Late Mesolithic Blade-and-Trapeze Industries between the Land and the Sea: example of Montenegro

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Abstract:

This article focuses on the Late Mesolithic blade-and-trapeze industries of southeastern Europe, with a special emphasis on the Crvena Stijena and Odmut sites located in present-day Montenegro and dated to the mid-7th millennium BCE. These two sites are situated in distinct ecological niches; Crvena Stijena is within the Mediterranean climatic zone, while Odmut is positioned in the mountainous area of the central Balkans. A typo-technological comparison of these two lithic assemblages is conducted to determine whether these industries exhibit common characteristics in blade making, indicating shared cultural traditions, or whether they diverge significantly. Furthermore, they are compared with other known blade-and-trapeze industries from southeastern Europe (Žukovica - Island of Korčula, and Lepenski Vir) to ascertain the homogeneity of the Late Mesolithic in the region. Finally, their position within the larger European context is discussed through the question of their possible origin (Mediterranean or Black Sea). The results point to many similarities in blade production, implying that the Crvena Stijena and Odmut assemblages share the same traditions. Additionally, they demonstrate surprising parallels with southern Italian assemblages (Grotta dell'Uzzo, Latronico 3). Furthermore, typologically (notched blades, symmetric trapezes) and technologically (possible use of pressure flaking), the Montenegro assemblages are comparable to industries found in northern Africa and southern France. However, the resemblances are not confined to the Mediterranean. Montenegro assemblages also share common traits with potentially earlier industries situated on the Danube and around the Black Sea. In addition, some features (notched blades, trapezes, probable use of indirect percussion) links Montenegro industries with those of central-western Europe and the Alps. Unfortunately, the lack of sites and detailed technological studies, as well as the unevenness of primary data, poses a challenge in drawing conclusions about the presence of distinct technological traditions in the Late Mesolithic of southeastern Europe. Another unresolved issue pertains to the timing of the emergence of the blade-and-trapeze industries, specifically whether they precede 6700-6500 cal. BCE. In conclusion, considering that technological and genetic diversity suggest that Southeastern Europe during the 8th and 7th millennia was a vibrant region hosting diverse groups with different origins and traditions, rather than attributing the development of the blade-and-trapeze technocomplex to a single centre of origin, it is plausible to envision a complex interplay of factors contributing to its development.

Keywords: Late Mesolithic; Blade-and-trapeze industries; Castelnovian; Southeastern Europe; Balkans; Adriatic; Pressure flaking; Indirect percussion

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1. Introduction and background

Between the 8th and 6th millennia BCE, European hunter-gatherers underwent significant socio-technological transformations, particularly evident in the lithic assemblages, marked by a sudden emergence of regular and standardized blade(let)s obtained by pressure flaking or indirect percussion (Biagi & Kiosak 2010; Binder *et al*. 2012; Clark 1958; Gronenborn 2017; Marchand & Perrin 2017). These changes denote the transition from the Early to the Late Mesolithic. The phenomenon, observed across western Eurasia, is known as the blade-and-trapeze technocomplex, while in central and western Mediterranean it is referred to as the Castelnovian which is considered a regionalized manifestation. Additionally, new tool types, such as trapeze microliths and, more locally, notched bladelets, are introduced. In central-western Europe, where the Late Mesolithic has been extensively studied, the change is perceived as external, driven by population movements and the transmission of ideas (Marchand & Perrin 2017; Yu *et al*. 2022). Different potential "centres of origins" have been proposed, ranging from northern Africa (Marchand & Perrin 2017) to Crimea (Biagi & Kiosak 2010) and eastern Asia (Gronenborn 2017; Inizan 2012: 22, 35).

This article focuses on the Late Mesolithic of southeastern Europe, a geographically and culturally diversified region, where Mesolithic studies are still somewhat underdeveloped. And yet, due to its geographical position between eastern and western Europe, the Mediterranean Basin and the Black Sea (Figure 1), it is a key region to understand the development and spread of the blade-and-trapeze technocomplex.

Figure 1. Location of sites mentioned in text (B. Frerix, ÖAI/ÖAW).
Slika 1. Položaj lokaliteta spomenutih u tekstu (B. Frerix, ÖAI/ÖAW).

The objective of this article is to characterize the Late Mesolithic period in southeastern Europe, with a specific focus on the blade-and-trapeze industries. These types of industries are mainly found in the territory of present-day Montenegro, at Crvena Stijena and Odmut caves, and are dated to the mid-7th millennium BCE. These two sites are situated in distinct ecological niches; Crvena Stijena is within the Mediterranean climatic zone, while Odmut is positioned in the mountainous area of the central Balkans. Consequently, despite being only about 70 km apart as the crow flies, these two sites were subject to distinct cultural influences during prehistory, namely Mediterranean and continental. Therefore, a typo-technological comparison of these two lithic assemblages is crucial to determine whether these industries exhibit common characteristics in blade making, indicating shared cultural traditions, or whether they diverge significantly. Furthermore, comparing them with other blade-and-trapeze industries in southeast Europe can help ascertain the homogeneity of the Late Mesolithic in the region. This analysis may also shed light on whether their origin can be linked to the Mediterranean (either Sicily or northern Africa) or, conversely, to the Black Sea.

2. Late Mesolithic of Montenegro

Present-day Montenegro hosts a notable concentration of Mesolithic sites relative to other Balkan regions. One likely explanation is its karstic topography, with numerous cave systems particularly attractive to archaeological research. Four sites in particular, Crvena Stijena, Odmut, Vruća Pećina, and Vrbička - are dated to a period broadly corresponding to the transition between the Boreal and Atlantic, with radiocarbon dates ranging roughly from c. 7350 to c. 6400 cal. BCE (Baković *et al*. 2009; Borić *et al*. 2019; Cristiani & Borić 2016; Mercier *et al*. 2017). All sites, except Vrbička, are characterized by the blade-and-trapeze industries attributable to the Late Mesolithic (Borić *et al*. 2019; Cristiani & Borić 2016; Kačar 2019; 2020; Kozłowski 2009; Kozłowski *et al*. 1994; Mihailović 2007; 2009: 102-110; 2017). However, the emergence of blade-and-trapeze industries in the region remains somewhat unclear. Although it is generally assumed that Castelnovian appears in the area around 6500 cal. BCE, recent radiocarbon dates obtained on bone harpoons from the caves of Odmut (OxA-34966 and OxA-35002) and Vruća (OxA-31133) suggest an earlier appearance, around 7350-7000 cal. BCE (Borić *et al.* 2019). While these dates may seem unexpected, as they predate those from southern Italy, it must be acknowledged that neither at Odmut nor at Vruća have any pre-Neolithic layers been reported other than those characterised by blade-and-trapeze industries. These industries are characterised by the use of more elaborate knapping techniques, such as indirect percussion and pressure flaking, and, regardless of the exact timing of their emergence in the region, their appearance would mark the earliest use of these techniques here.

2.1. Blade-and-Trapeze Industries in Montenegro: Case Studies from Crvena Stijena and Odmut

After Lepenski Vir, Crvena Stijena and Odmut are undoubtedly the two most prominent Late Mesolithic (and "Transitional" Mesolithic-Neolithic) sites in the Balkans. Both have yielded occupations characterised by blade-and-trapeze lithic assemblages, commonly attributed to the Late Mesolithic (Para-) Castelnovian traditions (Kačar 2019; 2020; Kozłowski 2009: 262-304; Mihailović 2007; 2009: 102-110; 2017).

The Crvena Stijena rock shelter exhibits a complex stratigraphic sequence more than 20 m thick, enabling the reconstruction of human occupation from the Middle Palaeolithic through the Upper Palaeolithic, Mesolithic, Neolithic and into the Bronze Age. Layer IV (subdivided into IVa, IVb1 and IVb2) has been attributed to the Mesolithic and was initially linked to the Capsian (Basler 1975: 103; Benac 1957: 36; 1975: 133; Benac & Brodar 1958). Recent excavations have revealed intact Mesolithic deposits (Baković *et al.* 2009). Level 2, correlated with Layer IVa from the earlier excavations, has produced a Castelnovian-like industry and radiocarbon dates of *c.* 6600-6400 cal. BCE (Beta-211504; Beta-211503), placing this occupation within the Late Mesolithic. Level 4, dated to the Boreal (*c.* 8000-7750 cal. BCE;

Beta-211505), is provisionally correlated with Level IVb2 from the earlier excavations and would therefore indicate an early Mesolithic phase (Baković *et al.* 2009). However, the chrono-cultural attribution of Level IVb2 remains somewhat uncertain due to the scarcity of diagnostic artefacts, and its correlation with the newly excavated Level 4 cannot yet be confirmed without ambiguity (Baković *et al.* 2009). Moreover, the technological homogeneity of the lithic assemblage in IVb2 with those from the overlying layers supports a preliminary classification within the Late Mesolithic (Kačar 2019: 279-290; Mihailović 2009: 102-110).

At Odmut Cave, rescue excavations following the construction of the Mratinje hydroelectric dam on the Piva River in the 1970s revealed a robust stratigraphic sequence about four metres thick, spanning occupations from the Mesolithic through to the Bronze Age (Srejović 1974). Despite the complexity of the stratigraphy and varying interpretations by different authors (Cristiani & Borić 2016; Kozłowski *et al*. 1994; Srejović 1974), layers XA, IA and IB are associated with the Late Mesolithic (for detailed discussion on Odmut's stratigraphy see Cristiani & Borić 2016: 1-5 and Kačar 2019: 327-331). A number of radiocarbon dates have been obtained from contexts attributed to the Mesolithic. The most recently obtained results, measured on short-lived samples (bone harpoons), fall into three main clusters (Borić *et al.* 2019): (1) dates of *c.* 6650-6500 cal. BCE (OxA-32283; OxA-35003), which correspond to the proposed chronology for the onset of the Castelnovian in the region (in accordance with dates from southern Italy); (2) a date younger than 6000 cal. BCE (OxA-35001), which aligns with the emergence of Neolithic in the area; and (3) earlier dates, older than *c.* 6700 cal. BCE (OxA-34966; OxA-35002).

In the framework of my PhD, material from the uppermost Mesolithic layer of Crvena Stijena (Layer IVa) was examined, along with Layers XA, IA, and IB from Sector 5 of Odmut (Kačar 2019). This represents, in the case of Crvena Stijena, 1066 pieces, approximately half of the total material from the Mesolithic layers (2115 pieces from Layers IVa, IVb1 and IVb2; Mihailović 2009: 31, table 2) and, in the case of Odmut, 678 pieces, which corresponds to a little less than two-thirds of the assemblage, according to Kozłowski's (1994) count of 1074 pieces associated with the Mesolithic layers. However, due to the limited space available in this article, the information provided here is a condensed version of the thesis. In the case of Odmut, only the material from the uppermost layer XA (artificial layers, "cuts" 13 and 14) is presented. Nevertheless, given the great homogeneity in raw materials used, technology and typology of the entire Late Mesolithic sequence (Kačar 2019; Kozłowski *et al*. 1994), this will not affect the quality of the results.

Furthermore, particular emphasis is given to grey cherts identified as Type 1 in both assemblages, as they constituted the primary raw materials used for the blade-and-trapeze industries.

2.1.1. Crvena Stijena Raw material economy and production

Based on the nature of the raw material, the assemblage from Crvena Stijena IVa (n=1066) was macroscopically sorted into five different groups. Except for Type 5, which consists of burnt and patinated specimens, individual groups may indicate variations in the raw material economy, suggesting the rocks were used in different ways and thus involved the implementation of distinct operational schemes (Table 1). In this article, we focus on Type 1 cherts, which represent the largest portion of the assemblage and were clearly used in the production of the blade-and-trapeze industries (see below). Other groups of cherts are present only sporadically. Type 2 comprises beige-grey and yellowish-pinkish, often translucent, high-quality homogeneous cherts of probably exogenous origin. These are likely intrusive from the upper Neolithic layers (Layer III), since the size and morphology of the blades point rather to Neolithic Anatolian traditions than to Castelnovian ones (Kačar 2019: 324-325). Type 3 consists of low-quality bluish cherts that appear unsuitable for blade production and are represented only by a few flakes and pieces of debris. Type 4 includes radiolarites, represented in Layer IVa by a single bladelet core, which nevertheless fits within the general Castelnovian technological scheme.

Table 1. Crvena Stijena IVa: Lithic assemblage breakdown by main raw material groups and technological categories. Type 1: grey cherts; type 2: beige-grey and yellowish-pinkish cherts; type 3: bluish cherts; type 4: radiolarites. Type 5 clusters the raw materials which could not be identified due to their altered surface (burnt, patinated).
Tablica 1. Crvena stijena IVa: razdioba litičkog skupa nalaza prema glavnim skupinama sirovina i tehnološkim kategorijama. Tip 1: sivi rožnjaci; tip 2: bež-sivi i žućkasto-ružičasti rožnjaci; tip 3: plavičasti rožnjaci; tip 4: radiolariti. Tip 5 obuhvaća sirovine koje nije bilo moguće odrediti zbog promijena na površini (gorenje, patina).

Technological category	**Type 1**	**Type 2**	**Type 3**	**Type 4**	**Type 5**		**Total Blanks**	**%**
					Burnt	**Patin.**		
Cortical blade(let)s	19				3	3	25	
Crested blade(let)s					2	1	3	9.9%
Central Blade(let)s	53	4			10	7	74	
Blade(let)s other	4						4	
Total blade(let)s	76	4			15	11	106	
Flakes	159	5	4		221	10	399	37.4%
Blade(let) cores	8			1	3	1	17	
Blade(let) & flake cores	4							2%
Core fragments	3					1	4	
Total cores	15			1	3	2	21	
Debris	80		2		452	6	540	50.7%
Total Raw materials	330	9	6	1	691	29	1066	100%
Total % RM	95.4%		4.6%		96%	4%		
Total % MP determ./indet.		32.5%			67.5%		100%	

Type 1 includes cherts occurring in the form of small to medium-sized nodules or pebbles of good quality, with colours ranging from grey and brown to dark beige. The material is translucent or matt, often displaying a greasy, shiny, and smooth appearance, and is characterised by a homogeneous, fine-grained structure. A light patina has sometimes developed on these pieces. The cortex is thin, beige in colour, and consistently rough, indicating a primary rather than a secondary geological position. Although figures are not available, the description provided by Ćulafić *et al.* (2017: 259) suggests a possible correspondence: "[…] In the lower level, tiny nodules appear that are almost perfect spheres, whitish to light yellow in colour. Their dimensions are 10×10 cm at most. In the upper level, lenses and very large nodules of chert show up. These are of irregular shape and decimetres to a metre in length and up to around 30 cm in thickness. These cherts from the upper level are grey to dark grey in colour, of massive texture, conchoidal fracture, and semi-glassy shine." It is therefore possible that Type 1 cherts correspond to locally available cherts deriving from Lower Jurassic formations, which extend into western Montenegro and eastern Herzegovina, with sources located within a 12-40 km radius (Ćulafić *et al.* 2017; Pamić 1975), all of which can be considered local. With 330 pieces, accounting for 95.4% of all determined raw materials, the grey cherts were the main resource used by the Mesolithic peoples at Crvena Stijena. The number is probably higher, as a big majority of burnt and patinated pieces corresponds to these cherts. Grey cherts were worked on site, as evidenced by the presence of cortical and core rejuvenation elements, flakes, and cores, and were probably brought to the site as pebbles or, if nodules, as pre-shaped blocks, given that large and thick cortical flakes corresponding to the initial shaping are absent. They were principally used for blade production, as reflected in the high proportion of blades and bladelets (n=76), and blade or mixed blade-flake cores (n=12). Flakes often bear negatives of previous laminar removals. Fifteen cores (12 cores and 3 core fragments) are made on grey cherts.

Of a total of 76 blades, 38 are preserved completely (Table 2). The average length is 27.8 mm corresponding to the average size of the cores, which is 31.4 mm. Other blades were broken into fragments and preserved in the following forms: proximal (n=13), distal (n=17), and medial (n=8). The longest (and largest) blade measures 45.5 x 14.9 x 4.1 mm (Supplementary File 1: Plate 1: 7). It belongs to the central phase of the blade debitage (*lames de plein debitage*) and is slightly arched in its distal part indicating that during the flaking part of the core was accidentally removed (plunging blade). The blade was retouched with two notches on the right edge, representing a notched blade(let), a typical Castelnovian tool.

Table 2. Crvena Stijena IVa: typometry (in mm) of blade(let) in relation to determinable and indeterminable (burnt, patinated) raw materials. n = total number of blades and bladelets.
Tablica 2. Crvena stijena IVa: tipometrija (u mm) sječiva u odnosu na odredive i neodredive (goreno, patinirano) sirovine. n = ukupan broj sječiva.

	Type 1		**Type 2**		**Type 3**		**Burnt**		**Patinated**		**All blades**	
	n	**Values**	**n**	**Values**	**n**	**Values**	**n**	**Values**	**n**	**Values**	**Total**	**Values**
Average length		27.8						30.6		28.7		28.9
Minimum length	38	20.6	0		0		8	23.2	4	23.5	50	20.6
Maximum lenght		45.5						53.3		38.4		53.3
Average width		9.5		16.0				9.2		8.9		9.6
Minimum width	76	5.7	3	13.9	1	14.9	15	7.3	11	5.7	106	5.7
Maximum width		14.9		18.0				14.6		14.4		18.0
Average thickness		2.8		3.1				3.3		2.7		2.9
Minimum thickness	76	1.5	3	2.9	1	3.2	15	2.3	11	1.5	106	1.4
Maximum thickness		5.6		3.4				5.0		4.1		5.6

The blades are between 5.7 and 14.9 mm wide (average 9.5 mm) and between 1.5 and 5.6 mm thick (average thickness 2.8 mm). The scatter plot (Figure 2) shows that blades wider than 13 mm are very rare: there are only four of them, and of these, two are (slightly) plunging blades (Figure 3: 1-2). Using a width of 12 mm as a criterion for distinguishing bladelets from blades, we can see that the type 1 chert is mainly used for bladelet production.

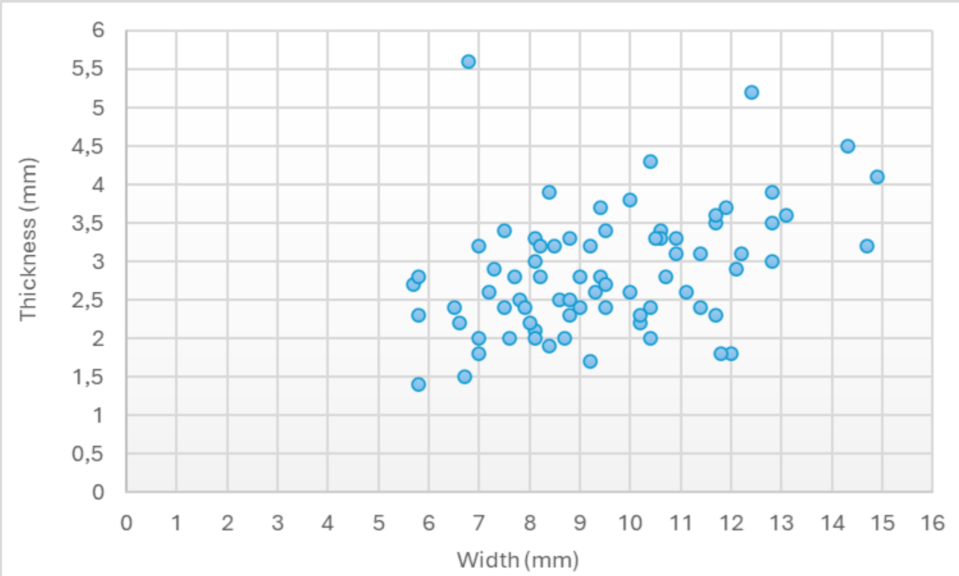

Figure 2. Crvena Stijena IVa: blades on grey chert ("Type 1", n=76) dispersion of thickness (ordinate) and width (abscissa).
Slika 2. Crvena stijena IVa: sječiva od sivog rožnjaka („Tip 1", n = 76), distribucija debljine (ordinata) i širine (apscisa).

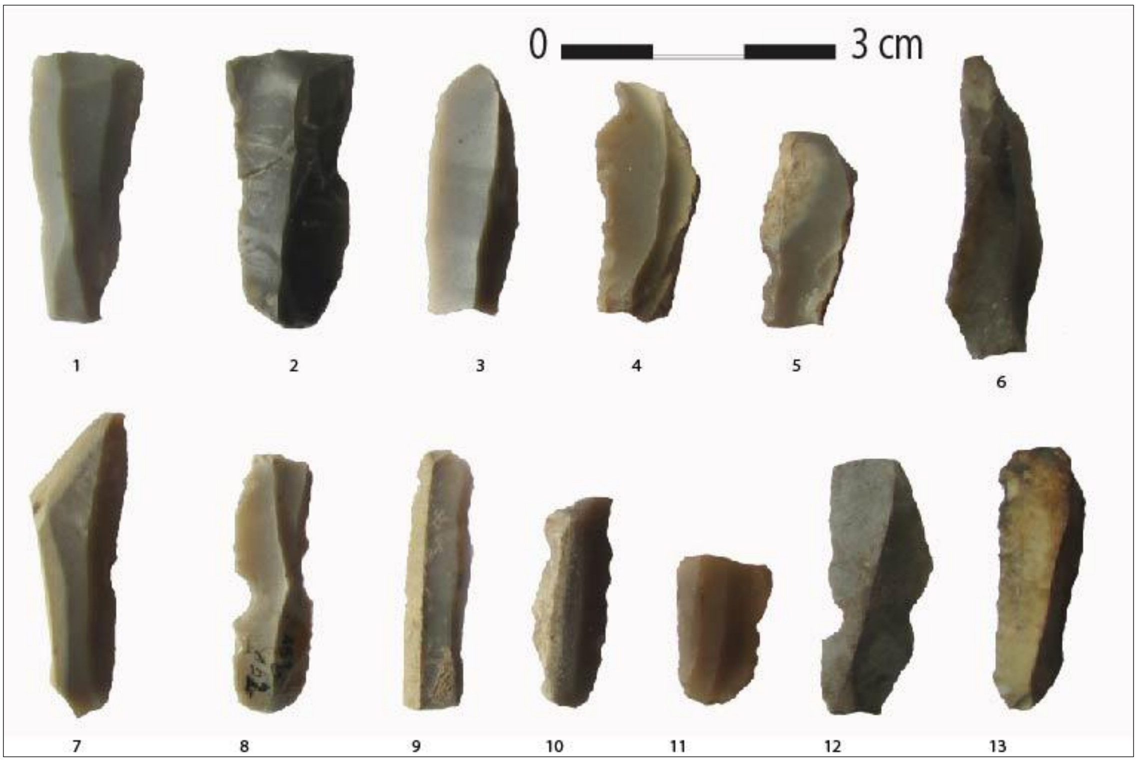

Figure 3. Crvena Stijena IVa: Blade(let)s on grey cherts ("Type 1").
Slika 3. Crvena stijena IVa: sječiva od sivih rožnjaka („Tip 1").

In 50 cases, the butts have been preserved: with 48 facetted butts, the systematic preparation of the striking platform is obvious. One butt is linear and one punctiform. The bulbs are generally diffuse (n=29) or pronounced (n=23), but they are never too thick. Nineteen blades are cortical. However, the cortex covers up more than two thirds of the upper surface in only 3 blades and there are no entirely cortical blades. Most of the blades (n=57) do not have a cortex and blades showing core maintenance (crested or core-rejuvenation blades) are absent (Table 3). Therefore, technologically they belong to the central phase of the blade production (*lames de plein debitage*). Of these blades, 8 show characteristics of so-called "debitage optimum" in the form of prismatic blades with a trapezoidal cross-section, two parallel dorsal ridges, and three longitudinal surfaces.

Table 3. Crvena Stijena IVa: Description of blade(let) according to the flaking rhythm (debitage phase) (according to Binder 1987).
Tablica 3. Crvena stijena IVa: opis sječiva prema ritmu odlamanja (faza odlamanja) (prema: Binder 1987).

Description blades	Code	Type 1	Type 2	Type 3	Burnt	Patin.	Total
Opening blades	A1						
Cortical blades	A1a	19			3	3	25
Core rejuvenation blades: crested	A2				2	1	3
Core rejuvenation blades: other	A2a						
Upper surface two removals	B1	10	2		1	2	15
Upper surface more than three removals	B2	35	1		5	4	45
Trapezoidal section	C	5			3	1	9
Trapezoidal section (rhythm 2-1-2')	C1	2					2
Trapezoidal section (rhythm 1-2-3 or 3-2-1)	C2	1		1			2
Indeterminate blades	D	4			1		5
TOTAL		76	3	1	15	11	106

While most of the blade blanks were probably used unretouched, given the macroscopically visible use-wear along the edges, the tools include 21 pieces, indicating a high rate of retouched specimens (27% of all blades). Within this study, only tools on blades were examined. However, tools on flakes are also included, primarily consisting of common tools such as end scrapers and side scrapers (Supplementary File 1: Plate 1: 11, also see Mihailović 2009: 59-65).

The majority take the form of notched blades (n=10; Table 4; Figure 3: 2, 5, 7, 8, 10, 11, 12; Supplementary File 1: Plate 1: 5-7). Other categories include truncations, one of which may represent a microburin (n=3; Supplementary File 1: Plate 1: 3-4), blades with an abrupt retouch (n=2), trapezes (n=2; Supplementary File 1: Plate 1: 1-2) and blades with irregular retouch (n=2). There is also a single burin.

Cores are of small size with the biggest being 33mm long. Most cores bear cortex (n=10), and in 4 specimens this cortex covers up to 25% of the total surface. Most of the cores (n=11; Table 5) are unidirectional and have a single striking platform (Figure 4; Supplementary File 2: Plate 2: 1-4): the debitage took place preferentially on one face of the core (n=8), generally on the single large side (n=7; Figure 4: 3; Supplementary File 2: Plate 2: 1) and on a single narrow side in only one specimen (Figure 4: 1; Supplementary File 2: Plate 2: 3). In 3 specimens the debitage occurred on different sides of core (*débitage tournant*) (Figure 4: 2; Supplementary

File 2: Plate 2: 2, 4). In all unidirectional cores the striking platform is carefully prepared, usually by small continuous removals. Only one core has 2 striking platforms implying bidirectional flaking. In this case, the first used striking platform is facetted while the second is not. This probably indicates that direct or indirect percussion was used (at least for the second phase of the debitage) because the pressure flaking is always unidirectional. All twelve cores were used for bladelets: in 8 cases, negatives indicate that only bladelets were detached and in 4 cases, both bladelets and flakes were detached at the end of core use. This suggests that after initial flaking more expedient production occurred.

Table 4. Crvena Stijena IVa: Tools on blades, typological breakdown.
Tablica 4. Crvena stijena IVa: oruđa na sječivima, tipološka razdioba.

	Type 1	Type 2	Type 3	Burnt	Patin.	Total
Notched blade(let)s	10			1	3	14
Troncations	4			1		5
Side scrapers	2					2
Bitroncations/ Trapezes	2		1			3
Burins	1					1
Blades with irregular removals	2	1				3
Total retouched blade(let)s	21	1	1	2	3	28

Table 5. Crvena Stijena IVa: Description cores.
Tablica 5. Crvena stijena IVa: opis jezgri.

Description core	Type 1	Type 4	Burnt	Patin.	Total
Unidirectional on different sides (*débitage tournant*)	3				3
Unidirectional on single large side	7		3		10
Unidirectional on single narrow side	1				1
Bidirectional on distinct sides (two opposite directions)	1	1		1	2
Undetermined (fragments)	3			1	5
Total	15	1	3	2	21

The dimensions of the blade negatives and the prepared striking platforms are consistent with the morphometry of the debited blades - the average width of the bladelets is 9.6 mm and their butts are facetted. The cores were abandoned for the following reasons: a succession of hinge accidents and loss of angle, or a striking surface that had become too small. Some cores display overhangs (Supplementary File 2: Plate 2: 1-3).

Occasionally, the presence of elongated flakes on the striking surface of the core indicates evidence of rejuvenation (Figure 4: 3; Supplementary File 2: Plate 2: 2). Two tablets are also recorded indicating the rejuvenation of the cores' platforms (Supplementary File 2: Plate 2: 5). More rarely we can observe lateral removals that indicate re-centring of the debitage surface (Figure 4: 3).

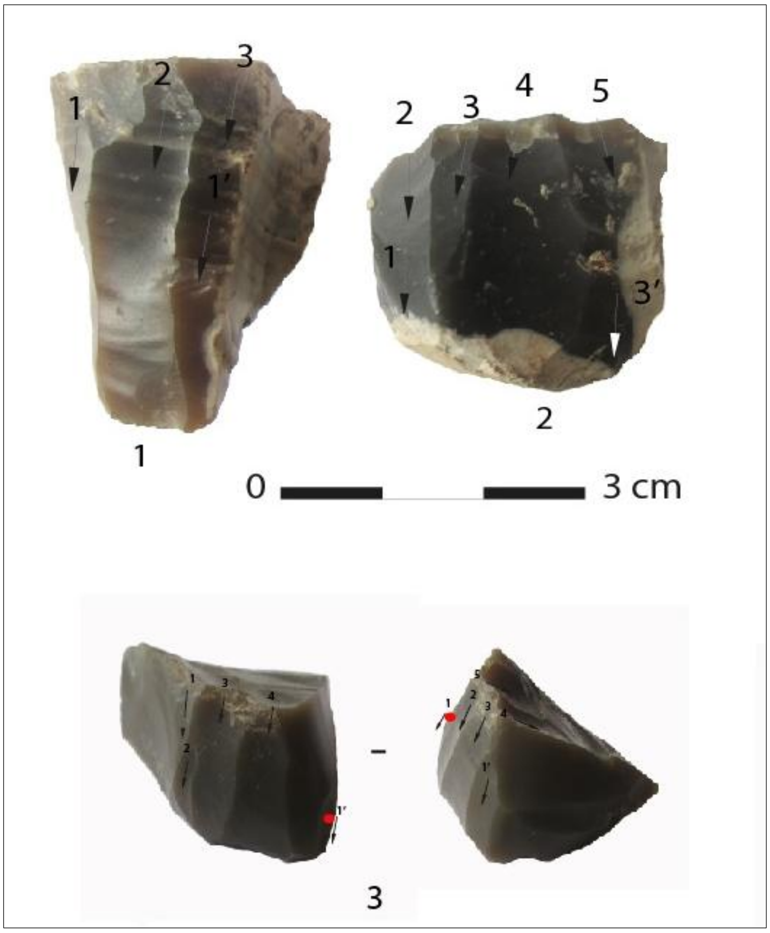

Figure 4. Crvena Stijena IVa: Cores on grey cherts (“Type 1”). Black triangles indicate the direction of blade removals, and the numbers show the order of removals (n. 1 indicating the first removal). Red dots indicate the same reference point on different views of the same core.
Slika 4. Crvena stijena IVa: jezgre od sivih rožnjaka („Tip 1”). Crni trokutići označavaju smjer odlamanja sječiva, a brojevi prikazuju redoslijed odlamanja (br. 1 označuje prvo odlamanje). Crvene točkice označavaju istu referentnu točku na različitim prikazima iste jezgre.

2.1.2. Odmut layer XA Raw material economy and production

Based on the nature of the raw material, the assemblage from Odmut was macroscopically sorted into six different groups. Except for Group 6, which consists of burnt and patinated specimens, individualized groups may indicate variations in the raw material economy, suggesting different ways in which the rocks were used and thus distinct operational schemes.

Likewise, for the Crvena Stijena assemblage, we focus on Group 1 cherts, which are the most numerous and clearly illustrate blade-and-trapeze production (Table 6). Other groups of raw materials are present only sporadically. Group 2 comprises highly translucent green-black cherts that are very homogeneous in structure and display a waxy, shiny surface. They correspond to the Castelnovian *schème opératoire* but given their small quantity and presence only as bladelets and flakes, they were most likely introduced to the site as finished products - provided they do not represent a variation within Group 1, which macroscopically seems not to be the case. Group 3 includes radiolarites, mostly red in colour, that also follow the Castelnovian technological scheme and, despite their low quantity (n=12), were probably worked on site, as indicated by the presence of cores, flakes and debris. Group 4 contains medium-quality cherts of greenish-bordeaux colour that were probably only tested (one tested block and flakes, with no blades). Group 5 refers to a blond, translucent, homogeneous, high-quality chert of probable exogenous origin, represented by only two pieces (an irregular blade and a core-rejuvenation flake), probably indicating Neolithic intrusion, given that ceramics were also reported in Layer XA (Kačar 2019: 345-346).

Table 6. Odmut XA Lithic assemblage breakdown by main raw material groups and technological categories. Group 1: grey cherts; group 2: green translucid cherts; group 3: radiolarites; group 4: greenish-bordeaux cherts; group 5: blond cherts; group 6: undetermined (clusters the raw materials which could not be identified due to their altered surface, i.e. burnt and patinated specimens).
Tablica 6. Odmut XA: razdioba litičkog skupa nalaza prema glavnim skupinama sirovina i tehnološkim kategorijama. Grupa 1: sivi rožnjaci; grupa 2: zeleni svjetlopropusni rožnjaci; grupa 3: radiolariti; grupa 4: zelenkasto-bordo rožnjaci; grupa 5: svijetli („blond") rožnjaci; grupa 6: neodređeno (obuhvaća sirovine koje nije bilo moguće odrediti zbog promijena na površini (goreni i patinirani primjerci).

Technological category	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6		Total
						Burnt	Patin.	
Cortical blade(let)s	5						1	6
Core rejuvenation blade(let)s: crested	2						2	4
Core rejuvenation blade(let)s: other	1						1	2
Central blade(let)s	35	5	2			10	2	54
Blade(let)s: other	1	1			1	2		5
Total blade(let)s	44	6	2		1	12	6	71
Flakes	67	5	7	10	1	30	16	136
Cores for bladelets	5		1					
Cores for bladelets and blades	1							
Cores for bladelets and flakes	2					1		
Total cores	8		1			1		
Chips	1							1
Debris	18	1	2	10		19	2	52
Tested bloc	1			1				2
TOTAL	139	12	12	21	2	62	24	272

Group 1 contains grey-brownish cherts. With 139 pieces, accounting for 74.7% of all determined raw materials, grey cherts were the primary raw material used. As evidenced from the high rate of blade(let) (n=44; 23.6%), and blade or mixed blade-flake cores (n=8; 5.6%), these cherts were principally used to produce blade(let)s. Flakes often bear negatives of previous blade removals.

Flakes (n=67. 48%) and blades (n=44; 31.7%) are the most frequent types of artefacts within this group. Cores are represented by 8 specimens (5.8%) (Supplementary File 4: Plate 4: 1-6). There are also 18 pieces of debris (12.9%), one chip and one tested block.

Of a total of 44 blades, 16 are preserved completely (Table 7). The average length is 30.6 mm corresponding to the average size of the cores (see below). Other blades were broken into fragments and preserved in the following forms: medial (n=14), proximal (n=10) and distal (n=4). The longest (and the thickest) blade measures 48.4 x 11.4 x 5.9 mm (Supplementary File 3: Plate 3: 9). Along its left side the blade has remaining cortex suggesting that it was detached in order to clean the flaking surface. On the right distal side continuous removals suggest this cortical blade was used.

Table 7. Odmut XA: typometry (in mm) of blade(let) in relation to determinable and indeterminable (burnt, patinated) raw materials. n = number of blades/bladelets.
Tablica 7. Odmut XA: tipometrija (u mm) sječiva u odnosu na odredive i neodredive (gorene, patinirane) sirovine. n = broj sječiva.

	Group 1		Group 2		Group 3		Group 5		Burnt		Patinated		Total	
	n	Value	n	Value	n	Value	n	Value	n	Value	n	Value	n	Value
Average length		30.6										33.5		31.1
Minimum length	16	22.0	1	20.7	0		1	44.9	0		2	27.7	20	20.7
Maximum length		48.4										39.3		48.4
Average width		10.0		11.4		10.5				11.5		10.5		10.5
Minimum width	44	4.3	6	8.1	2	9.8	1	17.2	12	7.8	6	6.3	71	4.3
Maximum width		15.1		14.0		11.2				20.7		15.6		20.7
Average thickness		2.8		2.5		2.6				3.0		3.0		2.8
Minimum thickness	44	1.1	6	1.9	2	2.2	1	3.3	12	2.2	6	2.3	71	1.1
Maximum thickness		5.9		3.2		3.0				5.4		4.6		5.9

The blades are between 4.3 and 15.1 mm wide (average 10 mm) and between 1.1 and 5.9 mm thick (average thickness 2.8 mm) (Figure 5). When preserved (n=25), the butts are generally facetted (n=23), and two are cortical. This implies systematic preparation of the striking platform. The bulbs are generally diffuse (n=15) or pronounced (n =11), but they are never too thick. Five blades made on grey cherts are cortical (Table 8) and in 3 cases the cortex covers up more than two thirds of upper surface.

Eight blades show core maintenance: two are crested, while the others generally bear traces of hinge accidents on the ventral side, indicating they were struck out to clean the flaking surface (Figure 6: 4, 7-9). Central blades are the most common (n=27) of which only 3 belong to the “debitage optimum” flaking phase.

Ten blades are retouched and typology-wise can be sorted as follows (Table 9): trapezes (n=4; Supplementary File 3: Plate 3: 1-3, 5), blades with irregular retouch (n=3), truncations (n=2; Supplementary File 3: Plate 3: 7, 8) and a bladelet with abrupt removals (n=1, Supplementary File 3: Plate 3:10). All trapezes are symmetrical and their widths (15.1 mm/15 mm/ 13.4 mm/ 13.8 mm) suggest that the larger blade blanks were selected for the trapeze manufacture.

Cores (n=10) are of small size, rarely exceeding 30 mm. Most of cores are without cortex (n=6), and at only 2 specimens cortex covers more than 25% of surface (Supplementary File 4: Plate 4: 4) Most of the cores (n=7) are unidirectional (Table 10; Supplementary File 4: Plate 4: 2-6) and have a single striking platform: the debitage takes place preferentially on the single face of the core (n=5), generally on one large side (4). In one specimen debitage occurred on a single narrow side (Supplementary File 4: Plate 4: 2), and in another on two distinct large sides. At one the debitage occurred on different sides of the core (*débitage tournant*) (Figure 7;

Supplementary File 4: Plate 4: 3). In unidirectional cores the striking platform is prepared either carefully by small continuous removals (n=4) or, in 2 cases, with more discontinuous removals. One core has 2 striking platforms implying bidirectional flaking. In this case two distinct large sides of the core were used as two distinct flaking surfaces (of which one is facetted) and blades were removed in opposite directions (Supplementary File 4: Plate 4: 1).

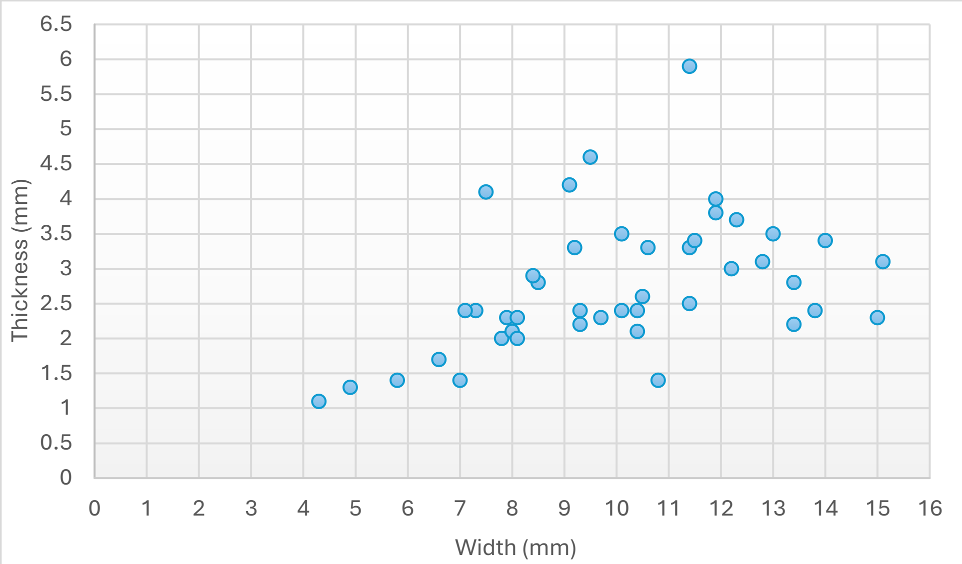

Figure 5. Odmut XA: blades on grey cherts ("Group 1", n=44) dispersion of thickness (ordinate) and width (abscissa).
Slika 5. Odmut XA: sječiva od sivih rožnjaka („Grupa 1", n=44), distribucija debljine (ordinata) i širine (apscisa).

Table 8. Odmut XA: Description of blade(let) according to the flaking rhythm (debitage phase) (according to Binder 1987).
Tablica 8. Odmut XA: opis sječiva prema ritmu odlamanja (faza odlamanja) (prema: Binder 1987).

Description of blades	Code	Group 1	Group 2	Group 3	Group 5	Burnt	Patin.	Total
Cortical blades	A1a	5					1	6
Core rejuvenation blades: crested	A2	2					2	4
Core rejuvenation blades: other	A2a	6					1	2
Upper surface two removals	B1	7	1	1		2	1	12
Upper surface more than three removals	B2	20	3	1		6	1	36
Trapezoidal section	C					1		1
Trapezoidal section (rhythm 2-1-2')	C1	2				1		3
Trapezoidal section (rhythm 1-2-3 or 3-2-1)	C2	1	1					2
Indeterminate blades	D	1	1		1	2		5
TOTAL		44	6	2	1	12	6	71

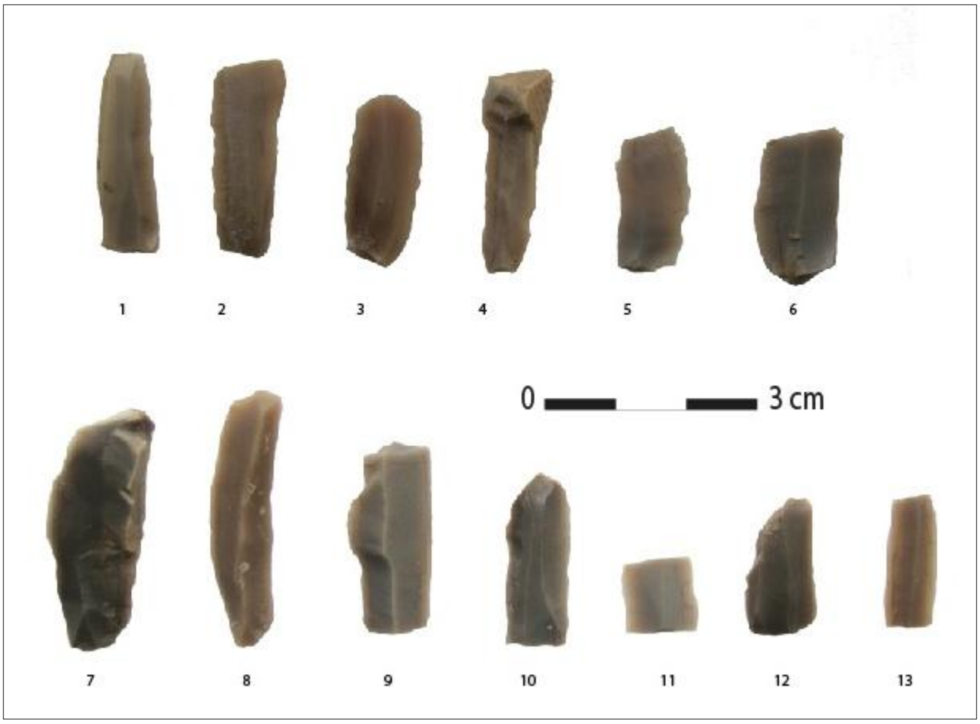

Figure 6. Odmut XA: blades on grey cherts (“Group 1”).
Slika 6. Odmut XA: sječiva od sivih rožnjaka („Grupa 1”).

Table 9. Odmut XA: Tools on blades, typological breakdown.
Tablica 9. Odmut XA: oruđa na sječivima, tipološka razdioba.

	Group 1	Group 2	Group 3	Burnt	Patin.	Total
Notched blade(let)s					1	1
Truncations	2			2		4
Bladelet with abrupt removals	1	1		1		3
Bi-Truncations/ Trapezes	4	1			1	6
End scrapers				1		1
Blades with irregular removals	3	1	1			5
Total retouched blade(let)s	10	3	1	4	2	20

Table 10. Odmut XA: Description cores.
Tablica 10. Odmut XA: opis jezgri.

Description core	Group 1	Group 3	Patin.	Total
Unidirectional on different sides (*debitage tournant*)	1			1
Unidirectional on single large side	4	1		5
Unidirectional on single narrow side	1			1
Unidirectional on distinct large sides	1			
Bidirectional on distinct sides (two opposite directions)	1			1
Bidirectional on the same multiple sides (two orthogonal directions)			1	2
TOTAL	8	1	1	10

Figure 7. Odmut XA: blade(let) core made on grey chert (“Group 1”).
Slika 7. Odmut XA: jezgra za sječiva izrađena od sivog rožnjaka („Grupa 1”).

In their last phase of use, all cores were still used for production of blade blanks. Usually only bladelets were detached (n=4), and in one case bladelets and a blade (14 mm wide) were detached. More rarely, both bladelets and flakes were detached at the end of the core use (n=3). Last blade negatives indicate that bladelets, preferentially between 5 and 9 mm, were removed. The dimensions of the blade negatives and the prepared striking platforms are consistent with the morphometry of the debited blades - the average width of the bladelets is 10 mm and their butts are facetted. The cores were abandoned because it was impossible to continue the flaking due to the succession of hinge accidents and loss of angle, or more rarely, because the striking surface had become too small. Overhangs are still visible on some cores.

2.2. Comparison between Crvena Stijena and Odmut

When comparing lithic production between the two sites, we note many similarities. First of all, both sites use primarily local or regional cherts in the form of pebbles or smaller nodules, for production *in situ*, as evidenced by the presence of elements pointing to the first phases of debitage (cortical elements) and abandonment (cores, debris). The main raw materials used (Group 1 from Odmut and Type 1 from Crvena Stijena) at both sites exhibit macroscopic similarities, with similar cherts also found in the Vruća Pećina assemblage. While this suggests a possible common geological origin in Lower Jurassic formations that extend into western Montenegro and eastern Herzegovina (Ćulafić *et al.* 2017; Pamić 1975), the cherts were probably available in the vicinity of the sites and were collected locally.

High numbers of bladelets, blade cores and flakes bearing blade negatives suggest that at both sites production was oriented towards the production of bladelets. Technical procedures used in core preparation, maintenance and flaking are similar at both sites (Figure 8). The preparation is often minimal, especially when pebbles were employed. After the opening of a striking platform, with one or few removals, the flaking surface is opened by detachment of a cortical blade. The cores are quadrangular or semi-conical in shape and the debitage surface is generally convex. They generally have one striking platform, and the flaking is limited to one large side. Probably during the central phase of the debitage, the knapper intervened on the striking platform in order to prepare it for each bladelet detachment as evidenced by the predominance of the facetted butts. The butts are often wide and, in some cases, inclined. Overhangs are not systematically abraded. The morphometric data from both assemblages indicate the production of similar blade(let) products: in all layers from Odmut the average length is 30.6 mm, while the average width is 10 mm and thickness 2.8 mm and in Crvena Stijena the average length is 27.8 mm, width 9.5 mm and thickness 2.8 mm.

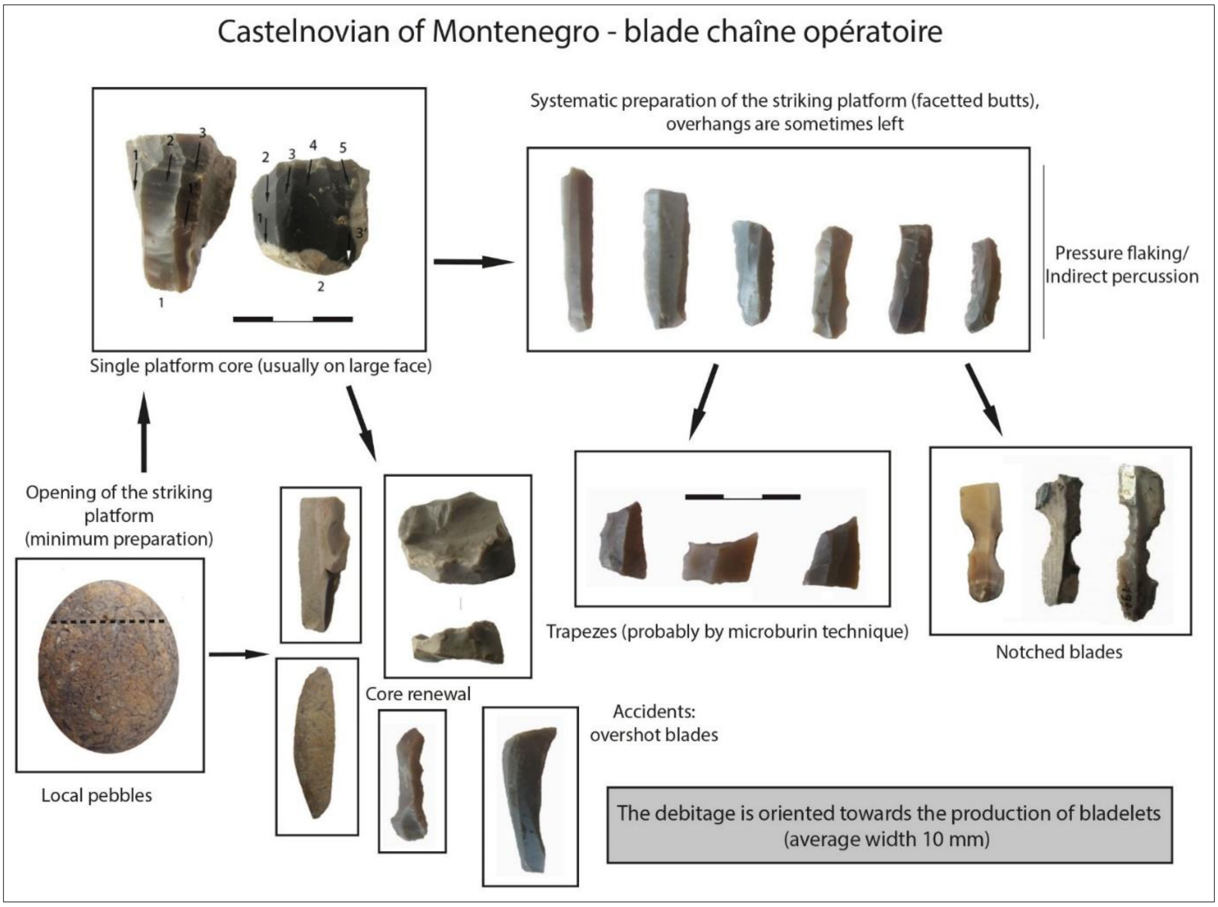

Figure 8. Castelnovian of Montenegro: lithic operational scheme (modified after Kačar 2020).
Slika 8. Kastelnovijen u Crnoj Gori: litička operativna shema (modificirano prema Kačar 2020).

The important question is how these blades(let)s were produced, *i.e.,* what techniques were used? In both assemblages distinct knapping techniques were probably employed in blade production. Nevertheless, it must be acknowledged that determining the primary technique used, whether it was indirect percussion or pressure flaking, is challenging due to the difficulty in distinguishing between them. In both assemblages some blades are very regular with almost parallel ridges and arrises and very straight profiles that evoke the pressure flaking technique. Others are more irregular in morphology with a more S-shaped profile which is usually a feature of indirect percussion. Experiments indicate that while product regularity is characteristic of pressure flaking, it is not a conclusive criterion, since indirect percussion may also produce regular forms; nevertheless, systematic and consistent regularity is still considered the main diagnostic feature distinguishing the two techniques. In addition, the presence of overhangs on a quite large number of the proximal parts, also points rather to the use of the indirect percussion. This is the case namely for the presence of overhangs on both blades and cores meaning that they were not abraded and therefore, that they did not interfere with the flaking. While it is possible to leave the overhangs when detaching by pressure, this is quite rare and generally associated with a plain butt (F. Abbès, pers. comm.). In the case of both Crvena Stijena and Odmut this is not a case because most of the butts are facetted, meaning that the preparation of the striking platform is systematic. Plunging accidents are common in both assemblages, but are not exclusive, as they occur during both pressure flaking and indirect percussion. The main technique used at the Montenegro sites therefore remains an open question. While indirect percussion appears more likely, it is possible that both techniques were used concomitantly.

In addition to this, at the end of the core life, in some cases direct percussion was possibly used in order to obtain last products such as smaller bladelets and, more rarely, flakes. This is possibly evidenced by some thicker and less regular bladelets, and also by the reorientation from the directional to bidirectional flaking in some cases. However, while pressure flaking is always unidirectional, during indirect percussion it is possible to switch the striking platforms.

Tools were mostly made on blades and at both sites typically Castelnovian tools, such as notched bladelets and trapezes, are recorded. At both sites, trapezes are generally symmetrical and made on rather wide laminar supports, possibly by the microburin technique. In addition to this, at both sites, bladelets with irregular removals and side scrapers are well represented tool-types.

Many similarities in the blade production would imply that the Crvena Stijena and Odmut assemblages share the same traditions and therefore are part of the same cultural sphere.

However, it is important to note that differences also exist. One significant distinction between the two industries is that, as a general observation, the blades appear more regular and standardized in Crvena Stijena compared to Odmut. However, instead of seeking an explanation in different techniques (such as that pressure flaking was used more in Crvena Stijena and indirect percussion in Odmut), this might be due to several different reasons. For example, the 'best' products from Odmut might have been transported away from the site (note that only 3 specimens refer to the “debitage optimum”, *i.e.,* prismatic blades), or the observed regularity could stem from the diverse skills of various knappers, from constraints related to raw materials, or from a combination of both. Moreover, knappers at Odmut, for one reason or another, may have maximized the exploitation of raw materials, whereas those at Crvena Stijena either did not need to or did not want to do so. Also, compared to Crvena Stijena, there is a slight dominance of blades (≥ 12mm) in Odmut (particularly in the layer XA), but this difference is statistically insignificant and also probably reflects some of the above-mentioned factors. To avoid potential misinterpretations, it is also important to elucidate the absence of crested blades in Crvena Stijena. This absence is likely coincidental, as two crested specimens have been discovered on patinated raw materials (Type 6), believed to be originally Type 1 cherts.

Differences are also evident in the representation of tool types. In Odmut, bladelets with irregular removals are the most common tool type, followed by trapezes, truncations and side scrapers, while notched bladelets are rather rare. On the contrary, at Crvena Stijena notched tools are the most common tool type, and trapezes are rare. However, rather than pointing to different traditions or different preferences this might again reflect the fact that the final products were taken away from the Odmut site. Also, the relative rarity of the trapezes, as well as the absence of microburins in Odmut and their rarity in Crvena Stijena, is probably due to the selective recovery of the finds during the excavation and the absence of sieving. Indeed, in the case of Crvena Stijena trapezes were not mentioned in the original reports (Basler 1975; Benac 1957, 1975; Benac & Brodar 1958) and were considered as absent, but were later confirmed by the revision of the assemblage (Mihailović 2009: 78-79) and by recent excavations (Baković *et al*. 2009: 27-28).

3. Discussion: Montenegro Late Mesolithic assemblages in the context of European Blade-and-Trapeze industries

The beginning of the Late Mesolithic (also referred to as the Second Mesolithic) in the Central-Western Mediterranean, associated with the Blade-and-Trapeze Technocomplex or Castelnovian, is generally placed at the transition to, and throughout, the second half of the 7th millennium cal. BCE (Binder *et al.* 2022; Marchand & Perrin 2017; Perrin *et al.* 2020). The earliest evidence derives from Grotta dell'Uzzo in Sicily, where direct radiocarbon dates obtained on human remains suggest that the Castelnovian emerged as early as *c.* 6700-6600 cal BCE (Yu *et al.* 2022). This period appears to have been characterised by complex social dynamics across the Mediterranean basin, involving increased mobility and intensified interactions among distinct groups. Archaeogenetic data suggest the arrival of new hunter-fisher-gatherer groups (bearers of the Castelnovian technocomplex) in Sicily (Yu *et al.* 2022), while in Greece, the pioneering Neolithic farming communities arriving from the east were establishing first settlements in the Aegean (=Initial Neolithic).

In the Western Balkans, this shift remains poorly understood, mainly because the scarcity of sites attributed to this period limits the amount of data available for study. Based on current evidence, blade-and-trapeze industries characterise the lithic assemblages of three sites in the Western Balkans, which can therefore be confidently associated with the Castelnovian or Blade-and-Trapeze technocomplex: Odmut, Crvena Stijena, and Žukovica on the island of Korčula. As already mentioned, the first site to be recognised as such was Crvena Stijena, followed by the discovery of Odmut in the 1970s, which, due to typological similarities in the lithic material, was immediately attributed to the same cultural tradition as Crvena Stijena (Srejović 1974: 5). Later, some minor differences between assemblages were observed, but both assemblages were connected to the Paracastelnovian (Kozłowski *et al*. 1994; Kozłowski 2009: 262-304) or local Castelnovian (Mihailović 2007; 2009: 102-110; 2017). According to S. K. Kozłowski, the term Paracastelnovian emphasizes the local particularities of the Southeast European blade-and-trapeze industries, which developed on the Epigravettian traditions. As such, they differ from the typical Castelnovian industries of northern Italy and southern France, which build upon the Sauveterrian traditions. According to D. Mihailović (2007: 23-24; 2009: 103), the presence of typical Castelnovian elements at Montenegrin sites closer to the coast, such as Crvena Stijena and Vruća Pećina, and their decreasing prominence further inland, as at Odmut, or complete absence at sites like Medena Stijena, suggest that the Castelnovian spread from the coast toward the hinterland.

The combined typo-technological approach also suggests that the Late Mesolithic industries from Crvena Stijena and Odmut are very similar pointing to the same traditions in blade making and therefore possibly to the same origins (Kačar 2019: 366-368; 2020). However, to determine whether these traditions are more related to a Mediterranean or continental influence, it is necessary to compare the lithic data from Montenegro with other published typo-technological studies of blade-and-trapeze industries within a broader European context. It must nevertheless be acknowledged that this is not an easy task primarily due to the unevenness of primary data. For example, in regions like southwestern Europe, we have a considerable amount of systematically published data, while in other cases, such as the area around the Black Sea, the data is either fragmented or non-existent. Moreover, in southeastern and eastern Europe, typological approaches traditionally dominated lithic studies until recently, with a notable absence of research incorporating the technological aspects.

Recent excavations at Žukovica Cave on the island of Korčula, which was likely already insular by *c.* 8000 cal. BCE (Dean *et al.* 2020), have revealed the earliest Castelnovian occupation in Dalmatia (Forenbaher *et al.* 2020). The radiocarbon dates are still not published but fall into the Late Mesolithic (S. Forenbaher & N. Vukosavljević, pers comm.). A small (n=173) yet intriguing lithic assemblage was studied using combined petroarchaeological and typo-technological approaches (Vukosavljević & Perhoč 2020). According to the authors, local and non-local (almost two thirds of all raw materials probably originate from Gargano) cherts were used for bladelet-oriented production. The small number of bladelets (n=19; 11%) makes technology identification difficult, nevertheless, the regularity of the blades suggests the use of pressure flaking or indirect percussion. I had the chance to briefly examine this assemblage. Since it had already been published, I focused solely on blade elements, which aligns with the primary focus of this article. However, due to the limited time available for examination, my count differs slightly from N. Vukosavljević's: he identified 19 blades, I identified 18. Additionally, in my opinion, one of the 18 blades undoubtedly represents a Neolithic intrusion, as it is made of Gargano cherts identical to those found in later layers associated with the Neolithic. Consequently, this blade was excluded from consideration, and I have attributed 17 blades to the Mesolithic. Out of 17 bladelets, only 3 are complete (the longest is 36. 2 mm and the average would be 26.5 mm) (Figure 9: 1). The average width of a bladelet would be 9.8 mm, with a thickness of 2.5 mm, making Dalmatian specimens similar in size to Montenegro bladelets (average 10 mm; average thickness 2.8 mm). Blade butts when identified (n= 8) display greater variability including both facetted and plain specimens, and overhangs are present in both cases. While it is not easy to determine whether pressure flaking or indirect percussion was used in blade making, one specimen (the longest blade) has a concave butt which is a feature of indirect percussion (Figure 9: 1). Again, it is possible that both techniques were used concomitantly. Regarding the tool categories, the most common tools are truncations (n=3). One symmetric trapeze is also present (Figure 9: 5). The main difference with Montenegro tool types is the absence of notched blades. While there are no notched bladelets *sensu stricto*, the 36.2 mm long complete bladelet, which is also truncated at its distal part, displays continuous semi-abrupt retouch, forming shallow notches, on its left edge.

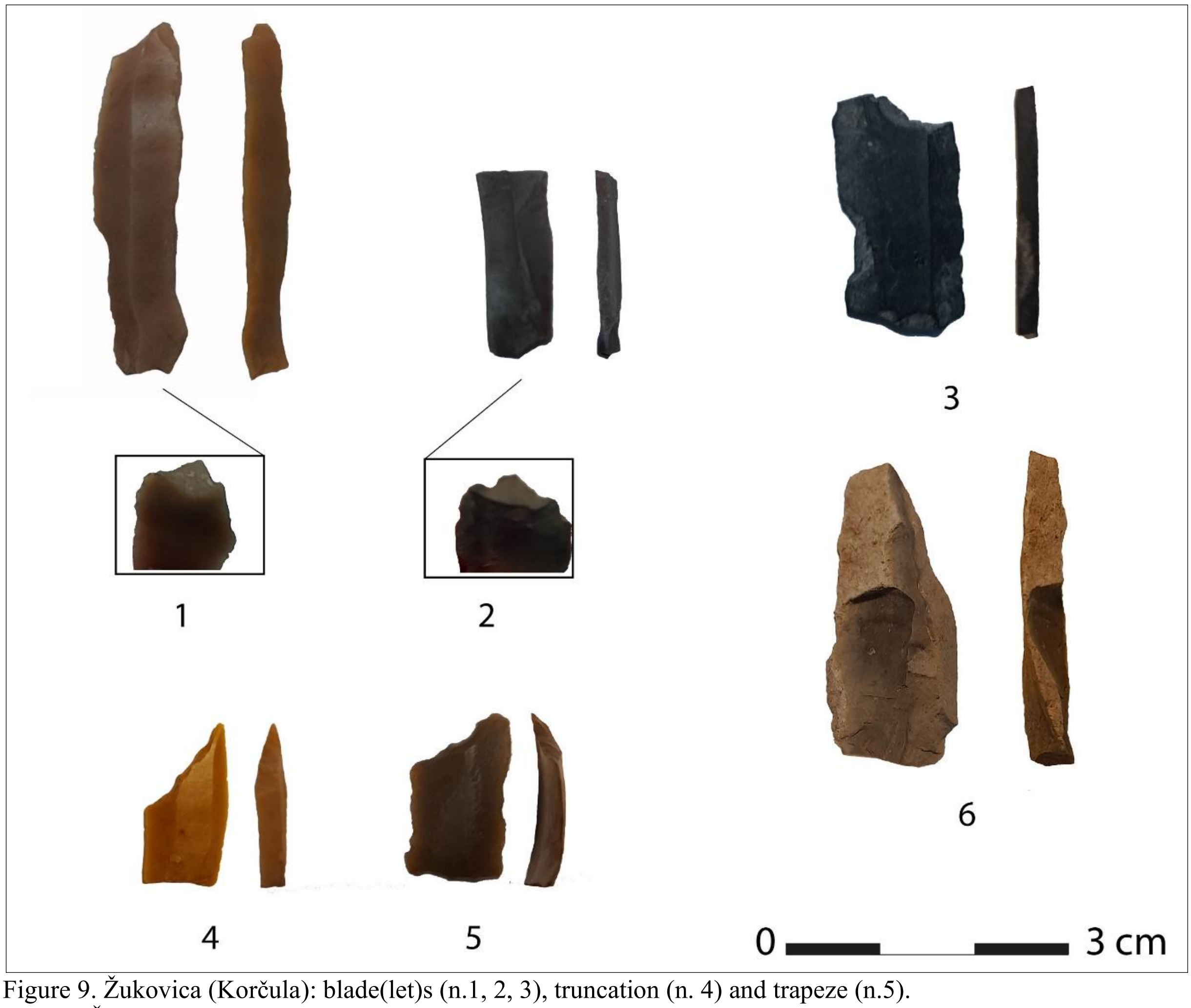

Figure 9. Žukovica (Korčula): blade(let)s (n.1, 2, 3), truncation (n. 4) and trapeze (n.5).
Slika 9. Žukovica (Korčula): sječiva (br. 1, 2, 3), zarubak (br. 4) i trapez (br. 5).

In the context of the Central Mediterranean Late Mesolithic, Montenegrin assemblages exhibit even more significant similarities with the southern Italian Castelnovian industries, particularly those from Grotta dell'Uzzo (Sicily) and Latronico 3 (Basilicata) (Collina 2009; Collina *et al*. 2019; Kačar 2020). Both Italian sites yielded the earliest radiocarbon dates for the entire Mediterranean placing the emergence of the Blade-and-Trapeze Technocomplex or Castelnovian around 6700-6600 cal. BCE (Collina 2009; Dini *et al*. 2008; Marchand & Perrin 2017; Perrin *et al.* 2020).

Compared to Montenegrin specimens, bladelets from Southern Italy are smaller, with the average bladelet width being around 8 mm (Collina 2009: 211; Collina *et al*. 2019: 5). In terms of length, the average blade from Grotta dell'Uzzo measures 23.3 mm long; however, metric data are not provided for the Latronico assemblage (Collina *et al*. 2019: 211; Dini et *al*. 2008). Despite their smaller dimensions, which may simply reflect differences in the size of the pebbles used, and their greater regularity, which suggests the use of the pressure technique (although the authors also acknowledge the possible concomitant use of indirect percussion), the technological procedures are remarkably similar. The preparation of the core is minimal and unidirectional flaking occurred preferentially on one side of the core, either large or narrow. The striking platform is prepared, either by continuous or discontinuous removals, but the overhangs are not systematically abraded (combination of facetted butts and remaining presence of proximal overhangs (Collina 2009: 227-233; Kačar 2019: 366-368). Bigger diversity can be seen in the typology: Uzzo assemblage contain important number of bladelets with abrupt retouch, some of which form smaller notches, however, notches in Montenegro assemblages seems to be more pronounced. Greater diversity can be seen in trapeze manufacturing: while symmetrical trapezes are the most common, asymmetrical specimens are also present. J. Kozłowski (1994) suggests that the lack of asymmetric trapezes serves as a distinguishing feature between the Castelnovian industry in Northern Italy and Southern France and the Montenegrin industries. However, this likely stems from local preferences, reflecting mere stylistic variations that may signify the expression of group identity rather than indicating distinct technological traditions. Or, as C. Collina and collaborators point out, the variations between symmetric and asymmetric trapezes within the Italian assemblages indicate functional and chronological variability (Collina *et al*. 2019). Interestingly, unlike in Southern Italy, the Montenegro trapezes are made on blades rather than bladelets, indicating that the largest supports were selected for their manufacture.

The possibility of the Mediterranean origin for the Crvena Stijena (and Vruća Pećina; Đuričić 1997) industries is supported by the fact that, despite their relative distance from the Adriatic Sea, these sites exhibit tangible Mediterranean influences, both climatically and culturally (*i.e.,* as part of the Impressed Ware culture during the Early Neolithic), owing to their inherent natural connection.

However, Odmut cave is located deep in the hinterland, surrounded by high mountains, and lacks any direct natural connection to the Adriatic Sea. Additionally, despite Crvena Stijena and Odmut being approximately 70 km apart in a straight line, they are separated by challenging mountainous terrain, including the Somina, Golijat, and Ledenice mountains. In contrast, Odmut is situated at the confluence of the Vrbica and Piva rivers, and the Piva River is connected to the Danube through the Drina and Sava rivers, or alternatively via the Ibar and Morava rivers. This connection with the Danube provides a pathway to the Black Sea, thereby rendering the question of a possible origin in the Crimean blade-and-trapeze industry plausible. The radiocarbon dates from Ukraine and Crimea show that blade-and-trapeze industries were present in southeastern and eastern Europe by 7750-7300 cal. BCE (Biagi & Kiosak 2010), *i.e.*, about 700-1000 years before their emergence in the central-western Mediterranean. On the one hand, we can bridge this nearly 1000-year 'gap' by considering some of the rejected dates from Odmut and Vruća Pećina as reliable. Local prehistorians conventionally mark the beginning of the Late Mesolithic around *c.* 6500 cal. BCE, corresponding to the onset of the Castelnovian period in southern Italy, with older dates typically dismissed as unreliable. In this regard mention should be made of recently obtained radiocarbon dates on bone harpoons from Vrućа and Odmut which suggest that these caves had been occupied since *c.* 7350-7000 cal. BCE (Borić *et al*. 2019). Although these dates were obtained on harpoons which, in the wider central-western Mediterranean context, appear in the Sauveterrian, neither Odmut nor Vrućа have recorded a lithic industry distinct from the Castelnovian. On the other hand, the similarity with the Black Sea blade-and-trapeze industries is currently limited to the presence of symmetrical trapezes (Hrebenyky and Murzak Koba cultures) and the use of the pressure technique (in Hrebenyky, Murzak Koba and Kukrek) (Biagi & Kiosak 2010; Kiosak *et al*. 2022; Telegin *et al*. 2020). Interestingly, a high number of notched bladelets has been recorded at the multilayered site of Laspi 7 on the southern coast of Crimea, most likely dated to *c.* 7750-7600 cal. BCE, while earlier and later dates, extending into the first half of the 6th millennium BCE, are likely to be dismissed (Telegin *et al.* 2020).

Unfortunately, due to insufficient or fragmented data, characterizing these industries beyond typological aspects, as well as establishing their relationships through reliable radiocarbon dating, poses a challenge.

If there were interactions between the Montenegrin hinterland and the Black Sea during the Late Mesolithic, one would expect to find archaeological evidence along the Danube, particularly at the Lepenski Vir site. Personal ornaments suggest connections between the Danube and the coast (Cristiani & Borić 2012), yet current data do not permit their correlation with the diffusion of blade-and-trapeze industries. In the Iron Gates region, 11 pieces of *Columbella rustica* beads found in grave no. 49 at the Vlasac site and associated with an individual of non-local origin, attest to connections with the littoral during the Late Mesolithic (*c.* 7350-6850 cal. BCE) (Borić & Price 2013: 3301; Cristiani & Borić 2012). A bead made from a Danube carp-type fish (*Rutilus* sp.) was discovered in Vrbička Cave in Montenegro, suggesting connections between the Danube and inland Montenegro (Borić *et al*. 2019). However, based on the published material, even though the Vrbička site was occupied during the Atlantic climatic phase, it did not exhibit any elements related to blade-and-trapeze industries.

Despite Iron Gates sites being well known and extensive studies having been conducted on diverse archaeological materials, a comprehensive synthesis on lithic technology remains notably absent. According to published material, blade elements and trapezes are found in the lithic assemblages of some sites such as Lepenski Vir and Vlasac alongside flake-based production (Borić *et al*. 2014; Mihailović 2004; 2007; Mitrović 2018). According to M. Mitrović some narrow bladelets from Vlasac and Lepenski Vir were obtained by pressure flaking and can be dated to the Late or Final Mesolithic (Mitrović 2018: 60, 95, 186-187). Unfortunately, the publication suffers from a notable absence of visual aids, such as pictures and drawings, making it challenging to substantiate these claims with clarity. Another concern is that certain assemblages may be compromised due to intrusions from the later contexts associated with the so-called Transformative phase. While the author associates the introduction of the pressure technique in Iron Gates with the onset of the Late Mesolithic in the broader Mediterranean, the connection between the Iron Gates region and the Blade-and-Trapeze technocomplex remains underexplored. To address this gap and understand the connection with other Late Mesolithic industries, I have briefly re-examined the Lepenski Vir assemblage.

According to general but still preliminary observations the material associated with trapezoidal houses is very heterogeneous in terms of both typo-technology and raw materials. At least four main *chaînes opératories* could be identified, two of which recall Late Mesolithic traditions akin to those attributed to the Blade-and-Trapeze technocomplex. In both cases the production is oriented towards the production of bladelets, but one utilises greyish opaque chert of presumably local origin (Figure 10: 1-2) and the other employs brownish-yellowish cherts that strongly recall the famous “Balkan flint” (Figure 10: 3-5). The bladelets made of greyish cherts are more irregular in morphology and it is difficult to ascertain the technique used in their production. A bladelet (Figure 10: 2) with a regular, but slightly S-shaped profile and a large, rounded, partially facetted butt suggests the use of indirect percussion, but other knapping techniques, such as direct percussion could not be ruled out. Although, due to the limited time, I did not come across a single trapeze in the Lepenski Vir assemblage, according to M. Mitrović, several pieces made of Balkan flint are found in the Late Mesolithic context (Mitrović 2018: 88-89). Notched blades are present with at least one specimen of a plunging blade made from grey chert (Figure 10: 1).

Figure 10. Lepenski Vir: blades on grey cherts (n.1, 2) and blades on presumably "Balkan flint" (n. 3, 4, 5).
Slika 10. Lepenski Vir: sječiva od sivih rožnjaka (br. 1, 2) i sječiva od pretpostavljenog „balkanskog kremen(a)” (br. 3, 4, 5).

Bladelets of presumably Balkan flints are more numerous, and their production differs slightly from bladelets made of grey cherts. They are also often short (up to 35 mm long) with a similar width range (*c.* 10.5-13.5 mm), but their proximal parts differ. Probably indirect percussion was employed. Butts are mostly faceted and overhangs are often non-abraded (Figure 10: 5), which is very interesting because such technological procedures are evidenced in the Late Mesolithic context of Southern Italy (Collina 2009), and in continental and littoral Montenegro. It is tempting to consider whether this specific configuration of technological practices associated with one community (Castelnovian hunter-gatherers) and raw-material choices linked to another (Balkan flint, conventionally associated with the first farming communities and also used for a typically Neolithic blade production attested at the site) was deliberately brought together in the production of stone tools. Such a combination may have served to express a shared, newly emerging identity shaped through processes of cultural syncretism arising from the co-existence of hunter-gatherer and farming communities at Lepenski Vir. Yet advancing such an interpretation requires not only detailed raw-material and technological analyses - capable of confirming the Bulgarian provenance of the flint - but also a critical engagement with the assumption that the circulation of Balkan chert begins only with the arrival of farming communities, an assumption that may itself represent an oversimplification.

Another possible explanation for the origin of the Montenegrin blade-and-trapeze industries is that local hunter-gatherer groups imitated the production practices of newly arrived farmers, particularly blade technologies rooted in Anatolian traditions and associated with the "Neolithic package". In this scenario, local hunter-gatherers would have attempted, using their own *savoir-faire*, raw materials and techniques, to reproduce the elongated blanks seen among their farming neighbours. Although there is no evidence for the spatial coexistence of the two groups, either in Montenegro or in southern Italy, this hypothesis could be supported by the fact that the first farming communities appeared around 6700-6500 cal. BCE in present-day Greece. Nevertheless, such a somewhat tenuous interpretation would require rejecting radiocarbon dates earlier than the mid-7th millennium cal. BCE, and also the mastery of indirect percussion (and pressure?) techniques.

4. Conclusions

The scarcity of sites and detailed technological studies poses a challenge in characterizing the lithic traditions of the Late Mesolithic in southeastern Europe and, consequently, in drawing conclusions about their possible phylogenetic links. Another unresolved issue pertains to the timing of the emergence of blade-and-trapeze industries, specifically whether they precede 6700-6500 cal. B.C.E.

While positioned in distinct ecological niches, the Crvena Stijena and Odmut assemblages exhibit remarkable homogeneity, suggesting shared cultural traditions. Notably, they demonstrate surprising parallels with South Italian assemblages, particularly those from Grotta dell'Uzzo and Latronico 3. Typologically, with notched blades and symmetric trapezes, the Montenegro assemblages are comparable to industries found in Northern Africa and Southern France. This similarity extends to technological aspects, especially when we consider that some Montenegro bladelets might have been made using pressure flaking.

However, the resemblances are not confined to the Mediterranean. Montenegro assemblages also share common traits with potentially earlier industries, particularly from the Iron Gates, but also typologically with the industries around the Black Sea. Furthermore, in addition to the presence of notched blades and trapezes, the probable use of indirect percussion in blade making links Montenegro industries with those of central-western Europe and the Alps (*e.g.*, Romagnano Loc III, Pradestel).

Furthermore, based on the currently available data, it seems that in certain sites, such as Vrbička Cave (Montenegro), this phenomenon has not been observed. Instead, simpler flake-oriented industries characterize the lithic assemblages in this area.

This typo-technological diversity, along with genetic diversity (Borić & Price 2013; Hofmanová *et al.* 2016; Yu *et al.* 2022), suggests that southeastern Europe during the 8th and 7th millennia was a vibrant region hosting diverse groups with different origins, traditions, and subsistence strategies. Despite this diversity and the changes through time, such as the arrival of farmers from c. 6700 cal. BCE and the probable disappearance of some groups, the communities inhabiting these areas remained interconnected, maintaining long-distance networks that extended across both the Mediterranean and the Black Sea. Naturally, the degree of inclusion likely varied among these groups, with some being more prominently integrated into these networks than others, while the networks themselves developed and disintegrated over time.

Given that the spread of innovations associated with the blade-and-trapeze technocomplex took place over a long time span and across a vast territory, it cannot be understood other than through a *longue durée* approach, which allows us to consider the myriad of ways through which they could have emerged and spread: people moved, exchanged objects and ideas, and novelties were not only received but also adapted, imitated and further transmitted. Rather than attributing the formation of the Blade-and-Trapeze technocomplex to a single centre of origin or a single event, it is more plausible to envision a complex interplay of multiple factors contributing to its development.

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Data accessibility statement

The author confirms that the data supporting the findings of this study are available within the article, or were compiled from the author's unpublished doctoral thesis (available here: https://theses.hal.science/tel-04580608), as well as from other published and unpublished sources, all of which are appropriately cited.

List of supplementary files

Supplementary file 1
"Kačar_2025_Supplementary File 1_Plate 1" (Lithic drawings)

Supplementary file 2
"Kačar_2025_Supplementary File 2_Plate 2" (Lithic drawings)

Supplementary file 3
"Kačar_2025_Supplementary File 3_Plate 3" (Lithic drawings)

Supplementary file 4
"Kačar_2025_Supplementary File 4_Plate 4" (Lithic drawings)

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Kasnomezolitičke industrije sječiva i trapeza između kopna i mora: primjer Crne Gore

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Sažetak:

Između 8. i 6. tisućljeća kal. pr. Kr., europski lovci-sakupljači prošli su kroz značajne društveno-tehnološke promjene, koje su posebno vidljive u litičkim skupovima nalaza, a karakterizira ih pojava pravilnih i standardiziranih sječiva dobivenih novim tehnikama cijepanja, poput tehnike pritiskom ili tehnike neizravnim odbijanjem (Clark 1958; Biagi & Kiosak 2010; Binder et al. 2012; Gronenborn 2017; Marchand & Perrin 2017). Te promjene označavaju prijelaz iz ranog u kasni mezolitik. Ovaj fenomen, opažen je u cijeloj zapadnoj Euroaziji te je poznat kao tehnokompleks sječiva i trapeza, dok se na Sredozemlju naziva Kastelnovijen te se smatra njegovom regionalnom inačicom. Osim novih tehnika, pojavljuju se i novi tipovi alatki, poput trapezoidnih mikrolita, i, više lokalno, udupci na sječivu.

Ovaj se članak fokusira na kasnomezolitičke industrije sječiva i trapeza jugoistočne Europe, s posebnim naglaskom na lokalitete Crvena Stijena i Odmut koji se nalaze u današnjoj Crnoj Gori i datiraju u sredinu 7. tisućljeća. Ova dva lokaliteta nalaze se u različitim ekološkim nišama; Crvena Stijena nalazi se u mediteranskom klimatskom pojasu, dok se Odmut nalazi u planinskom području centralnog Balkana. Tipološko-tehnološka usporedba ovih dvaju litičkih skupova nalaza provodi se kako bi se utvrdilo pokazuju li te industrije zajedničke karakteristike u izradi sječiva, što bi moglo ukazati na zajedničke kulturne tradicije, ili se značajno razlikuju. Nadalje, litički skupovi nalaza se uspoređuju s drugim poznatim industrijama sječiva i trapeza iz jugoistočne Europe (Žukovica na otoku Korčula i Lepenski Vir na Đerdapu) kako bi se utvrdila homogenost kasnog mezolitika u regiji. Naposljetku, njihov položaj u širem europskom kontekstu razmatra se kroz pitanje njihovog mogućeg podrijetla (iz Sredozemlja ili Crnog mora). Rezultati upućuju na mnoge sličnosti u proizvodnji sječiva, sugerirajući da litički skupovi Crvene Stijene i Odmuta dijele iste tradicije. Osim toga, uočavaju se iznenađujuće sličnosti s južnotalijanskim skupovima (Grotta dell'Uzzo, Latronico 3: Collina 2009; Collina et al. 2019): oslanjanje na lokalne rožnjake (evenutalno regionalne, ali za koje je izvjesnija direktna nabava) i zastupljenost potpunog lanca operacija (proizvodnja *in situ*), metodama pripremanja jezgre (pripreme udarne plohe facetiranjem, prevjesi (*in English, overhangs*) nisu sustavno odstranjivani) dok su željeni proizvodi sječiva manjih dimenzija (tj. „pločice“ najčešće uže od 12mm). Tehnike proizvodnje nije lako identificirati pogotovo s obzirom na asocijaciju facetirani plohak i neodstranjeni prevjes, te se čini da u Kastelnovijenu Crne Gore obje tehnike koegzistiraju.

Nadalje, tipološki (udupci na sječivu, simetrični trapezi) i tehnološki (moguća upotreba tehnike pritiska), skupovi iz Crne Gore usporedivi su s industrijama sjeverne Afrike i južne Francuske. Međutim, sličnosti nisu ograničene samo na Mediteran. Litički skupovi nalaza Crne Gore također dijele zajedničke osobine s potencijalno ranijim industrijama, poput onih zabilježenih na lokalitetima na Dunavu (Lepenski Vir) i oko Crnog mora. Osim toga, neke značajke (udupci na sječivu, trapezi, vjerojatna upotreba neizravnog odbijanja) povezuju crnogorske industrije s industrijama srednje i zapadne Europe i Alpa. Nažalost, nedostatak nalazišta i detaljnih tehnoloških studija, kao i neujednačenost primarnih podataka, predstavlja izazov u karakterizaciji litičkih tradicija kasnog mezolitika u jugoistočnoj Europi i, posljedično, u donošenju zaključaka o njihovim mogućim filogenetskim vezama. Još jedno neriješeno pitanje odnosi se na vrijeme pojave industrije sječiva i trapeza, posebno prethode li one razdoblju prije 6700-6500 pr.n.e. Također, na temelju trenutno dostupnih podataka, čini se da na određenim lokacijama,

poput Vrbičke pećine (Crna Gora) i regijama poput Grčke, ovaj fenomen nije uočen. Umjesto toga, jednostavnije industrije orijentirane na proizvodnju odbojaka karakteriziraju litičke skupove u ovim područjima.

Ovakva tipo-tehnološka raznolikost, zajedno s genetskom raznolikošću (Borić & Price 2013; Hofmanová et al. 2016; Yu et al. 2022) sugerira da je jugoistočna Europa tijekom 8. i 7. tisućljeća bila dinamična regija koju su obitavale različite zajednice različitih porijekla, tradicija i strategija preživljavanja (uz razlike između ribarskih i lovnih gospodarstava, prisutnost prvih zemljoradnika evidentna je u najjužnijim regijama od c. 6700-6500 cal pr. Kr.).Unatoč toj raznolikosti, ove su različite zajednice - u različitim omjerima i na različite načine - međusobno povezane, odrzavajući mreže razmjene na velikim udaljenostima koje se rasprostiru od Sredozemnog do Crnog mora. Promatrano iz perspektive dugog trajanja (*longue durée*), ovakav širi okvir omogućuje oprezno razmatranje načina na koje su inovacije nastajale i širile se: ljudi se kreću, razmjenjuju stvari i ideje, a noviteti se ne samo primaju, već se i prilagođavaju, oponašaju i potom ponovno šire. Umjesto da se razvoj tehnokompleksa sječiva i trapeza pripisuje jednom ishodištu, vjerojatnije je zamisliti složeno međudjelovanje brojnih čimbenika koji su pridonjeli njegovom razvoju.

Ključne riječi: Kasni mezolitik; industrije sječiva i trapeza; Kastelnovijen; jugoistočna Europa; Balkan; Jadran; tehnika pritiska; tehnika neizravnog odbijanja