849**	**13130**	**120**	**0,9**	**15740**	**200**	*						**Hedges *et al.* 1992**
Kniegrotte	**VIII middle**	**b**	**E**	**AMS**	**OxA-4848**	**13150**	**130**	**1,0**	**15760**	**210**	*						**Hedges et al. 1992**
Kniegrotte	**VIII middle**	**b**	**Ax**	**AMS**	**OxA-4850**	**13160**	**140**	**1,1**	**15770**	**220**	*						**Hedges *et al.* 1992**
Kniegrotte	**VIII upper**	**b**	**E**	**AMS**	**OxA-4846**	**13190**	**130**	**1,0**	**15830**	**200**	*						**Hedges *et al.* 1992**
Kniegrotte	**VIII upper**	**b**	**R**	**AMS**	**OxA-4832**	**13310**	**110**	**0,8**	**16000**	**160**	*						**Hedges *et al.* 1992**
Kniegrotte	**VIII lower**	**b**	**E**	**AMS**	**OxA-4852**	**13520**	**130**	**1,0**	**16300**	**190**	*						**Hedges et al. 1992**
Kniegrotte	**lower**	**b**	**ns**	**CON**	**Bln-1564**	**13585**	**165**	**1,2**	**16400**	**240**	*						**Hedges *et al.* 1992**
Kniegrotte												**9,9**	**13238**	**43**	**15920**	**90**	
Kniegrotte	VIII lower	b	Ma	AMS	OxA-4851	14470	140	1,0	17630	180						5	Hedges *et al.* 1992
Barbed points (≥15.000 calBP)																	
Bois-Ragot	**6 Magda**	**ns**	**Brp**	**AMS**	**OxA-12080/Ly-2103**	**12630**	**50**	**0,4**	**15000**	**110**							**Pétillon 2016**
El Castillo	**CS 11**	**b**	**Brp**	**AMS**	**OxA-972**	**12930**	**130**	**1,0**	**15470**	**200**							**Barandiaran 1988**

TABLE 2: Continued.

Espalugue	NA	a	Brp	AMS	OxA-28086	13120	55	0,4	15750	100	Pétillon 2016
Fontales	I–III	b	Brp	AMS	GifA-96327	13140	120	0,9	15750	200	Tisnérat-Laborde 1997
Isturitz, Gr. Salle	I, F1	ns	Brp	AMS	OxA-19833	13095	55	0,4	15710	110	Szmidt *et al.* 2009
Montastruc		ns	Brp	AMS	GifA-96346	13020	130	1,0	15580	210	Tisnérat-Laborde 1997
Morin	A III	a	Brp	AMS	OxA-26667	12705	55	0,4	15130	80	Pétillon 2016
Morin	AIV	a	Brp	AMS	OxA-26669	12785	60	0,5	15240	80	Pétillon 2016
Morin	B I	a	Brp	AMS	OxA-26666	12870	60	0,5	15380	120	Pétillon 2016
Morin	B I	a	Brp	AMS	OxA-26668	12920	60	0,5	15440	120	Pétillon 2016

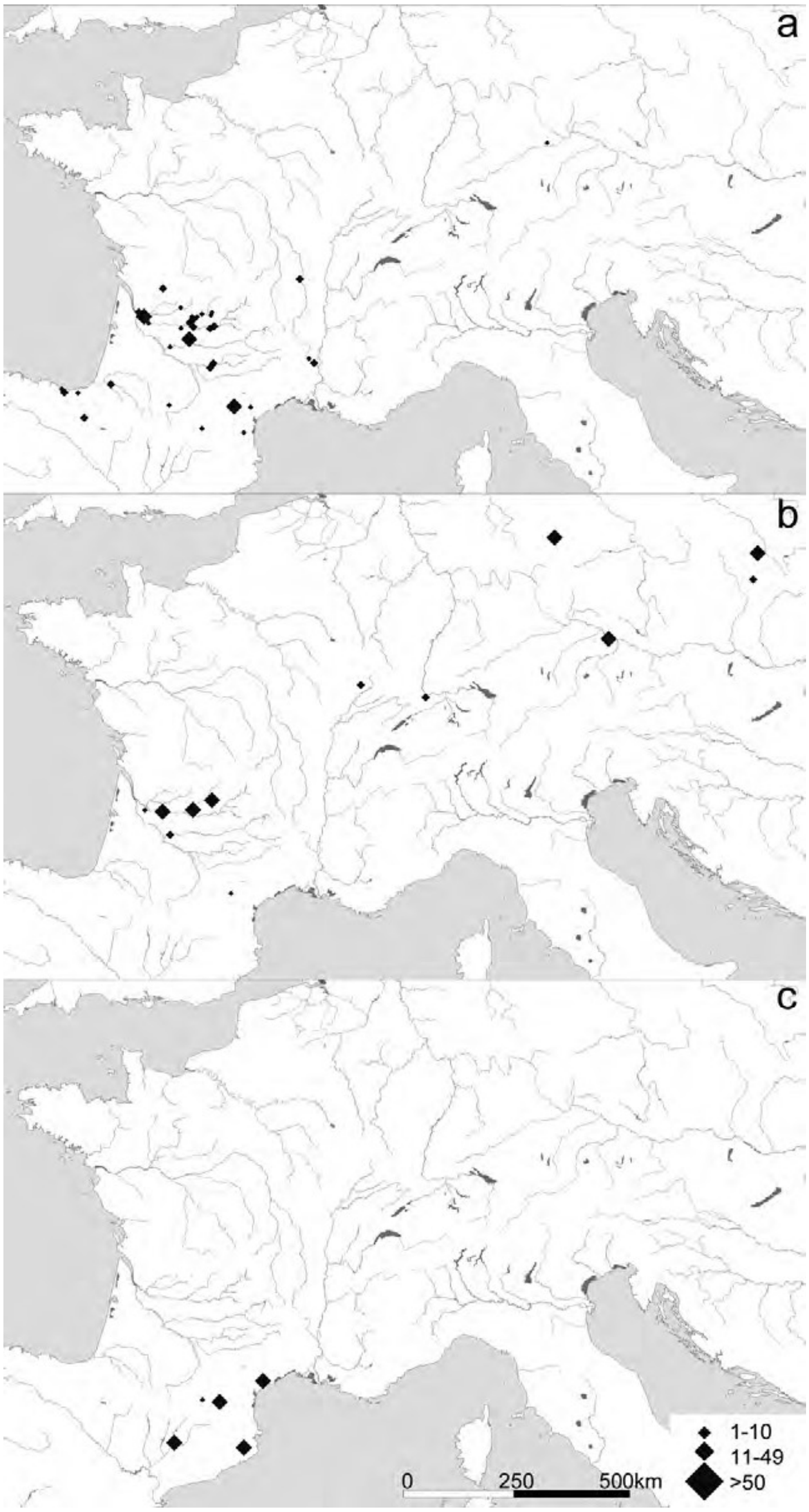

FIGURE 3: Spatial distribution of scalene bladelets (a), scalene triangles (b), and scalene bladelets of the microlithic variant (c).

Eventually, it can be stated that despite a superficial morphological similarity and a clear temporal proximity, the criterion of spatial proximity is only partly met. Most important, however, is the finding that scalene bladelets and scalene triangles, on closer examination, differ strongly from one another with regard to morphology and, likely, function. Thus, it has to be concluded that scalene bladelets and scalene triangles are probably phylogenetically unrelated.

4. DISCUSSION

In the following, two aspects of the results shall be discussed in more detail. First, the outcome of the chronological review is tested against the evidence from typologically dated assemblages. Afterwards, the finding that scalene bladelets and scalene triangles are probably phylogenetically unrelated is discussed and an alternative view is presented.

4.1 Assemblages with triangular implements and their chronological signals

This section compares the findings of the revised radiocarbon chronology to the typology-based chronological attribution of 81 sites yielding assemblages with triangular implements. Here, an attribution of assemblages containing scalene bladelets to the Middle Magdalenian or Magdalenian II and III is seen as in line with the findings from the revised radiocarbon chronology. The same applies to assemblages with scalene triangles attributed to the Late Middle Magdalenian or Magdalenian III. Those assemblages with a divergent attribution are critically assessed with regard to the morphology of the triangular pieces in question, their stratigraphic integrity, and argumentative capacity in terms of chronology. To be sure, also those assemblages corroborating the findings of the chronological review eventually require a thorough discussion. Additionally, it needs to be stressed that several assemblages are attributed to a Middle Magdalenian (or Magdalenian II and III) exactly

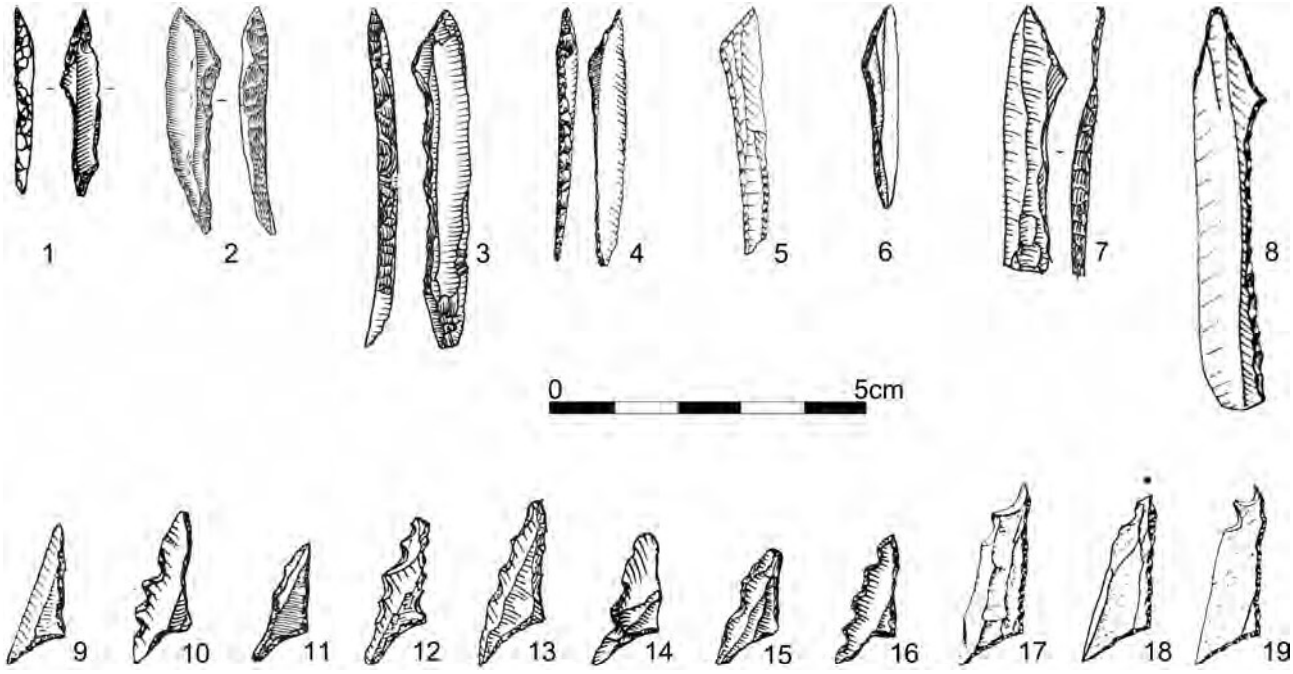

FIGURE 4: 1–2, Shouldered points between 23.5 and 20 ka calBP (Cuzoul de Vers, layers 20 and 21, Ducasse 2010); 3–6, scalene bladelet variant of shouldered points between 19 and 16 ka calBP (3: Laugerie-Haute; 4: Chair-à-Calvin; 5: Abri Lafaye; 6: Puy-de-Lacan; Höck 2000); 7–8, shouldered points at around 16 ka calBP (7: Abri Morin, Lenoir 2003; 8: Duruthy c3, Langlais 2007); 9–19, scalene triangles (9–11: Puy-de-Lacan; 12–13: Garrigue; 14–16: Crabillat; 17–19: Kniegrotte; Höck 2000).

because of the presence of scalene bladelets or triangles. Such an attribution is thus not a chronological argument in itself, but merely indicates that no artefacts contradicting such an attribution are present in the assemblages. Having that said and given the aim of this section, emphasis is given to the divergent attributions.

Large parts of this review are based on the works of Höck (2000) and Langlais (2007), who provide thorough reviews and analyses of assemblages with triangular lithic implements, to which the reader is referred for more details. Here only those information relevant for an assessment of the integrity and chronology of the assemblages will be stated.

Abauntz, Cueva de: Two triangular pieces have been recorded in the Magdalenian layer together with organic points with lateral grooves. The assemblage is assigned to the Middle Magdalenian (Höck 2000). However, no drawings have been available and the ^{14}C-dates indicate Middle and Upper Magdalenian components (*Table 2*).

Abzac, Grotte d': There is a single triangular artefact reported from a raclette-bearing layer from Abzac (Höck 2000). However, the 40 mm long and 10 mm wide piece shows an angle between the short and the long leg of around 105°. The artefact is morphologically very different from scalene bladelets or triangles and thus cannot be considered.

Aitzbitartre IV, Cueve de: The Magdalenian layer probably yielded two levels, which are, however, recorded together and contain three scalene bladelets (Höck 2000). Since the integrity of the assemblage is doubtful, it cannot be used for a chronological assessment.

Alonsé, Cova: There is a scalene bladelet reported from this site (Langlais 2013). Two ^{14}C-dates give an average date of roughly 18.1 ka calBP.

Baume-Loire I, Abri de: Four triangular pieces are reported from a Late Magdalenian assemblage with backed points from Baume-Loire I (Höck 2000). One fragmented piece does not resemble a triangle at all. A second fragment is rather large and might belong to an angled backed point. Two pieces resemble scalene bladelets, but are rather thin and with an angle at around 125° well within the spectrum of obliquely truncated backed bladelets. They thus cannot be considered.

Bellet: Two long scalene bladelets are reported from an assemblage attributed to the Lower Magdalenian (Höck 2000).

Belvis, Cauna de: There are 137 scalene bladelets of the microlithic variant (Langalis 2007) reported from an assemblage roughly dated to 15.7 ka calBP (see *Table 2*).

Benet, Sant: This collection contains 189 triangular pieces described as scalene bladelets and attributed to a Middle Magdalenian (Langlais 2007). With regard to their small dimensions and high numbers, they might also belong to the younger, microlithic variant.

Birseck-Ermitage: The Magdalenian assemblage contains 13 scalene triangles (Höck 2000). Two ^{14}C-dates gave results of around 13.7 ka calBP, indicating admixture with younger finds. Thus, the assemblage cannot be used to determine the chronological position of scalene triangles.

Bize, Grotte de Grande: Two scalene bladelets are reported, which are associated with baguettes demi-rondes and organic projectiles with longitudinal grooves attributed to the Middle Magdalenian (Höck 2000).

Blanchisserie: Two scalene bladelets are reported from a layer attributed to a Magdalenian II (Onoratini *et al.* 1996: 26).

Bois-Ragot, Grotte du: One triangle is reported for the upper of two Final Magdalenian layers (Höck 2000). However, no drawing is available. Since this piece occurs singly and cannot be assessed further, it has no argumentative capacity in this discussion.

Bora Gran: The cave was excavated at many attempts and mainly at an early date. The assemblage assigned to an Upper Magdalenian (Langlais 2007) likely has a strong palimpsest character and cannot be used in a chronological discussion. Also, the depicted pieces referred to as scalene bladelets are morphologically different to those addressed in this study.

Bourouilla: The assemblage B attributed to an Upper Magdalenian contains triangular pieces resembling those from Gare de Couze (Langlais 2007). Since the triangles from Gare de Couze are morphologically different from both scalene bladelets and scalene triangles, this assemblage cannot be considered in this discussions.

Caldas, Las: In Sala II, triangular artefacts are reported from layers XI, XII, and XIII (Corchon-Rodriguez *et al.* 2015). Three AMS dates place layers XIII at 18.4, XII at 17.8, and XI at 16.6 ka calBP (*Table 2*). Much as at Parpalló (see below) the morphological variability of the triangular lithic artefacts is extremely large.

Cancaude I, Grotte de: Eight scalene bladelets are associated with self-barbed points, Lussac-Angle points, double-beveled points, and fragments of

baguettes demi-rondes. Additionally, fragments of points decorated with raised humps and a pierced hyoid bone (Sacchi 1986: 142 et seqq.) occur. The organic artefacts are thus characteristic of a Middle Magdalenian in both its older and younger phase. A single radiocarbon date gives an age of about 17.3 ka calBP (*Table 2*).

Cap-Blanc, Abri du: One artefact found at Cap-Blanc is classified as triangle and together with a baguette demi-ronde attributed to the Magdalenian III (Höck 2000). The large laterally retouched piece, however, has a morphology which neither allows a classification as scalene bladelet nor as scalene triangle. It is thus not considered in this discussion.

Castelmoron, Roche de: 139 triangular pieces are reported from an up to 100 cm thick colluvial, reworked layer (Höck 2000). Judging from the available drawings, the assemblage comprises scalene bladelets, scalene bladelets of the microlithic variant as well as scalene triangles. Given the reworked character of the sediments, the assemblage likely represents a palimpsest and is thus unsuited for chronological questions.

Cendres, Cueva de: After illicit digs had taken place in the cave, an excavation in 1981 should assess the amount of destruction and secure the profiles. The first 80 cm were recorded as strongly disturbed. Below lay an about 60 cm thick horizon which contained, among others, triangular implements and fragments of barbed points (Höck 2000). The thickness of the horizon and the contact to the disturbed layers calls the integrity of the assemblage into question. Thus, it cannot be considered.

Chair-à-Calvin, Abri de la: 12 scalene bladelets are reported from a layer roughly dated to 19 ka calBP (Höck 2000; *Table 2*).

Chariez-Guillotine: In a narrow crack below a terrace accumulated eroded sediments, which were accessed by a sondage in 1955. The small inventory yielded, among others, three angled fragments and three small triangular pieces (Höck 2000). Since the assemblage represents a collection of artefacts eroded from the surface above, its integrity is highly questionable and a Mesolithic component cannot be ruled out. Thus it cannot be considered for a chronological discussion.

Chez-Galou, Abri de: One scalene bladelet is reported from an ensemble attributed typologically to the Magdalenian V–VI (de Sonneville-Bordes 1960, Höck 2000). However, given the early date of the excavation, a palimpsest character of the assemblage is highly liekly and it cannot be considered here.

Combe Cullier, Grotte de: Three scalene bladelets are reported from an assemblage of an old excavation, which is attributed and dated to the Middle Magdalenian (Höck 2000; *Table 2*). Recent works have confirmed an intact stratigraphic sequence with at least 13 scalene bladelets in layers 13b and 13c, 4 pieces in layers 12 and 13a, and 6 pieces in layer 11 (Sécher 2017: 175–181, Fig. 76, 80, 81). There seems to be a trend of the scalene baldest getting narrower from the lower to the upper layers.

Conques, Les: The assemblage comprises single- and double-bevelled based points, barbed points, and half-round rods, as well as simple and truncated backed bladelets, among which some might represent scalene bladelets comparable to those from Cova Parco (Langlais 2007). Since the organic industry suggests an admixture of Late Middle and Upper Magdalenian finds, this assemblage cannot be used for a chronological discussion.

Crabillat, Abri de: The small assemblage of about 770 artefacts comprises 161 scalene triangles (Höck 2000). Given the presence of a baguette demi-ronde, a late Middle Magdalenian age seems likely.

Crès, Le: The assemblage contains 161 scalene bladelets, most of them extremely narrow, and is attributed to the Middle Magdalenian (Langlais 2007). Given their high numbers, dimensions, and general resemblance to the pieces from Cova Parco, a chronological position at around 15.7 ka calBP may also be likely.

Duruthy, Abri de: Triangular artefacts have been found in three levels (Höck 2000). The lowermost layer 5 yielded one scalene bladelet and is roughly dated to 17.2 ka calBP (*Table 2*). Layer 4, dated to roughly 17 ka calBP, yielded 3 pieces. With angles between the short and the long leg at around 110°, they must be considered questionable in their attribution to scalene bladelets or scalene triangles. Layer 3 yielded 15 pieces which are small and typologically different from scalene bladelets in their microlithic variant. Here, an intrusion of younger, potentially Mesolithic elements is very likely. A date of around 13 ka calBP is – in any case – clearly outside the Magdalenian range. Except for the lower layer, the assemblages thus cannot be considered.

Dzierżysław 35: The open-air site has been excavated in the 1990s and yielded a rich inventory with a larger number of lithic triangles (Ginter *et al.* 2005). ^{14}C-dates indicate an age of about 15.9 ka calBP (*Table 2*).

Eitensheim-Windhöhe: A single scalene bladelet is reported from this surface collection which contains

Upper Palaeolithic and Levallois material (Höck 2000). As with all surface collections, it cannot be used for chronological discussions.

Ekain: From layer VII, 19 scalene bladelets and 2 triangles are reported (Cazals, Langlais 2005). Since radiocarbon dates indicate stratigraphic mixing (*Table 2*) and a larger time depth for layer VII, it cannot be considered for a chronological discussion.

Farincourt I+II, Grottes de: From the caves I (n=7) and II (n=2) as well as from the surface collection (n=8), 17 scalene triangles are reported in total (Höck 2000). The argumentative capacity in terms of chronology seems to be low.

Faurélie II, Abri: The lowermost level 5 was up to 50 cm thick and subdivided into 15 archaeological levels, which are reported to be very variable in detail and location and yielded an unknown number of "*triangles scalene allongés*", i.e. scalene bladelets (Tixier 1974: 192). The absence of Laugerie-Basse points, present in the overlying layer, indicates and age older than 15.5 ka calBP. The fact that 15 archaeological layers are treated together suggests a larger chronological depth and renders the lumped assemblage unsuited for a chronological discussion.

Faustin, Abri: The assemblage with backed and shouldered points yields four remotely triangular pieces (Höck 2000). Since their morphology does not match with scalene bladelets or scalene triangles, they are excluded from further discussions.

Flageolet II, Abri: Layer IX yielded among others 16 scalene bladelets (Rigaud 1970). The presence of baguettes demi-rondes and absence of barbed points speaks in favour of a Middle Magdalenian component, which is corroborated by the ^{14}C-dates (*Table 2*).

Fontalès, Abri: Under a disturbed layer with mixed Magdalenian, Neolithic, and Gallo-Roman artefacts followed another Magdalenian layer with 2 levels, the upper attributed to the Magdalenian VI, the lower to the Magdalenian V. The excavators, however, remark that it was virtually impossible to distinguish both levels lithologically. Both levels varied strongly in thickness and sometimes progressively merged together, which is why the lithic artefacts became mixed up during excavation (Darasse, Guffroy 1960: 4). It is from these levels that 10 scalene bladelets are reported together with early Upper Magdalenian shouldered points. Together with the fact that barbed points occur together with a baguette demi-ronde, a short single-bevelled point and decorated double-bevelled points, it seems most likely that the assemblage represents a palimpsest of Upper and Middle Magdalenian finds. It thus cannot be considered in this discussion.

Forge, Abri de la: The fairly large assemblage from an excavation in the 1920th yields 6 scalene bladelets and is attributed to a Magdalenian III (Sonneville Bodes 1960: 407).

Gandil, Abri: From the upper parts of the rock-shelter, at least two scalene bladelets are reported and attributed to the Middle Magdalenian (Langlais 2007). Available radiocarbon dates are not in accord with the stratigraphy and are older than the underlying layers. This strong signal of stratigraphic mixing excludes Gandil from the debate.

Gare de Couze: The site-complex of Gare de Couze consists of a small cave, two rock-shelters, and a forecourt. After activities in the 19th and early 20th century, further excavations took place on the forecourt during the 1960s (Bordes, Fitte 1964: 159). The layer attributed to the Magdalenian was about 100 cm thick and has been subdivided into 9 levels. The first yielded Magdalenian finds mixed with modern pottery. Pottery fragments are also found in the underlying layers B to D. Apparently, roots from trees and wine stocks are at least partly responsible for the admixture. Fragments of barbed points were found from layer B to G1 and backed points were also observed. Geometric microlith are said to be more numerous to the top (B to D), but never very abundant and include triangular and trapezoidal forms as well as segments and rectangles. The triangular pieces, however, neither conform to scalene bladelets nor to scalene triangles. Eventually, Gare de Couze probably displays a mixture of Magdalenian, Azilian, and likely Mesolithic components and cannot be considered for chronological questions.

Garrigue: This open-air site is known from surface-collections and several sondages during the 1970s. The site brought about a rich assemblage with at least 100 scalene triangles and arch-backed points, some of which classified as Malaurie points (Höck 2000). Because of the latter, the assemblage was assigned to the Upper Magdalenian. Since the integrity of the finds still is to be demonstrated, it cannot be used for a chronological discussion.

Gazel, Grotte: An assemblage with 539 scalene bladelets is attributed to a Middle Magdalenian (Langlais 2007), which is corroborated by radiocarbon dates (*Table 2*).

Goutte Roffat: 29 scalene bladelets are reported and attributed to the Magdalenian II (Höck 2000). Judging from the drawings, some of them are maybe better described as truncated bladelets.

Granet I: The lowermost of 6 layers yielded an assemblage with one scalene bladelet and is attributed to the Middle Magdalenian (Höck 2000).

Hranice: The open-air site is known from surface-collections and sondages conducted during the 1950s. The assemblage comprises approximately 50 scalene triangles (Höck 2000).

Huguenots, Grotte de: Layer 2B yielded one scalene bladelet and is attributed to a Magdalenian II (Höck 2000).

Infern, Coma d': In this surface collection, 349 pieces of varying size and shape are labelled scalene bladelets (Langlais 2007). However, only a part of the drawn pieces would conform to the definition given above. Given that an admixture of different periods cannot be excluded, this assemblage certainly contains a number of scalene bladelets, but cannot be used for a chronological assessment.

Jaurias, Grottes des: The two small caves were discovered and excavated in the 1940s and are reported to have shown a similar stratigraphy. In the first cave, however, the Magdalenian finds were found at the base of level B, whereas in the second cave they were associated with levels A' and B. Single- and double-bevelled organic points with lateral grooves, baguettes demi-rondes, and two contour découpés have been found together with a lithic spectrum that comprises two triangular pieces alongside a variant of shouldered points (Höck 2000) characteristic for the Lower Magdalenian. A recent investigation could also identify microbladelets (Langlais 2007: 138). Backed points or barbed points are absent. The ^{14}C-dates are unfortunately inconclusive, but an occupation prior to 16 ka calBP seems most likely. Eventually, the integrity of the assemblage is questionable and the time depth accumulated in the assemblage difficult to assess, rendering it unsuited for this chronological discussion.

Jean Blanc, Abris des: The lowermost layer of the western shelter yielded three scalene bladelets and the assemblage is attributed to a Magdalenian III (Höck 2000).

Jolivet, Abri: Two of the three mentioned triangular pieces are assessable through drawings (Höck 2000) and are very different from scalene bladelets and scalene triangles. Being both about 20 mm in length, one is an isosceles triangle; the other one has a straight base. Thus, this assemblage is not suitable for the discussion of the chronological significance of scalene bladelets and scalene triangles.

Kniegrotte: Excavated from 1931–38, the 30–110 cm thick layer 8 contains backed bladelets, some very narrow and pointed), and 122 scalene triangles (Höck 2000). The osseous artefacts suggest an occupation between 19 and 15.8 k calBP (Maier *et al.* 2020). Seven AMS dates on humanly modified bones centre at around 15.8 ka calBP and another two dates at around 16.3 ka calBP. Although a palimpsest with younger material cannot be excluded, a lack of corresponding radiocarbon dates or tools, however, does not corroborate this assumption.

Lafaye, Abri: The assemblage yields 6 scalene bladelets and is attributed to the Magdalenian III (Höck 2000). A dated human bone, possibly associated with the find layer, gives an age of roughly 18.5 ka calBP (*Table 2*).

Lascaux, Grotte de: The assemblage yields three scalene bladelets, partly debatable in their attribution, and is assigned to the Magdalénien II, which is corroborated by the available ^{14}C-dates (Höck 2000; *Table 2*).

Lassac: The open-air site is known from surface collection and excavations and the assemblage is attributed to the Badegoulian (Petillon, Ducasse 2012). It also yielded 4 scalene bladelets. Five ^{14}C-dates place the occupation prior to 20 ka calBP (*Table 2*). One date, however, indicates some younger components, casting doubts about the integrity of the assemblage.

Laugerie-Haute, Abri de: Scalene bladelets, some of them quite large, are reported from the assemblages attributed to the Magdalenian II and III (Höck 2000).

Legintxiki B: The rock-shelter shows an stratigraphy of about 120 cm, which is divided into 0, 0-1a, 0-1b, Ia, and Ib (Nuin Cabello, Prieto Prat 1997). In total, 27 scalene bladelets are reported, 13 of which come from level Ia. This level is dated to 18.1 ka calBP (*Table 2*).

Martinet, Abri du: The assemblage from a rather thin Magdalenian layer, sandwiched between two sterile horizons, contains 52 scalene bladelets as well as shouldered points of the Lower Magdalenian variant (Le Tensorer 1981). Initially attributed to an Upper Magdalenian (ibid.), a palimpsest of Lower and Middle Magdalenian components seems more likely. The latter is also indicated by radiocarbon dates (*Table 2*). The assemblage thus cannot be considered.

Métaire de Belcayre, Abri de: The Magdalenian layer contains organic points with longitudinal grooves and a single scalene bladelet and is attributed to the Magdalenian III (Höck 2000).

Mirón, El: The site has been excavated at several locations in the cave. Triangular pieces are only reported from two areas, namely Spit 26 of layer 312 (n=8) of the O6-P6 sondages and layers 504/505 (n=35) in the rear vestibule (Fontes *et al.* 2015). Layer

504 contained a probably secondary burial. Sediment re-deposition during re-burial, scavenger and rodent activities draw the integrity of the assemblage into question (Ibid.). A direct date of the burial is in accordance with dates from layer 504 and 505 and roughly contemporaneous with spit 26 of layer 312, placing the triangular implements at around 19 ka calBP (*Table 2*). Since the triangular pieces are not depicted, it is difficult to assess their morphological properties.

Morin, Abri le: 180 cm of sediments are divided into 4 horizons (A'', A', A and B), whereof the two lowermost (B, 10 cm; A, 80 cm) contained finds. They are subdivided into six archaeological layers. In horizon B, there are a number of shouldered points with typical early Upper Magdalenian morphology. Horizon A shows a reported mixture of Upper Magdalenian and Azilien features (Bordes *et al.* 1973, Bordes, Sonneville Bordes 1979). Further admixture with younger material of Mesolithic age is indicated by a ^{14}C-date (Gif-2105, 10480 ±200; Delibrias, Evin 1974). As is probably the case for Gare de Couze (see above), it seems that in the upper layers of Abri Morin, we are dealing with a mixed assemblage comprising Magdalenian, Azilian and Mesolithic finds. The triangles reported are thus most likely to stem from Mesolithic occupations and cannot be considered here.

l'OEil, Grotte de: During the 1960s, excavations documented a stratigraphy strongly disturbed by illicit excavations, which mixed up artefacts of a Bronze Age burial with medieval and Stone Age finds, so that stratigraphic observations were impossible (Sacchi 1986: 172). The lithic assemblage is derived from sorting out ceramic and metallic objects, which is then in its entirety assigned to an Upper Magdalenian. The lithic industry comprises very thin, pointed backed bladelets and two fragments of triangular shape. Given the context, the integrity of the lithic assemblage is highly questionable, which is why this site cannot be considered in this chronological discussion.

Paloma, Cueva de la: Layer 8 contained organic single-bevelled points and scalene bladelets and is assigned to the Magdalenian III (Höck 2000).

Parpalló, Cova de: The often ransacked cave was subject to proper excavations between 1929 and 1931. The stratigraphy is divided in 29 spits, which are attributed to the Gravettian, Solutrean, and Magdalenian. While the spits 11 to 6 are attributed to a Lower Magdalenian or Badegoulian, those above are assigned to an Upper Magdalenian. Spits 5 to 1 together comprise a thickness of about 150 cm. Triangularly shaped pieces appear in spits 5, 4, 2 and 1. Spit 3 was more or less sterile according to the recordings, which is however doubted by Aura Tortosa (1995: 55), who thinks that finds from this spit have been labelled as belonging to spit 2. The morphological variability of triangular forms is large and only some pieces conform to scalene bladelets (large and small) or scalene triangles. The sediment unit IV comprising the 5 spits is described as chaotic and coarse, while the unit III below is described as very fine-grained and homogeneous (ibid., 43). It is further intriguing that the number of triangular pieces in the spits follow a unimodal curve (spit 5: n=3, spit 4: n=7, spit 2: n=48, spit 1: n=12), suggesting artefact movements to the bottom and top of this unit. Within this assemblage-complex, points with single- and double-bevelled bases occur, as do baguettes demi-rondes and a fragment of a barbed point. Eventually, the integrity of the assemblages from spits 1 to 5 must be considered doubtful and Parpalló must be excluded from this discussion.

Plateau Parrain: The rich Magdalenian assemblage was found at the base of layer 3. It contains one triangular piece and is attributed to the Magdalenian III (Höck 2000).

Pégourié, Grotte de: Layer 8 contained, among others, a shouldered point and a single triangular piece (Höck 2000). Conventional ^{14}C-dates with large standard deviations suggest an age older than 20 ka calBP (*Table 2*). Since the triangular piece is not assessable through drawings, its relevance for this discussion remains doubtful. It is thus not considered.

Peyrugues, Les: The assemblage contains 46 scalene bladelets and is attributed to a Middle Magdalenian, which is corroborated by ^{14}C-dates placing the occupation before 16.5 ka calBP (Langlais 2007).

Placard, Grotte du: A single triangular artefact is reported from an excavation conducted in calcareous concretions during the 1960s, associated among others with a baguette demi-ronde and a contour découpé (Höck 2000).

Plantade, Abri: Initially, the Magdalenian layer 3 was subdivided into two levels. The lower one contained points with lateral grooves and the upper one barbed points. The lithic artefacts from both layers are mixed and contain at least eight scalene bladelets (Höck 2000, Langlais 2007). Stratigraphic mixing is also indicated by the available radiocarbon dates (*Table 2*). Clearly, the assemblage is unsuited for this chronological discussion.

Putois II, Grotte du: The assemblage from the find bearing layer (II), which is rather poor in tools, contains one scalene bladelet and a baguette demi-ronde and is attributed to the Middle Magdalenian (Höck 2000).

Puy-de-Lacan, Grotte: The site complex consists of a cave and a forecourt on a slope. Most of the relevant finds (about 300 scalene triangles and few scalene bladelets) have been collected when the open-air settlement structures were destroyed by local sand quarries. From the excavations in the cave itself, only four triangular pieces found in two layers are reported (Höck 2000). For this chronological assessment, the collections are thus unsuited.

Rascaño, Cueva de: The second of three caves was excavated in 1912/13 and 1974/75. Layer 4 contained one triangular artefact which is associated with Lussac-Angle points and assigned to the Magdalenian III (Höck 2000).

Raymondon-Chancelade, Abri: Layers 2 and 4 yielded 3 and 7 triangular artefacts, respectively, likely scalene bladelets, attributed to a Magdalenian II and III (Höck 2000).

Reverdit, Abri: During the investigation of the site between 1878 and 1935, two archaeological layers were documented, but their finds – due to their observed similarities – combined. Two triangular pieces, one of which is totally different from the forms discussed in this article, occur together with baguettes demi-rondes. The assemblage is assigned to the Magdalenian III (Höck 2000).

Rhodes II: The assemblage of the lowermost unit contains scalene bladelets of the microlithic variant (Langlais 2007).

Rond du Barry, Grotte de: Above the Badegoulian layer F lies layer E, containing among others barbed points, single- and double-bevelled points, some of which show lateral grooves, backed points, as well as 13 triangular pieces. Layer D contained an assemblage with finds described as remarkably small (Höck 2000). Those triangular pieces assessable from drawings show a straight base and are morphologically different from scalene triangles and scalene bladelets. ^{14}C-dates from layers E and D gave Upper as well as Middle Magdalenian and even Badegoulian dates (*Table 2*). Given the small dimensions of the finds in the overlying layer, the distinctive morphology of the triangular pieces, the mixed ^{14}C-signal, the occurrence of backed points, and a large variety of organic points, the integrity of the assemblage appears very doubtful. Thus, it is excluded from this discussion.

Saint-Germain-la-Rivière, niveau sup.: The upper layers of that site contain 142 scalene bladelets (Langlais 2007). The ^{14}C-measurements give an average date of roughly 18.3 ka calBP (*Table 2*).

Sâlpetrière: Layers 7 to 13 yielded triangular pieces (Höck 2000) which do not conform to scalene bladelet or scalene triangles and thus cannot be considered.

Souquette, Abri La: Digs in the rock-shelter were carried out in the early years of the 20th century. The finds attributed to the Magdalenian contain a barbed point, laterally grooved points, a shouldered point, and at least 4 scalene bladelets and 2 scalene triangles. Since the assemblage is considered mixed (Höck 2000), it is excluded from discussion.

Roc de Marcamps 2: From levels 2a, 2b, and 3 at sector 2 of Roc de Marcamps, 25 scalene bladelets have been recorded 25 scalene bladelets have been recorded (Sécher 2017). The ^{14}C-dates give a weighted average of about 18.8 ka calBP.

Roc Saint-Cirq, Abri du: The lower layer yielded an assemblage with 23 scalene bladelets and is attributed to a Magdalenian II or III (Höck 2000).

Teulera, La: The surface collections contains 3 triangular pieces, found together with shouldered and backed points (Höck 2000) and is unsuited for this chronological discussion.

Urtiaga, Cueva de: Magdalenian finds are reported from layers D, E, and F, while only E (n=3) and F (n=1) yielded scalene bladelets. They are attributed to a Lower Magdalenian (Höck 2000). A ^{14}C-date from layer F indicates an age of more than 20 ka calBP and it cannot be excluded that the piece from layer F is intrusive from above.

Vache, Grotte de la: The assemblage yields a mixed inventory of Upper and Middle Magdalenian finds, such as barbed points, baguettes demi-rondes, a variety of single- and double-bevelled points, and also triangular artefacts (Höck 2000). With regard to chronological resolution, the site thus cannot contribute further arguments.

Vilshofen-Kuffing: This surface collection contains one of the largest collections of scalene triangles (Adaileh 2017). However, since the integrity of surface collections is always doubtful, it cannot be considered for establishing a chronological framework.

After this brief discussion, it can be stated that the assemblages from 39 sites out of 81 do not contradict the findings of the chronological review. Three sites, i.e. Bellet, Lassac, and Urtiaga, may indicate an occurrence of scalene bladelets before 19 ka calBP (but

see discussion in 4.2). Another 39 sites mention the occurrence of scalene bladelets or triangles in assemblages together with finds indicative of an Upper Magdalenian. However, none of these assemblages can be considered a sound case for the contemporaneity of scalene bladelets and scalene triangles and Upper Magdalenian types. To the contrary, the assemblages in question seem all rather doubtful with regard to their integrity. They either come from surface collections or from caves and rock-shelters with long and often complicated stratigraphies, where the possibility of stratigraphic mixing is high. Moreover, the triangular pieces reported from these assemblages often do not conform to the morphology of scalene bladelets or scalene triangles.

Eventually, it can be stated that the discussion, by and large, confirms the results of the review of radiocarbon dated assemblages.

4.2 Scalene bladelets – a variant of shouldered points?

Shouldered points start occurring at around 29 ka calBP in Central and Eastern Europe (e.g. Maier, Zimmermann 2017, Noiret 2004, 448, Svoboda 2007), from where they likely spread towards the west (Tiffagom 2006: 217et seqq., Planche XIV). These early shouldered points in Central and Eastern Europe between 29 and 25 ka calBP usually take the form of a short tip and a long shoulder. With their occurrence in Western Europe between 25 and 23.5 ka calBP, they often show an even ratio or a shift in favour of a longer tip. Between 23.5 and 20 ka calBP, shouldered points are not very numerous, but do occur, often in the variant with a short tip and a long shoulder (Ducasse 2010). Later, at around 20 ka calBP, a short appearance of shouldered points with a long tip and a short shoulder is attested for instance at Gandil, Fontgrasse, and Jaurias (Langlais 2007).

In traditional readings of the archaeological record, shouldered points virtually disappear at around 20 ka the latest and reappear at around 16 ka calBP, again in the form of short point and long shoulder. For the 4000 years in between, there are rarely any artefacts which could serve as frontally hafted lithic insets. While it is certainly possible that lithic frontal insets got out of use and subsequently have been re-invented, the loss of such a pivotal aspect of hunting weaponry seems rather unlikely. In the following, an alternative view is thus proposed.

Already during the period between 23.5 and 20 ka calBP, some shouldered points show a strong reduction in the concavity of their shoulder and strongly resemble scalene bladelets (*Figure* 4, 1–2). The chronological attribution of scalene bladelets to pre-Middle Magdalenian periods at Bellet, Lassac, and Urtiaga could be explained with this phenomenon. Here it is worth recalling that Cheynier (1965, 318) stressed the observation of a clear concave bending of the long leg of scalene bladelets before transitioning into the truncation. Such a bending runs contrary to the idea of lateral hafting, but makes sense when seen as a strongly reduced shoulder of a shouldered point. Thus, instead of assuming that shouldered points (and along with them frontally hafted insets) disappear between 20 and 19 ka calBP from the archaeological record, it seems to me much more likely that the trend towards a less pronounced shoulder continues. In this view, shouldered points of the variant with a long shoulder and a short tip become very elongated and narrow between 19 and 16 ka calBP, where they are referred to as scalene bladelets (*Figure* 4, 3–6). At around 16 ka, these armatures become larger again. Together with this increase in size, the concavity of the shouldered part becomes again more pronounced (*Figure* 4, 7–8). Subsequently, they develop into the shouldered points of the Late Glacial. It thus seems that shouldered points did not get out of use, but have been continually present since their invention with changes in their morphological details.

Completely independent from this development are laterally hafted scalene triangles (*Figure* 4, 9–19). Only few assemblages containing scalene triangles provide reliable dates. Those dates, however, indicate a rather short-lived phenomenon at around 16 ka calBP. It is well possible that future discoveries may prove an older appearance. However, the fact that barbed points carved from one piece make their appearance when scalene triangles get out of use is a strong hint that with the advent of the former, the latter become obsolete. This interpretation is supported by ornamental lines that sometimes run in pairs from one barb to the next or are depicted on the barbs themselves (cf. Julien 1982), probably being a typological rudiment (Allain, Rigaud 1986) of strings which stabilized the insets. Such a supplementary hafting would also correspond with the denticulation often encountered at the unretouched edge of scalene triangles.

5. CONCLUSION

Long stratigraphies have been important for the development of relative chronologies during the early

days of prehistoric research. However, they have the strong disadvantage of the omnipresent possibility of stratigraphic mixing. Hence, assemblages from caves and rock-shelters are problematic for the establishment of high-resolution chronologies. Single-layered open-air sites are much better suited for this task. However, the preservation of organic material is often rather poor and the option of absolute dating thus sparse.

Fragmented artefacts of presumably triangular shape and triangularly shaped pieces with a morphology different from those described above are unsuited to attest for the presence of scalene bladelets or scalene triangles in an assemblage. Alleged fragments of scalene bladelets or triangles can result from breakage of angled backed points, oblique truncations, and others. It is thus important to distinguish between different triangular forms – in contrast to subsuming them in a lump-category called "triangles" – particularly in assemblages with indications of stratigraphic mixing.

In rather reliable contexts, scalene bladelets seem to be usually associated with artefacts indicative of the period between 19 and 16 ka calBP. An earlier occurrence is possible, but so far not convincingly demonstrated. Anyway, the assumed continuous development from shouldered points of the Badegoulian to scalene bladelets renders this border arbitrary and potentially misleading.

Reliable occurrences of scalene bladelets between 16 and 15.5 ka calBP seem to be restricted to the microlithic variant, mainly distributed between Tarn and Ebro.

Scalene triangles (and with them composite barbed points) seem to have been a rather short lived phenomenon at around 16 ka calBP before they became replaced by barbed points carved from a single piece of organic material at around 15.8 ka calBP. Scalene triangles do not seem to occur together with barbed points in reliable contexts.

Scalene bladelets and scalene triangles are most probably morphologically and functionally different objects. While the former seem to be frontal insets, the latter seem to be lateral insets. Given these distinctions and their clearly different spatial distribution, it can be concluded that scalene bladelets and scalene triangles are probably phylogenetically unrelated to one another.

Scalene bladelets seem to be a variant in the development of shouldered points between 19 and 16 ka calBP, where they bridge the gap between the shouldered points of the Badegoulian and the Upper Magdalenian.

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REFERENCES

ADAILEH A., 2017: Zum Stand der Magdalénien-Forschung in Niederbayern. In: L. Husty, K. Schmotz (Eds.): *Vorträge des 35. Niederbayerischen Archäologentages*. Pp. 23–36. Verlag Marie Leidorf, Rahden/Westf.

ALLAIN J., RIGAUD A., 1986: Décor et Fonction, quelques exemples tirés du Magdalénien. *L'Anthropologie* 90: 713–738.

ALTUNA J., MERINO J. M., Eds. 1984: *El yacimiento prehistórico de la cueva de Ekain (Deba, Guipuzcoa)*. Eusko Ikaskuntza, San Sebastián.

AURA TORTOSA J. E., 1995: *El Magdaleniense mediterráneo: La Cova del Parpalló (Gandia, Valencia)*. SIP 91. Department de Prehistòria i Arqueologia de la Universitat de València, València.

BARANDIARAN I., 1988: Datación 14C de l'art mobilier magdalénien cantabrique. *Préhistoire Ariégeoise* XLII: 63–84.

BARSHAY-SZMIDT C., COSTAMAGNO S., HENRY-GAMBIER D., LAROULANDIE V., PÉTILLON J.-M., BOUDADI-MALIGNE M., KUNTZ D., LANGLAIS M., MALLYE J.-B., 2016: New extensive focused AMS ^{14}C dating of the Middle and Upper Magdalenian of the western Aquitaine/Pyrenean region of France (ca. 19–14 ka cal BP): Proposing a new model for its chronological phases and for the timing of occupation. *Quaternary International* 414: 62–91. https://doi.org/10.1016/j.quaint.2015.12.073

BORDES F., FITTE P., 1964: Microlithes du magdalénien supérieur de la Gare de Couze (Dordogne). In: E. Ripoll Perelló (Ed.): *Miscelánea en homenaje al abate Henri Breuil (1877-1961)*. Pp. 259–267. Instituto de prehistoria y arqeología: Barcelona.

BORDES F., DEFFARGES R., SONNEVILLE-BORDES DE D., 1973: Les pointes de Laugerie-Basse dans le gisement du Morin. Essai de définition. *Bulletin de la société préhistorique française* 70: 145–151.

BORDES F., SONNEVILLE-BORDES DE D., 1979: L'azilianisation dans la vallée de la Dordogne les données de la Gare de Couze (Dordogne) et de l'abri Morin (Gironde). In: D. de Sonneville-Bordes (Ed.): *La fin des temps glaciaires en Europe. Chronostratigraphie et écologie des cultures du Paléolithique final, Colloque de Talence*. Pp. 449–459. Ed. CNRS, Paris.

BOUYSSONIE J., LEJEUNE L., PEROL J.-F., 1935: La station de Lacan et son outillage. In: *Compte Rendu de la XIe Session du Congrès Préhistorique de France, Périgueux, 1934*. Pp. 318–323. Bureaux de la Société Préhistorique Française, Paris.

CABELLO J. N., 1993: Excavaciones en el término de Echauri (Navarra):campañas de 1991, 1992 y 1993. *Trabajos de arqueología Navarra* 11: 261–264.

CATTELAIN P., 2005: Propulseurs magdaléniens: marqueurs culturels régionaux? In: V. Dujardin (Ed.): *Industrie osseuse et parures du Solutréen au Magdalénien en Europe*. Pp. 301–317. Société préhistorique française, Paris.

CAZALS N., LANGLAIS M., 2005: La place d'Ekain (couche VII) au sein du Magdalénien basco-cantabrique: nouvelles contributions sur l'organisation des productions lithiques. *Munibe* 57: 177–191.

CHEYNIER A., 1951: Les industries protomagdaléniennes. *Bulletin de la société préhistorique française* 48: 190–192.

CHEYNIER A., 1965: Les têtes de brochet, fossile directeur du Saint-Germien (Proto-Magdalénien IIb). *Bulletin de la société préhistorique française* 62: 315–321.

COLLINS C. M., 2012: *Population Dynamics in the Late Glacial Refugium of Southwest France*. Ph.D-thesis. University of Sheffield.

CORCHON RODRIGUEZ M. S., ORTEGA MARTINEZ P., VICENTE F. J., 2015: El origen del Magdaleniense: una cuestión controvertida. La cueva de Las Caldas y los yacimientos del Nalón (Asturias, Norte de España). *Munibe* 66: 53–75. DOI: 10.21630/maa.2015.66.03

COSTAMAGNO S., BARSHAY-SZMIDT C., KUNTZ D., LAROULANDIE V., PETILLON J.-M., BOUDADI-MALIGNE M., LANGLAIS M., MALLYE J.-B., CHEVALLIER A., 2016: Reexamining the timing of reindeer disappearance in southwestern France in the larger context of late glacial faunal turnover. *Quaternary International* 414: 34–61. doi.org/10.1016/j.quaint.2015.11.103

COUCHARD J., 1960: Gisement de Bellet, près Brive, Corrèze: note complémentaire. *Bulletin de la société préhistorique française* 57: 282–286.

DARASSE P., GUFFROY S., 1960: Le Magdalénien supérieur de l'abri de Fontalès près Saint-Antonin (Tarn-et-Garonne). *L'Anthropologie* 64: 1–35.

DE SONNEVILLE-BORDES D., 1960: *Le Paléolithique supérieur en Périgord*. Delmas, Bordeaux.

DE SONNEVILLE-BORDES D., PERROT J., 1956: Lexique typologique du Paléolithique supérieur. Outillage lithique (suite et fin) – V Outillage à bord abattu – VI Pièce tronquées – VII Lames retouchées – VIII Pièces variées – IX Outillage lamellaire. Pointe azilienne. *Bulletin de la Société Préhistorique Française* 53: 547–559.

DELIBRAS G., ÉVIN J., 1974: Sommaire des datations ^{14}C concernant le Préhistoire en France. I. Dates parues de 1955 à 1974. *Bulletin de la société préhistorique française* 71: 149–156.

DEMARS P.-Y., LAURENT P., 1989: *Types d'outils lithiques du Paléolithique supérieur en Europe*. Ed. CNRS, Paris.

DJINDJIAN F., 2000: Identité, chronologie et territoires du Magdalénien en Europe occidentale: questions posées. In: G. Pion (Ed.): *Le Paléolithique supérieur récent : nouvelles données sur le peuplement et l'environnement. Acte du colloque de table ronde de Chambéry, 12-13 Mars 1999*. Pp. 95–112. Edition SPF, Paris.

DRUCKER D., G., BOCHERENS H., BILLIOU D., 2003: Evidence for shifting environmental conditions in Southwestern France from 33 000 to 15 000 years ago derived from carbon-13 and nitrogen-15 natural abundances in collagen of large herbivores. *Earth and Planetary Science Letters* 216: 163–173.

DUCASSE S., 2010: *La 'parenthèse' Badegoulienne: fondements et statut d'une discordance industrielle au travers de l'analyse techno-économique de plusieurs ensembles lithiques méridionaux du Dernier Maximum glaciaire*. Ph.D. Dissertation, Université de Toulouse 2.

DUJARDIN V., TYMULA S., 2005: Relecture chronologique de sites paléolithiques et épipaléolithiques anciennement fouillés en Poitou-Charentes. *Bulletin de la société préhistorique française* 102: 771–788.

EVIN J., MARTEN G., PACHIAUD C. 1976: Lyon Natural radiocarbon Measurements VI. *Radiocarbon* 18: 60–88.

FONTES L. M., STRAUS L. G., GONZÁLEZ MORALES M. R., 2015: Lithic and osseous artifacts from the Lower Magdalenian human burial deposit in El Mirón cave, Cantabria, Spain. *Journal of Archaeological Science* 60: 99–111. https://doi.org/10.1016/j.jas.2015.03.010

GAMBIER D., VALLADAS H., TISNERAT-LABORDE N., ARNOLD M., BRESSON F., 2000: Datation de vestiges humains présumés du Paléolithique supérieur par la méthode du Carbone 14 en spectrométrie de masse par accélérateur. *Paléo* 12: 201–212.

GINTER B., POLTOWICZ M., PAWLIKOWSKI M., SKIBA S., TRABSKA J., WACNIK A., WINIARSKA-KABACINSKA M., WOJTAL P., 2005: Dzierżysław 35 – Ein neuer Fundplatz des Magdalénien in Oberschlesien. *Archäologisches Korrespondenzblatt* 35: 431–446.

GOWLETT J. A. J., HEDGES R.E.M., LAW I. A., PERRY C., 1986: Radiocarbon dates from the Oxford AMS system: Archaeometry Datelist 4. *Archaeometry* 28: 206–221.

HEDGES R. E. M., HOUSLEY R. A., BRONK C. R., KLINKEN G. J. V., 1992: Radiocarbon dates from the Oxford AMS system: Archaeometry datelist 15. *Archaeometry* 34: 337–357.

HÖCK C., 2000: *Das Magdalénien der Kniegrotte – Ein Höhlenfundplatz bei Döbritz, Saale-Orla-Kreis*. Theiss: Stuttgart.

JULIEN M. 1982: *Les Harpons Magdaléniens*. Ed. CNRS, Paris.

KIDDER L., KIDDER H., 1936: Le Puy-de-Lacan et ses gravures magdaléniennes. *L'Anthropologie* 46: 17–31.

LANGLAIS M., 2007: *Dynamiques culturelles des sociétés magdaléniennes dans leurs cadres environnementaux. Enquête sur 7000 ans d'évolution de leurs industries lithiques entre Rhône et Èbre*. Ph.D-dissertation. University of Toulouse and University of Barcelona.

LANGLAIS M., 2013: Productions et équipements lithiques de la Cova Alonsé. In: L. Montes, R. Domingo (Eds.): *El asentamiento magdaleniense de Cova Alonsé (Estadilla, Huesca)*. Monografías Arqueológicas Prehistoria 48. Pp. 81–89. Prensas de la Universidad de Zaragoza, Zaragoza.

LANGLAIS M., SECHER A., CAUX S., DELVIGNE V., GOURC L., NORMAND C., SANCHEZ DE LA TORRE M.,

2016: Lithic tool kits: A Metronome of the evolution of the Magdalenian in southwest France (19,000–14,000 cal BP). *Quaternary International* 414: 92–107. https://doi.org/10.1016/j.quaint.2015.09.069

LANGLAIS M., SECHER A., LAROULANDIE V., MALLYE J.-B., PETILLON J.-M., ROYER A., 2018: Combe-Cullier (Lacave, Lot): une séquence oubliée du Magdalénien. Apport des nouvelles dates 14C. *Bulletin de la société préhistorique française* 115: 385–389.

LE TENSORER J.-M., 1981: *Le Paléolithique de l'Agenais*. Editions CNRS, Paris.

LE TENSORER J.-M., 1998: Le Paléolithique en Suisse. Jerôme Million, Grenoble.

LEESCH D., MÜLLER W., NIELSEN E., BULLINGER J., 2012: The Magdalenian in Switzerland: Re-colonization of a newly accessible landscape. *Quaternary International* 272–273: 191–208. https://doi.org/10.1016/j.quaint.2012.04.010

LENOIR M., 1983: *Le Paléolithique de Basses Vallées de la Dordogne et de la Garonne*. Ph.D. Dissertation. University of Bordeaux I.

LEROI-GOURHAN A., EVIN J. 1979: Les datations de Lascaux. In : A. Leroi-Gourhan (Ed.): *Lascaux Inconnu*. Pp. 81–84. Éditions du CNRS, Paris.

MAZO C., UTRILLA P. 1995–96: Excavaciones en la cueva de Abauntz (Arraiz). Campañas de 1994 y 1995. *Trabajos de arqueología Navarra* 12: 270–279.

MAIER A., ZIMMERMANN A., 2017: Populations headed south? The Gravettian from a palaeodemographic point of view. *Antiquity* 91: 573–588. https://doi.org/10.15184/aqy.2017.37

MAIER A., LIEBERMANN C., PFEIFER S. J., 2020: Beyond the Alps and Tatra Mountains – the 20–14 ka Repopulation of the Northern Mid-latitudes as Inferred from Palimpsests Deciphered with Keys from Western and Central Europe *Journal of Paleolithic Archaeology*. https://doi.org/10.1007/s41982-019-00045-1

MANGADO X., PETIT M. A., FULLOLA J. M., BARTROLI R. 2006/2007: El paleolític superior final de la cova del Parco (Alòs de Balaguer, la Noguera). *Revista d'Arqueologia de Ponent* 16–17: 45–62.

MANGADO X., MERCADAL FERNANDEZ O., FULLOLA J. M., GRIMAO J. 2009: Montlleó: un punt clau en la travessa del Pirineu. In: X. Mangado (Ed.): *Els Pirineus i les àrees circundants durant el Tardiglacial. Mutacions Filiacions, XIV Colloqui Internacional d'Arqueologia de Puigcerdà. Homenatge al Prof. Georges Laplace, Puigcerdà, 10–12 de novembre de 2006*. Pp. 549–564. Institut d'Estudis Ceretans, Puigcerdà.

MILLER R. 2012: Mapping the expansion of the Northwest Magdalenian. *Quaternary International* 272–273: 209–230. https://doi.org/10.1016/j.quaint.2012.05.034

NOIRET P., 2004: Le Paléolithique supérieur de la Moldavie. *L'Anthropologie* 108: 425–470.

NUIN CABELLO J., PRIETO PRAT M., 1997: Los utensilios de caza en Legintxiki (Navarra). *Isturitz: Cuadernos de prehistoria - arqueología* 7: 95–130.

ONORATINI G., DEFLEUR A., JORIS C., 1996: Mise en évidence du Magdalénien ancien II dans les Gorges de l'Ardeche. *Bulletin de la société préhistorique française* 93: 25–32.

PÉTILLON J.-M., 2016: Technological evolution of hunting implements among Pleistocene hunter-gatherers: Osseous projectile points in the middle and upper Magdalenian (19–14 ka cal BP). *Quaternary International* 414: 108–134. https://doi.org/10.1016/j.quaint.2015.08.063

PETILLON J.-M., DUCASSE S., 2012: From flakes to grooves: A technical shift in antlerworking during the last glacial maximum in southwest France. *Journal of Human Evolution* 62: 435–465. 10.1016/j.jhevol.2011.12.005

PÉTILLON J.-M., LANGLAIS M., KUNTZ D., NORMAND C., BARSHAY-SZMIDT C., COSTAMAGNO S., DELMAS M., LAROULANDIE V., MARSAN G. 2015: The human occupation of the northwestern Pyrenees in the Late Glacial: New data from the Arudy basin, lower Ossau valley. *Quaternary International* 364: 126–143. https://doi.org/10.1016/j.quaint.2014.09.022

PEYRONY D., 1936: Le Magdalénien à triangles scalènes. *L'Anthropologie* 46: 363–366.

RAYNAL J.-P., LAFARGE A., REMY D., DELVIGNE V., GUADELLI J-L., COSTAMAGNO S., LE GALL O., DAUJEARD C., VIVENT D., FERNANDES P., LE CORRE-LE BEUX M., VERNET G., BAZILE F., LEFEVRE D. 2014: Datations SMA et nouveaux regards sur l'archéo-séquence du Rond-du-Barry (Polignac, Haute-Loire). *C. R. Palevol* 2014. http://dx.doi.org/10.1016/j.crpv.2014.03.010

REIMER P. J., BARD E., BAYLISS A., BECK J. W., BLACKWELL P. G., BRONK RAMSEY C., BUCK C. E., CHENG H., EDWARDS R. L., FRIEDRICH M., GROOTES P. M., GUILDERSON T. P., HAFLIDASON H., HAJDAS I., HATTE C., HEATON T. J., HOFFMANN D. L., HOGG A. G., HUGHEN K. A., KAISER K. F., KROMER B., MANNING S. W., NIU M., REIMER R. W., RICHARDS D. A., SCOTT E. M., SOUTHON J. R., STAFF R. A., TURNEY C. S. M., VAN DER PLICHT J., 2013: IntCal 13 and Marine 13 radiocarbon age calibration curves 0–50,000 years cal BP. *Radiocarbon* 55: 1869–1887. https://doi.org/10.2458/azu_js_rc.55.16947

RIGAUD J.-P., 1970: Étude préliminaire des industries magdaléniennes de l'abri du Flageolet II, commune de Bézenac (Dordogne). *Bulletin de la société préhistorique française* 67: 456–474.

SACCHI D., 1986: *Le Paléolithique supérieur du Languedoc occidental et du Roussillon*. Editions CNRS, Paris.

SÉCHER A., 2017: *Traditions techniques et paléogéographie du Magdalénien moyen ancien dans le Sud-Ouest de la France (19 000–17 500 cal. BP). Des groupes humains à plusieurs visages?* Ph.D-thesis, University of Bordeaux.

SIMPSON G. G., 1944: *Tempo and mode in evolution*. Columbia University Press, New York.

STRAUS L. G., GONZÁLEZ MORALES M., 2007: Further radiocarbon dates for the Upper Paleolithic of El Mirón cave (Ramales de la Victoria, Cantabria, Spain). *Radiocarbon 49:* 1205–1214.

STRAUS G. L., GONZÁLEZ MORALES M. R., CUENCA SOLANA D., 2015: The Magdalenian Human Burial of El

Mirón Cave (Ramales de la Victoria, Cantabria, Spain): Introduction, Background, Discovery and Context. *Journal of Archaeological Science* 60: 1–9. https://doi.org/10.1016/j.jas.2015.02.018

SVOBODA J., 2007: The Gravettian on the Middle Danube. *Paleo* 19: 203–20.

SZMIDT C., PETILLON J.-M., CATTELAIN P., NORMAND C., SCHWAB C. 2009: Premières dates radiocarbone pour le Magdalénien d'Isturitz (Pyrénées-Atlantiques). *Bulletin de la société préhistorique française* 106: 588–592.

TIFFAGOM M., 2006: *De la pierre à l'homme. Essai sur une paléoanthropologie solutréenne.* ERAUL 113. Université de Liège, Liège.

TISNÉRAT-LABORDE N., VALLADAS H., LADIER E. 1997: Nouvelles datations carbone 14 en SMA pour le Magdalénien supérieur de la vallée de l'Aveyron. *Bulletin de la Société préhistorique de l'Ariège* 52: 129–135.

TIXIER J., 1974: Microburins du magdalénien V à la Faurélie II (Dordogne). *L'Anthropologie* 78: 189–196.

UTRILLA M. P., 1981: *El Magdaleniense inferior y medio en la Costa Cantábrica.* Min. de Cultura, Dir. General de Bellas Artes, Archivos y Bibliotecas, Santander.

UTRILLA P., MONTES L., 2007: La période 19000–14000 BP dans le bassin de l'Ebre. *Bulletin de la société préhistorique française* 104: 797–807.

WENINGER B., JÖRIS O., DANZEGLOCKE U., 2014: *CalPal-2014. Cologne Radiocarbon Calibration & Palaeoclimate Research Package.* http://www.calpal.de, (access 09 November 2016).

WIŚNIEWSKI A., POŁTOWICZ-BOBAK M., BOBAK D., JARY Z., MOSKA P., 2017: The Epigravettian and the Magdalenian in Poland: new chronological data and an old problem. *Geochronometria* 44: 16–29. DOI 10.1515/geochr-2015-0052.

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