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CHAPTER 1

Introduction

1.1. GOALS AND SCOPE

The Eurasian Middle Paleolithic is by and large variable and diverse in its technological and, to a lesser extent, typological traits, with a rather similar character over a large geographic area and for a long period of time. Regardless of the repetitive nature and with only a few advancements and accumulations of technological traits, it evidently represented a successful adaptation. Many decades of intensive research into Middle Paleolithic assemblage variability, including diverse approaches, has been directed towards an understanding of which scales and under the influence of which factors the technological behavior of Neandertals fluctuated. Some of the major factors recognized as driving variability include distinctive techno-typological signatures recognized as culture-historical units, a multitude of local and paleoenvironmental factors affecting the techno-economical decisions, and demography as a factor that allowed or prevented changes and innovation in the material culture domain. Each of these has varying relative importance in explaining Middle Paleolithic variability and each acts at different scales. Lithic researchers have struggled to select appropriate approaches relevant for the particular questions asked, to decide how to measure variability, and ultimately how to interpret it. After a significant departure from the typological method, other approaches have contributed significantly to a better understanding of the overall technological behavior of Neandertals, within and particularly beyond tool types. Regardless of these advances, Mousterian facies, whether they are constructed on typological or technological grounds, still dominate Middle Paleolithic discourse, which is potentially a major drawback in current studies of Neandertal technological adaptations.

Even more challenging is to understand how Middle Paleolithic technological
behavior is organized and how it varies in time and space in regions where the record is quite meager, either for the scarcity of Paleolithic locations and assemblages or due to the shortage of studies addressing technological variability. One such region, almost regularly omitted from the heated debates about Middle Paleolithic variability, is the Balkan peninsula. Understanding the larger scale regional patterning and chronological changes of the European Middle Paleolithic would benefit from a better record from regions where such variation is unknown. Datasets from the southeastern areas of Europe can provide a necessary link for a wider context of the variation to be exposed. Do the Balkan industries contain some variability that is not expressed elsewhere? Is there variability known in other regions that is absent in the Balkans? Do the data from the Balkans provide a necessary link to relate techno-typological phenomena from other regions of Europe?

The barrier to a clearer picture of the Middle Paleolithic of the Balkans is to a certain extent tied to the fact that the majority of what is currently known about the Middle Paleolithic comes from a few regions in Europe, particularly southwestern France or Italy, for the obvious historical reasons, and may not be entirely applicable to other areas. An illustration of this problem is the application of Mousterian facies to assemblages in the Balkans that now feature, to name a few, Charentian (or southeastern Charentian), Typical Mousterian, Denticulate Mousterian, Pontinian, and Micromousterian. The correspondences of these groups to their analogues else in Europe are not always made explicit; moreover, it has often been acknowledged that they are not fully consistent with how they have been defined elsewhere. A particular case is the Micromousterian, a group where many stratified sites in the Mediterranean region are merged together based on the small artifact size. Its name refers to technological behavior adapted to small raw material on the one side and intentional small flake production on the other, and it apparently contains the additional internal variability revealed by the facies in this group (e.g., Denticulate, Pontinian). This case exemplifies the confusion about the defining criteria for the facies distinction and the inherent question about recognizing the intentionality in technological process upon which separate groups are defined. This said, in the current context of the “crisis” in Middle Paleolithic studies where the core issue still remains the recognition of
intentionality in technological behavior and the reality of the Mousterian groupings, a fresh appraisal of industrial variability, with new analyses and with renewed consideration of the available record, is needed for regions where the understanding of the Middle Paleolithic is affected by long-established and potentially outdated classifications.

This thesis is primarily motivated by several objectives intended to advance our understanding of the drivers of technological variability in the Middle Paleolithic and a better understanding of the variability of the Middle Paleolithic industries of the Balkan Peninsula. The first goal is driven by the incentive to evaluate our methods in assessing variability, improve measures we use in analysis to better grasp past technological decisions and to eventually get a better look at the variability. As a great deal of variability concerns the morphology of the blank, an attempt was made to evaluate better ways to examine how we assess and measure that variability, namely blank size and overall morphology, and how we approach knapping practices related to platform management that impact that variability, in order to elucidate the past technological strategies. The techno-economic framework followed in this work with its focus on economic properties of the blanks will constitute the background for exploring the past technological decisions and questions of how hominins used raw materials.

The second objective is to investigate the technological and typological variability expressed the Middle Paleolithic assemblages from the Mediterranean zone of the Balkan peninsula where previous assemblage examinations established that the industries belong to the Micromousterian and some were additionally classified into several Mousterian groups (Pontinian, Denticulate Mousterian, Late Mousterian). Within the major goal that seeks to investigate the variability by overcoming firm associations to the facies, the two interrelated goals are stipulated: first, to evaluate the variability by an examination of the flaking methods, toolkit structure, the ways these two aspects are interrelated along with the accompanying reduction intensities in these assemblages; and second, to use this variability to better understand the reasons behind the relatively small size of artifacts in this region. If the raw material factor posed certain limitations, as is often the case with “micro-industries”, by restricting technological
options, how did the knappers of the past navigate the technological process in this region? If they only represent “diminutive Mousterian” are there still trends here comparable to other regions?

Third, an objective of this thesis is to provide a wider chronological and geographic perspective and assess patterns of technological behavior in the Middle Paleolithic of the Balkans or a lack thereof. The current knowledge about the Middle Paleolithic in the Balkans suffers from the confusion coming from facies defined 40 years ago by mirroring Mousterian variants from western Europe, and particularly from the somewhat confusing terminology used to describe these assemblages. Only a critical consideration of the technological methods and typological features at spatial and temporal scales and the correlation of these two aspects of technological behavior - as much as the data already published can allow for - might alleviate the current confusion about the Middle Paleolithic of the Balkans. Given the unexpectedly sparse record in a region that is generally considered to be a sheltered glacial refugium, it is an additional aim here to evaluate the occupational history of Neandertals in the peninsula.

The introduction of this thesis will first provide a background on previous research into Middle Paleolithic variability, with an overview of the different approaches to understanding the topic. It will proceed with the earlier descriptions and interpretations of the Balkan Middle Paleolithic with a special concern for the Micromousterian issue, followed by the description of the sites and the samples studied in this dissertation.

This chapter will end with an outline of the thesis chapters that will cover the particular goals, methods, and summaries of each separate project.

1.2 ORGANIZATION OF MIDDLE PALEOLITHIC INDUSTRIAL VARIABILITY

The stagnant, monotonous, and conservative behavior of Neandertals across their vast territories and over the long duration of their existence has often been contrasted with the technological record of modern humans, who, having a similar brain volume, exhibited technological behavior represented by higher variation across time and space, standardization and specialization, marking their greater capacity for
innovation, and potentially cognitive differences compared to Neandertals (Klein, 1995, 2000; Mellars, 1989, 2005).

One aspect of the long-going discussions about cognitive differences has been the notion of intentionality in pre-modern hominins. Initially, the discussion was expressed in disagreements over the imposition of artifact forms (Chase, 1991; Gowlett, 1984; Mellars, 1989; Noble and Davidson, 1991; Wynn, 1981). It later extended to questions over the ability to recognize intentions in the production process (Bar-Yosef and Van Peer, 2009; Boëda, 1994; Dibble, 1995). The idea of an intentional product or process underlies the cultural-normative concept of the Middle Paleolithic. Ultimately, interpretations of Middle Paleolithic variability, as will be described in the following section, swung between notions of cultural traditions where techno-typological association is regarded as a cultural entity, confined in time and space in a similar manner to the Upper Paleolithic era, to ideas of technological variation as a response to varied climatic, environmental conditions to which hunter-gather groups adapted their subsistence activities, residential mobility levels, and consequently technology.

1.2.1. INTERPRETING TECHNO-TYPOLOGICAL VARIABILITY IN MIDDLE PALEOLITHIC INDUSTRIES

One of the initial tools for classifying Middle Paleolithic assemblages was Bordes’ typology (Bordes, 1961b; Bordes and Bourgon, 1951), an elaborated version of D. Peyrony’s (1930) system that helped identify distinct prehistoric group identities based on variation in tool frequencies. This pioneering work in lithic artifact classification considered toolkits as stylistic markers of populations that had a cultural cohesion similar to ethnic communities (Bordes, 1951, 1953, 1961a, 1961b, 1981; Bordes and Bourgon, 1951; Peyrony, 1920, 1930). This approach took a paleontological perception of a stone tool that considered the final finished product as equivalent to a fossil. Initially aimed at helping culture-historical research, soon its main advantages, the fact that it includes both technology and typology with a combination of qualitative with quantitative attributes, to name only a few, became the core of its main critiques (Bisson, 2000). Without departing from this acceptance of the discreet nature of the tool types defined by Bordes, various other interpretations of variation of Neandertal
industries have been proposed, one of the most influential being Binford’s view on functional properties as a driving factor of the variation between the facies (Binford and Binford, 1966, 1968). Without making an exclusive preference for one explanation over another in the formation of these industries, Mellars (Mellars, 1965, 1986, 1996) proposed a chronological sequence for the different variants. This idea of imposed forms was challenged by the notion of the “finished artifact fallacy” (or the Frison effect) (Davidson and Noble, 1993; Frison, 1968; Jelinek, 1976). In this formulation, final forms or artifact types reflect not imposed forms but rather the intensity of lithic reduction that “converted” one type to another, under the influence of factors such as the intensity of occupation or distance to raw materials (Dibble, 1987; Frison, 1968; Holdaway et al., 1996; McPherron, 1995; Rolland, 1981; Rolland and Dibble, 1990). As much as it disputed the strict distinction of types, the reduction hypothesis still maintained that the scraper typology built by Bordes is useful, because it reflected these reduction patterns, therefore the distribution of tool types in an assemblage can be envisioned as a proxy for reduction intensity (Dibble, 1987).

This recognition that typological variation reflects not the style but different points in use-life continuum has led to a denial of any stylistic input in tool forms in the Middle Paleolithic. The reduction hypothesis, which has been shown elsewhere (Blades, 2003; Hiscock et al., 2003; Hiscock and Clarkson, 2007; Shott and Sillitoe, 2005; Shott and Weedman, 2007) or among other Paleolithic tool types (Hiscock and Clarkson, 2007; Holdaway et al., 1996; McPherron, 1995, 2003), is usually taken as a null hypothesis from which research into typological variation in assemblages needs to begin (Brumm and McLaren, 2010). The reduction trajectory hypothesis, nevertheless, should not be taken as a simple explanation of the overall variability that may exist among already simple tool sets of Neandertals, and the goal should rather be directed towards consideration of several trajectories taking into account the initial morphology of the blank (Dibble, 1987; Hiscock and Clarkson, 2008; Kuhn, 1992). The latter idea was initially proposed by F. Bordes, who noted that the actual difference between Ferrassie and Quina assemblages in southwest France lies in the blank form used for scraper production (Bordes, 1961a).

Lithic researchers in both the Old and New Worlds understood early on that tool
variability is only the tip of the iceberg, and to fully understand the variability of an assemblage or industry better insights into the underlying process of lithic production are needed (Boëda et al., 1990; Dibble and Bar-Yosef, 1995; Pelegrin, 1990; Sellet, 1993; Shott, 2003; Tixier et al., 1980). As a reaction to the insufficient explanatory power of tool types, the so-called *châine opératoire* school, that became prominent in France during the 1980s, turned to studies of technological process that precedes the tool use and almost obliterated typological variation in assemblages in their assessment of industries (Boëda et al., 1990; Delpech et al., 1995; Karlin and Julien, 1994; Lemonnier, 1986; Pelegrin, 1990; Pigeot, 1991; Schlanger, 1991, 1996; Soressi and Geneste, 2011; Tixier et al., 1980). Their focus shifted towards traditions defined by techniques and methods of stone tool production, as reconstructed by archaeologists. In this approach, sets of technological actions involved in producing and using stones tools are constituent parts of the body of knowledge shared by a prehistoric group. This shared knowledge is the root of cultural variation in lithic industries and can be traced in space and time. Tool variability was, on the other hand, a neglected aspect of technological behavior since it was affected by functional aspects, i.e., activities performed at the site, and immediate economic goals. This said, the culture history perspective still prevailed in these studies of Paleolithic stone tools, with the only difference being the part of the technological process where informative power lies. The new perspective made a methodological shift and placed production process at the core of the analysis. Within this framework, the interpretation of Middle Paleolithic industrial variability hardly departed from Bordes’ distinction of Mousterian groups (Monnier and Missal, 2014). In the case of southwest France, the technologically based regrouping of Mousterian assemblages is quite similar to Bordes’ Mousterian facies; this time, distinct cultural groups are recognized by the shared technological knowledge of different blank production methods and techniques with the toolkit they produced being merely adjusted to immediate functional needs (Delagnes et al., 2007; Jaubert, 2010; Thiébaut et al., 2014).

One branch of the French *châine opératoire* school, the techno-economic approach, had a focus on adaptive aspects of lithic reduction sequences (Geneste, 1985; Perlès, 1991). Likewise, processualist and quantitative tendencies in lithic studies in the United States under the reduction sequence approach (Andrefsky Jr., 2001; Nelson, 1991;
Shott, 2003) emphasized, in a similar manner as the *châine opératoire* approach, the overall technological production, but concentrated on the economical side of technological behavior. The entire process of stone tool production was accommodated to the subsistence pattern which was in turn primarily responding to environmental factors, raw material availability, and mobility (Andrefsky Jr., 2001; Bamforth, 1991; Dibble, 1987; Kuhn, 1995; Nelson, 1991).

Within this framework, one can argue that, in a way similar to how the Frison effect challenged the static nature of toolkits, what appear as distinct core forms reflecting separate reduction trajectories actually represent cores at different stages of reduction (Baumler, 1987; Lenoir and Turq, 1995; Volkman, 1983). Along the same lines, recognition of a technology used to produce a particular blank suffers from the issue of equifinality, since a blank of a certain morphology could have been produced by various reduction strategies (Bar-Yosef and Van Peer, 2009; Boëda, 1995; Dibble and Bar-Yosef, 1995; Sellet, 1995; Shott, 2003). Furthermore, a significant methodological weakness in lithic studies is that different approaches lead to different conclusions about the reduction strategies; a representative example is the assemblage of Biache Saint-Vaast IIA, where a diacritic reading revealed two different reduction sequences, uni- and bi-directional modes performed on separate cores (Boëda, 1995), and a quantitative attribute analysis demonstrated a correlation of size with scar patterns indicating changing strategy during the core reduction (Dibble, 1995). Another example come from the Taramsa 1 assemblage where an additional reduction sequence was reconstructed when refitting was applied whereas the Levallois method had been detected with diacritic reading (Bar-Yosef and Van Peer, 2009). These examples brought into question our ability to unambiguously infer specific reduction strategies based on technological readings, the major methodological tool in *châine opératoire* approach (Baumler, 1988; Dibble, 1995; Lenoir and Turq, 1995). This problem of disentangling the reduction sequences is especially manifested in assemblages that primarily consist of methods that employ centripetal flaking, the most commonly employed flaking methods in the Middle Paleolithic, because of the similarities in the morphology of their cores and blanks. For instance, separating the discoidal and centripetal recurrent Levallois methods is often subjective (Lenoir and Turq, 1995) and determining whether reduction
sequences consist of several independent or one continuous reduction often rests on an individual researcher’s criteria, particularly because the definitions of flaking methods are at times broad and at times very strict (papers in Peresani, 2003).

The confrontation between different analytical approaches and methods has intensified in the last decade. The chaine opératoire approach has been criticized as being governed by subjective and intuitive principles for analyzing and interpreting lithic assemblage variability (Bar-Yosef and Van Peer, 2009; Monnier and Missal, 2014; Shea, 2014; Tostevin, 2011). Attempts to merge quantitative methods, such as multivariate statistics, with technological analysis of the chaine opératoire approach claim to corroborate the initial findings that essentially substantiate the technological groups originally identified (Faivre et al., 2016; Scerri et al., 2015; Thiébaut et al., 2014).

The current state of Middle Paleolithic lithic studies reveals that we are still far from finding a common ground not only in appropriate approach and analytical units for analyzing and comparing assemblages but also in agreeing on what the observed patterns mean for understanding variation of technological behavior. On one side, there is an increasing tendency to (re)create numerous lithic techno-complexes as cultural entities constructed from technological and to a certain extent typological signatures that supposedly convey cultural normative information (Delagnes et al., 2007; Jaubert, 2010, 2012; Ruebens, 2013). These techno-complexes can be, to various levels, traced geographically and are thought to exhibit chronological patterning (Conard and Fischer, 2000; Discamps et al., 2011; Faivre et al., 2016; Meignen et al., 2009; Ruebens, 2013; Thiébaut et al., 2014). Some maintain that the spatio-temporal distinctiveness and change through time in these Middle Paleolithic techno-complexes are comparable to what is seen in the Upper Paleolithic (Jaubert, 2012; Morin et al., 2014). Interpretations that favor the establishment of various techno-complexes have received a lot of criticisms, regardless of whether they are regarded as independent culturally meaningful units (e.g., Delagnes et al., 2007; Thiébaut et al., 2014) or real and well defined groups whose meaning and patterning can only be understood if their association with environment and subsistence is accounted for (Conard and Fischer, 2000; Faivre et al., 2016). These criticisms focused on the problems of intentionality and our abilities to recognize desired endproducts (Bar-Yosef and Van Peer, 2009; Dibble et
al., 2016; Holdaway and Douglass, 2012; Tostevin, 2011). According to these criticisms, hunter-gatherer mobility dynamics structure the lithic assemblage to a significant level which eventually may distort the “fossilized examples of former intentionality” (Turq et al., 2013: 642) and call into question the reality and integrity of techno-complexes.

Despite the apparent gap between approaches that accentuate typology versus technology, researchers have emphasized that the two are sides of the same coin, primary and interrelated lines of evidence on past technological behavior (e.g. Kuhn, 1995). Recent extensive work on variation in Middle Paleolithic industries in southwest France based on châine opératoire analyses considers that blank properties are anticipated during the core reduction process (Delagnes et al., 2007; Delagnes and Meignen, 2006; Meignen et al., 2009). According to these views, sought-after blank properties are driving the variation in flaking systems; different flaking methods produce blanks of different properties that fit a particular demand (i.e., to be transported, used immediately). The association of a particular techno-typological model, coupled with the faunal data on hunting practices and subsistence patterns, can explain a large portion of spatial and temporal variability of Mousterian industries in the region (Delagnes and Rendu, 2011; Discamps et al., 2011). While this indicates a clear economic background for the variation, the interpretation offered is that distinct time and space occurrences of specific flaking systems equates to different cultural groups (Delagnes et al., 2007; Jaubert, 2010; Jaubert et al., 2011; Thiébaut et al., 2014). In any case, such a position implies an inextricable link between tools and blank manufacture processes. Within a different, more quantification-oriented analytical framework, other research avenues also emphasized the importance of certain attributes that would enhance blank utility, either defined as the amount of cutting edge relative to volume or the potential for edge rejuvenation (Bamforth, 1986; Braun, 2005; Braun and Harris, 2003; Kuhn, 1994; Leroi-Gourhan, 1964; Lin et al., 2013; Shott, 1996; Shott and Sillitoe, 2005). A special place is given to the design properties of tools since the degree of investment in tools, their production, maintenance, immediate or future use, are seen as a technological response to changes in mobility and managing risk in resource acquisition activities (Bamforth, 1986; Shott, 1986, 1996; Torrence, 1983). This is where the two seemingly different approaches converge, notwithstanding the fact that their
analytical tools – attribute analysis and quantitative methods vs. technological reading - significantly differ (Richter, 2011; Shott, 2003; Tostevin, 2011).

Instead of focusing on the identification of techno-complexes, the approach to understanding lithic variability followed in this dissertation is primarily driven by the question of what kinds of variability are pre-defined techno-complexes trying to capture. This work commences with the idea that different flaking methods produce blanks of distinct properties and that the reduction intensities of cores and tools to a large extent structure lithic assemblages. Tendencies in changes in technological methods and tool use and discard are addressed with the use of attribute analysis and quantitative methods.

1.3. THE MIDDLE PALEOLITHIC IN THE BALKANS

The research history of the Paleolithic in the Balkans started as early as the late 19th century (e.g., excavations at Krapina, Gorjanović-Kramberger, 1899, 1906) and continued, though irregularly, in the 20th century depending often on the social and political circumstances in each country that would affect the level of support dedicated to research. Investigations continued with surveys and systematic excavations at many important sites (e.g. Crvena stijena, Asprochaliko, Bacho Kiro (Basler, 1975a; Brodar, 1962; Garrod, 1939; Higgs, 1965; Higgs and Vita-Finzi, 1966)) and later in the 1980s, especially in Bulgaria (Kozłowski et al., 1992; Sirakov, 1983). Recently, new surveys and excavation projects are directed towards investigating numerous Middle Paleolithic sites (Karavanić et al., 2016; Kuhn et al., 2014; Mihailović, 2008; Tourloukis et al., 2016).

Despite the long history of Paleolithic research, little is known about the Middle Paleolithic industries of the Balkans and their variation. It is indicative that the mentions of the Balkans during the Late Pleistocene is usually confined to a few noteworthy sites; for instance, often cited is Krapina with its rich paleoanthropological collection and a couple of sites (Vindija, Bacho Kiro) for their significant role in the Middle-Upper Paleolithic transition debates.
Fig. 1. Map of the Balkan region with the location of Crvena stijena, Bioče, and the following Middle Paleolithic sites: 1 – Krapina, 2 – Vindija, 3 – Zobiše, 4 – Londa, 5 – Mujina cave, 6 – Petrovaradin, 7 – Mališina sijena, 8 – Velika Balanica, 9 – Pešturina, 10 – Kozarnika, 11 – Temnata Dupka, 12 – Bacho Kiro, 13 – Theopetra, 14 – Asprochaliko, 15 – Klissoura, 16 – Lakonis, 17 – Kalamakia.

It is a paradox that the Balkans, regarded as one of Europe’s southern refugia with certain areas of the peninsula more permanently inhabited throughout the glacial-interglacial cycle, hosts a comparatively meager Pleistocene record. Such a pattern might normally be explained as reflecting low population densities during the Paleolithic. In the Balkans, however, one first needs to take into account both research and geological gaps. The sparse record is to some degree responsible for the lack of knowledge about the Middle Paleolithic of the Balkans. The region has lagged behind other areas of Europe in Paleolithic research and many sites need new and updated analyses and descriptions for data to be integrated into the known European record.

The majority of Paleolithic projects were carried out at a time when the dominate approach in lithic analysis was Bordian typology, a trend that swept over other parts of
Europe as well (e.g., Gabori, 1976; Ivanova, 1979). In the Balkans, these trends resulted in the identification of several Mousterian variants that have their counterparts in Europe, though sometimes these differ enough that they require a regional or other label to best describe their particularity. Balkan Pleistocene sites, however, most often feature low densities of lithic material, hampering analysis and characterization of the techno-typological character of assemblages. Often, when no prominent or specific features have been observed in an assemblage, Typical Mousterian, Late Mousterian (Basler, 1975b; Gabori, 1976) or another general designation is most often adopted.

The Charentian of southeastern Europe (or Southeastern Charentian) has been defined based on the Pontinian-like flaking method of cobbles and the frequent use of often cortical scrapers with demi-Quina and Quina retouch (Krapina, Vindija, Veternica) (Gabori, 1976; Ivanova, 1979; Kozłowski, 1975). Two different variants of the Typical Mousterian, Levallois-Mousterian and Moustero-Levallois are known across the peninsula (Bacho Kiro, Crvena stijena, etc.), with varying Levallois indices and low scraper counts (Ivanova, 1979; Kozlowski, 1975). Another variant is differentiated on the basis of the high presence of bifacially worked elements - the Eastern Balkan Mousterian with leafpoints (Sirakova, 1990, 2009); however, some of these assemblages have a technological component that is comparable to other Mousterian industries (prominent Levallois technology).

Kozłowski further delineated the Balkan Mousterian, a group that became an exemplar of the Middle Paleolithic of the Balkans, with prominent typological traits such as elaborate scrapers, including ventrally thinned examples, and recurrent Levallois flaking methods (Crvena stijena, Asprochaliko, Londza, Bacho Kiro, etc.) (Kozłowski, 1975). Later, these industries were depicted as having a Charentian character (Kozłowski, 1992; Kozłowski, 2002). The temporal correspondence, i.e., the last interglacial age, of this group with industries further east (Karain, Turkey) that also had Charentian features, justified a cultural link between these regions and further generated ideas about Neandertal movements (Kozłowski, 2002) and the Balkan origin of similar industries in eastern Europe (e.g., Cohen and Stepanchuk, 1999). However, this Charentian assignment refers to the predominantly Levallois based assemblages
rich in scrapers that, at least technologically, do not seem to be related to Southeastern Charentian (at Krapina, Vindija, Veternica). This confusion illustrates well the misuse of the taxonomic classification and the misunderstanding arising from the partial disregard of technological aspects. New research, however, accentuated the presence of Charentian elements in some industries in the Balkans (Velika Balanica, Serbia) that refer to non-Levallois industries with a closer resemblance to the Quina technoeconomic system (Mihailović, 2009a; Mihailović and Bogićević, 2016).

Independent of techno-typological parameters, the definition of the Micromousterian as a group that encompasses several industries in the Adriatic coast was established based on the small artifact size these assemblages shared. As evidenced by the examples at Crvena stijena, for instance, where various Mousterian groups were defined, it likely involves a certain level of techno-typological variation. For instance, this site contains Mousterian with points, Pontinian that bears similarities to the previously defined Southeastern Charentian, and a Denticulate Mousterian noted also at a few sites along the Adriatic coast (Basler, 1983). Micromousterian as a group remained in use despite the vague criteria used for its attribution, sometimes owing to the lack of any other particular element that would classify or describe an assemblage. This variable group included assemblages that contain evidence of purposeful production of small flakes and assemblages with the characteristic use of small raw materials.

A number of studies of the Balkan assemblages departed from the normative view of industries and contributed to better understanding technological behavior beyond the facies. For instance, more detailed studies of reduction sequences of the Typical Mousterian (or Balkan Mousterian according to some) at Zobište elucidated the technological process and the associated core and blank forms, blank selection and tool production (Baumler, 1987). Variability within the Micromousterian is better understood from studies of the reduction sequences within the seemingly homogeneous Klissoura sequence and of the differences between the Levallois based Interglacial Mousterian and late Micromousterian at Asprochaliko (Papaconstantinou, 1989; Sitlivy et al., 2008). More recently, attempts were made to deliver a chronological patterning
of the industries in the Mediterranean zone and resulted in a two-part scheme with Levallois industries prevailing in the Last Interglacial followed by the subsequent abandonment of Levallois flaking in the late phases (Papagianni, 2009).

The chronological aspect of variation in the taxonomic categories remained unclear for a long time. Except for a relative placement of Denticulate Mousterian in the late phases and the Last Interglacial age of the Balkan Charentian-like industries, most sites lacked chronological information.

The Balkan industries inherited the western European nomenclature and the normative view of industries that regard techno-typological associations as cultural entities; however, the contribution of new research and the adoption of different perspectives may promote fresh views and hypotheses about the industrial variability in the Balkans and its place in the European Middle Paleolithic. New appraisals should address the question of the distinctiveness of techno-typological occurrences and whether they actually form discrete lithic techno-complexes. Many questions remain to be tackled: how do these technological and typological occurrences vary in space and time? Does the chronological emergence and reappearance of certain technological behaviors coincide with developments in the Middle Paleolithic elsewhere? Can we observe an association of these traits with factors that may affect variability (raw material, transport, reduction, mobility, etc.) and at which scales do they operate? Does the geographical diversity of the Balkans impact technological behavior or should a uniform trajectory be expected across the entire peninsula? Can we assume that demography influenced technological variability?

1.4 Variability within the Micromousterian in the Southern Balkans

Unlike other Mousterian facies in the Balkans recognized according to Bordes’ method or by a predominant technological or typological element, the Micromousterian stands out as a group defined in a completely different way – on artifact size – thus obscuring the variability that likely exists in assemblages from numerous sites assigned to this group.
Extensive investigations of Paleolithic sites in Greece and former Yugoslavia during the 1950s and 60s revealed what seemed to be comparable industries along the eastern coast of the Adriatic Sea and the Epirus (Crvena stijena, Asprochaliko) (Basler, 1983; Brodar, 1962; Higgs, 1965). Subsequent investigations yielded more Paleolithic sites in the region whose industries apparently resembled the industries from former sites at least in their distinctive small artifact size (Karavanić et al., 2008; Koumouzelis et al., 2001; Đurđić, 1997). Raw material was forwarded early on as a driving factor influencing their appearance, and comparisons were sought especially in Italy (San Bernandino, Pontian) (Brodar, 1962).

Asprochaliko, a rock shelter excavated during the 1960s, is still one of the most influential Middle Paleolithic sites in Greece and the Balkans. Since its initial excavation and studies of the lithic material, two main industries have been described at this site: 1) basal Mousterian and 2) Micromousterian (Higgs, 1965, 1966). The former dates to early last glacial (Bailey et al., 1983; Huxtable et al., 1992), and it represents a Levallois-Mousterian industry with elongated blanks. Alongside the basal Mousterian there is evidence for the production of small flakes from small discoidal cores (Gowlett and Carter, 1997). However, the distinction between the two types of production in these assemblages is not demonstrated as evidence against the hypothesis that these two core types represent different stages in a single reduction sequence is lacking (Papagianni, 2000). The upper Mousterian, named Micromousterian, is characterized by the smaller size of implements and the production of pseudo-Levallois points, a non-Levallois industry, with rare blades, small Mousterian-type points and small scrapers with steep retouch (Bailey et al., 1983; Higgs, 1965, 1966; Higgs and Vita-Finzi, 1966).

After initial classification of the two main types of industries at Asprochaliko, a site further used as the reference sequence for the Paleolithic record of Greece, more detailed analyses of the lithic materials were done (Bailey et al., 1983; Gowlett and Carter, 1997; Papaconstantinou, 1989; Papaconstantinou and Vassilopoulou, 1997). Without an intention to make a definite interpretation of the small artifacts in the Micromousterian level, some authors noted a more intensive use of raw materials in this level, evidenced by a somewhat counterintuitive idea that fewer flakes and waste pieces, many rejuvenation flakes, and higher proportions of retouched flakes all indicate more
reduction (Bailey et al., 1983). This interpretation was, nevertheless, questioned (Papagianni, 2000). Subsequent studies brought more insight into the character of the Asprochaliko collections. The uniformity between two levels is expressed in the use of the same raw material from the Lourous valley. The quality and the size of the raw material were constant and thus differences in the industries could not be attributed to this constraint (Gowlett and Carter, 1997). This may be confirmed by the fact that the average size of debitage in both assemblages is not significantly different (ranging from 30 to 35 mm) (Papaconstantinou and Vassilopoulou, 1997).

The change between the two rather lies in the technology of blank production; the basal Mousterian contains up to 20% narrow blade-like blanks. These were also selected for retouch, which inevitably increased the overall tool length range for the basal Mousterian when compared with the upper Micromousterian. This feature is in accordance with a technological shift observed between these industries. A unipolar reduction sequence that produces elongated blanks, that can be considered Levallois, characterizes the Basal Mousterian. This technological aspect is absent in the Micromousterian where the aim is the production of small, pointed, pseudo-Levallois points from flakes coming from Kombewa or truncated-facetted methods (Papaconstantinou, 1989; Papaconstantinou and Vassilopoulou, 1997). Similarities with some radial methods and particularly with core-on-flake methods are obvious (Boëda, 1993); however, no exact analogies in any other known assemblage were observed and thus the method was named the “Asprochaliko method” (Papaconstantinou, 1989). The blanks produced this way are further retouched into scrapers, most commonly dejété scrapers. This specific and dominant flaking method for small blank production provides support for the idea that the Micromousterian indeed reflected the knapper’s intention to produce artifacts of smaller sizes. This said, technological choices in the two Asprochaliko assemblages, with the same raw material used, were oriented towards the production of two different blanks, and thus represent a matter of choice (Papaconstantinou, 1989; Papaconstantinou and Vassilopoulou, 1997). Moreover, if raw material availability and characteristics were constant, they cannot be taken as the crucial factor in determining the size of the implements (Papagianni, 2009).

The sequence of the rock shelter Crvena stijena in Montenegro yielded 9
Mousterian complexes in 19 layers, containing industries of Pre-Mousterian, Proto-Mousterian, Denticulate Mousterian, Pontinian, Mousterian with triangular points, and Late Mousterian (Basler, 1975b). These assemblages date from MIS 6 to MIS 3. More precise chronological information for each level is currently lacking (Brunnacker, 1975; Morley, 2007) (see Chapter 3). Early researchers noted that the most conspicuous feature in the entire sequence of Crvena stijena is the small dimensions of artifacts which seems to be constant, although more pronounced in the upper levels (Basler, 1975b). This prompted analogies to the then available Italian Middle Paleolithic record and in particular to the site of San Bernardino (Brodar, 1962) and Pontinian industries (Basler, 1975b). The increased use of river pebbles is some levels at Crvena stijena and the high numbers of scrapers, many of them on cortical blanks, gave rise to naming these industries as Pontinian. Yet, their “microlithism” was recognized as a continuous phenomenon at this site, indicating that the availability of local raw material could most likely be the primary driving factor in the overall small dimensions of the Crvena stijena assemblages, similarly to the Pontinian (Basler, 1983; Bordes, 1981). One of the possibilities brought up is that during colder climates the river bed might have been frozen, thus limiting access to raw materials (Basler, 1983). Variation within the rich sequence of Crvena stijena, however, was certainly more significant than the issue of the Micromousterian given that the observed variation provided a basis for describing and delimiting Mousterian facies in the Balkans (Ivanova, 1979; Kozlowski, 1992; Kozłowski, 1975).

Industries from sites more recently investigated along the Mediterranean coast of the Balkans have been given the Micromousterian attribution as well, usually based on comparisons to Asprochaliko, though interpretations of this phenomenon diverged. Mujina cave (Croatia) assemblages contain small sized artifacts, which still fall into the normal range of the variation of any Mousterian industry. They contain technological elements of Mousterian, though none of them (Levallois, radial) are exclusive; this has been interpreted as a consequence of this site having a workshop character (Karavanić et al., 2008; Rink et al., 2002). The low quality of the local raw material poses the main limitation to technological processes making it difficult to remove regular-sized flakes even from larger blocks (Karavanić et al., 2008).
At Klissoura, another site with an impressively long Middle Paleolithic sequence, the small raw material is considered responsible for the overall small artifact size. The entire sequence consists of industries of a rather homogeneous character with similar technological solutions that only vary in frequency between levels. Some of these also include the production of small blanks, particularly bladelets (Koumouzelis et al., 2001; Sitlivy et al., 2007, 2008).

The rich assemblages of Bioče rockshelter (Montenegro) are attributed to Micromousterian with various Levallois and radial methods of flaking and a rich repertoire of scrapers and other retouched implements (Đuričić, 2006; Ђуричић, 1997). The cause of the “microlithism” is found in the knapper’s selection of smaller nodules from the near-by river bed that nevertheless contained significantly larger pebbles as well, as indicated by today’s pebble size distribution (Đuričić, 2006).

Regardless of the cause of “microlithism”, be it in the raw material constraints, raw material selection, or a purposeful production of small blanks, all these assemblages are clustered together and considered to be a regional phenomenon. Using the size factor as a crucial feature, the authors made the “ping-pong effect” (Papaconstantinou, 1989) in mutual citation and analogies, yet what is lacking is evidence for the technological and typological similarities between them. To overcome this problem, several other questions need to be investigated in these assemblages. If the small artifact size results from raw material constraints, as suggested in most cases, how did the knappers organize the technological process (e.g., transport, flaking methods) to accommodate these constraints, and do these solutions vary between sites? What are the characteristic blank production methods and tool use strategies? Can we see more examples of purposeful small blank production, nowadays a widely recognized phenomenon in the Middle Paleolithic? Given the regional context and environmental comparability of the Mediterranean belt of the Balkan peninsula, do we see a regionally continuous development and chronologically consistent trends in the Middle Paleolithic (Papagianni, 2009)? Do these trends compare to the Middle Paleolithic of the adjacent regions (the rest of the Balkans, Italy)?
1.4.1 The Micromousterian Condundrum

Before undertaking the task of disentangling Micromousterian variation in the southern Balkans, it is useful to reflect upon Middle Paleolithic industries that share the question of small artifact size and provide guidance to understanding them better. Some Middle Paleolithic industries are characterized by the small dimension of either all artifacts or some classes of artifacts within the assemblage (e.g. cores or tools). Industries and assemblages where small artifact size has been emphasized as their main feature are present in different regions and in different periods; to name the well known ones, Taubachien pebble industries from Kûlna, Předmosti, Tata (Borel et al., 2016; Moncel, 2003a, 2003b; Moncel and Neruda, 2000) and the similar assemblages with microlithic components in Germany (Richter, 2001; Weißmüller, 1995), Pontinian in Italy (Bietti, 1982; Kuhn, 1990, 1995; Lai Pannocchia, 1950; Taschini and Bietti, 1979), one of the levels of Yabrud I in Syria (Rust, 1950), Zagros Mousterian (Dibble, 1984), the so-called Asinipodian at Pech de l’Azé IV in southwest France (Bordes, 1975; Dibble and McPherron, 2006), the Micromousterian of the eastern Adriatic coast and Greece (Basler, 1983; Higgs, 1966; Rink et al., 2002), and the Micromousterian with bifacial tools in Crimea (Gladilin, 1966).

François Bordes, who coined the term Micromousterian, thought such a term should be applied to assemblages where the small size of artifacts is a culturally driven feature, such as in the case of the Asinipodian of Pech de l’Azé IV with small Levallois and Kombewa cores and products (Bordes, 1975; Dibble and McPherron, 2006) and the case of the Micromousterian at Yabrud I that features small cores and micro-tools (Bordes, 1955; Rust, 1950; Waechter, 1952). Assuming that raw material provisioning of these sites would have been the same during all occupational episodes and considering that neither of them were deprived of the large pieces of raw material, as indicated by their use in other levels, the production of small artifacts is thought to have been a deliberate choice in lithic production. If “small scale” industries are found in areas where raw material comes in small nodules or pebbles, they represent only diminutive forms of “regular” Mousterian. Nevertheless, once the name “Micromousterian” was created, it was subsequently applied for any industry having artifacts of small size, irrespective of the cause of its “microlithic” character (Bordes, 1981).
Yet, the explanations of this feature, in a similar manner as for the other facies of the Mousterian, were found either in the cultural domain, where their small size was an intended feature deliberately produced by the knappers, or in economic or circumstantial factors, as in this case the raw material constraints or heavier flaking reduction. The prevailing explanations, nevertheless, were the ones that found the cause of the “microlithization” in the constraints of raw material (unavailability of larger nodules), and thus their small size is a feature that has little impact on the overall characterization of the technological behavior.

Several hypotheses for the formation of these industries can be proposed:

**Intensity of utilization of the lithic resources.** In assemblages with higher intensity of utilization of lithic resources, cores and blanks will have smaller sizes, on average, as a consequence of the intensive use of lithic resources. The nature of the knapping process is such that it produces artifacts of small sizes. The continuing reduction process increases the amount of smaller material, the blanks get smaller, and the cores as well reduce in size (Bar-Yosef et al., 1992: 513; Baumler, 1988; Baumler and Speth, 1990; Volkman, 1983). Small cores in that case represent the end result of an extensive sequence of increased core reduction. The equivalent phenomenon can be observed in retouched elements, namely, as their edges get more resharpened, they reduce in size (Dibble, 1987). In these cases, according to the models proposed before (Rolland, 1981; Rolland and Dibble, 1990), assemblages show increased blank production and tool reduction, i.e. more emphasis on producing blanks and retouching them into tools.

A closer look at certain features of lithic assemblages can help in estimating the raw material size and management. Size ranges of the longest flakes are indicators of the initial raw material. If there are larger elements in the assemblages but larger cores are absent, one may assume that the exhaustion of the cores is responsible for the significant presence of small artifacts. This extensive intensity of utilization of lithic resources can be assessed with the ratios of flakes to cores and flakes to tools. Whether the production of smaller elements through the extensive use of cores is due to economic factors reflecting raw material shortages is a debated matter. For instance, at
Kebara, Levallois cores range from 3 to 4 cm, while Levallois blanks range from 5-7 cm, much larger than the last removals on cores (1 - 2.5 cm). This discrepancy was seen as reflecting the high reduction and exhaustion of cores supported by the presence of cores on flakes that reflect the same exhaustion phenomenon in the context of increase blank demands (Bar-Yosef et al., 1992; Meignen and Bar-Yosef, 1991). However, the nodule cores in Kebara show high percentages of cortex, speaking potentially against the reduction argument (Goren-Inbar, 1988).

**Limitations in the raw material properties.** The most parsimonious explanation and the most likely cause of small artifacts is the size of the available raw material. As many have emphasized, such assemblages have a regular set of artifact classed as any other Mousterian assemblages, do not have any particularity in technological or typological sense, and represent diminutive forms of Mousterian. In this case, a cultural factor is not playing a role in determining the character of such industries in that the tendency towards production of small artifacts is not a matter of choice but rather a response to environmental conditions. The raw material factor, however, may direct the flaking options. One of the notable examples is the Pontinian in Italy where the exploitation of pebbles, the only available raw material, resulted in a minuscule type of Mousterian industry (artifacts average ~3 cm) (Taschini and Bietti, 1979). Small pebbles did not allow for “typical” Levallois methods so the knappers adapted and modified the common flaking methods to the small raw material. Several methods were employed depending on the pebble shape, resulting in different cores morphologies: centripetal cores, cores with one or two platforms with parallel flaking, “pseudo-prismatic” cores, and bipolar cores (Kuhn, 1991, 1995; Kuhn and Bietti, 2000). This seemingly uniform facies includes a certain diversity reflected in changes in the frequency of different core-reduction sequences and in the intensity of tool blank reduction and resharpening (Kuhn, 1993, 1995, 1996; Kuhn and Bietti, 2000; Stiner and Kuhn, 1992).

Similarly, most of the eastern Adriatic Micromousterian industries most likely demonstrate the effects of small or low quality locally available raw materials that have an impact on the size and the flaking dynamics (Basler, 1975b; Karavanić et al., 2008; Rink et al., 2002). Also, in the Taubachian small raw material was considered as the determinant factor in the formation of the microlithic assemblages, according to some
authors (Vertes, 1964); though there are contrasting views (see below).

Reliance on local raw material procurement reflects a system that was not aimed at provisioning raw material of perhaps better quality from more distant locations. This emphasis on local procurement can inform us on mobility patterns and site function within a broader subsistence pattern. Such dependence on local provisioning and low mobility may be a context where some microlithization can happen.

**Selection of small raw materials.** For certain sites that have a microlithic industry it has been reported that larger raw material nodules were available in the vicinity of the site. This is usually evidenced by the presence of larger nodules in the assemblage, by a study of the raw material availability in the area, or simply by the presence of larger artifacts that must have been made from larger nodules/pebbles in other occupations at a given site. This is sometimes used as an indication of the selection of smaller raw materials among the differently sized nodules in certain assemblages. In the last two hypotheses, the main problem researchers encounter is a lack of means to assess the past raw material availability; presence and accessibility can vary to a large extent, but our ways to assess that variability are often inadequate.

In the Taubachian, pebbles in the lithic assemblage range from 15 – 50 mm, but ones of greater dimensions, up to 135 mm in maximum length, could also have been collected (Valoch; Karel et al., 1984). This testifies to a purposeful trend in the production of small artifacts organized at the level of raw material selection as has been recently emphasized (Moncel and Neruda, 2000; Valoch, 2003). A similar argument has been proposed for Bioče, a Micromousterian site on the Adriatic coast, where larger pebbles from the close-by riverbed could have been selected for flake production but were not, which resulted in small tool size (Đuričić, 2006). In the Asinipodian, an industry directed to the production of small blanks (Bordes, 1975; Dibble and McPherron, 2006), often small knobs of larger nodules were chosen for producing small Levallois cores (Dibble and McPherron, 2006).

**Divergence in blank production.** The production of small flakes, which could be used in an unretouched state, is a recognized component of Middle Paleolithic assemblages and is associated with several techniques, most often different variants of
core-on-flakes technology. This independent reduction sequence based on the use of blanks as cores most often exists in parallel to another one based on the exploitation of nodules (Bourguignon et al., 2004; Dibble and McPherron, 2006; Goren-Inbar, 1988; Hovers, 2007; Newcomer and Hivernel-Guerre, 1974; Papaconstantinou, 1989; Rios Garaizar et al., 2014; Tixier and Turq, 1999). The idea that small flakes were used without further edge modification was not easily accepted because: 1) they were too small to have an advantage over larger flakes and tools, and 2) the pieces from which they were detached were usually interpreted as tools with hafting elements (Dibble, 1984; Hovers, 2007; Nishiaki, 1985; Schroeder, 2007; Wojtczak, 2015). Notwithstanding the disagreements about the purpose of cores-on-flakes, the existence of such an independent system of production of small implements would be a solid candidate for a genuine microlithism in the Middle Paleolithic. Some notable examples of assemblages with a strong small flake component are Asprochaliko (Papaconstantinou, 1989) and the Asinipodian at Pech de l’Azé IV (Bordes, 1975; Dibble and McPherron, 2006, 2007).

The Asinipodian is rich in Levallois flakes of small sizes (on average 4 cm), especially unretouched ones, and very small Levallois cores. It contains a considerable amount of Kombewa flakes and cores (Bordes, 1975), and truncated-faceted pieces (Dibble and McPherron, 2006, 2007; Richter et al., 2013). These three techniques, small Levallois cores, Kombewa cores, and truncated-faceted pieces were all used to produce very small flakes, that are made to be utilized in an unretouched state. Support for this hypothesis is found by the comparable sizes of the last flake scar negatives on these core types and their higher relative frequencies compared to other levels (Dibble and McPherron, 2006). Assuming that raw material provisioning of the site would have been the same or similar during all occupations of Pech de l’Azé IV, Bordes concluded that the small sized flakes in the assemblage was a culturally driven feature, the intentional production of small artifacts. He initially intended to name it Micromousterian (Bordes, 1975: 298), finally naming it Asinipodian (Latin for Pech de l’Azé). Furthermore, there is no evidence to support the idea that raw material size or the overall intensity of utilization of lithic resources significantly contributed to the characterization of this assemblage (Dibble and McPherron, 2006).
Cores-on-flakes have been considered for a long time to be “too small” to serve as cores for blank production; however, despite disagreements over their role as tools, hafted elements, or tools with a particular type of edge, there has been a strong tendency towards seeing them as cores (Bourguignon et al., 2004; Dibble, 1984; Dibble and McPherron, 2006; Goren-Inbar, 1988; Hovers, 2007; Newcomer and Hivernel-Guerre, 1974; Nishiaki, 1985; Tixier and Turq, 1999). The problem of the recognition of tools as cores is a widely debated question in Middle and Upper Paleolithic studies (McPherron, 2007). For instance, technological studies dealing with the Upper Paleolithic and especially with the Aurignacian introduced the idea that what was once thought to be a tool, such as carinated end-scrapers or burins, are actually cores for bladelets (Almeida, 2007; Belfer-Cohen and Grosman, 2007; Le Brun-Ricalens, 2005).

Small sized cores, both made on blanks or nodules, were usually recognized as exhausted cores, because the assumption is that the last scars on cores are an indication of the acceptable size of the blanks. This does not contradict the idea that they are cores for the purposeful production of small flakes. This is particularly the case when evidence for raw material exhaustion is missing and if the cores have a high percentage of cortex though the sites are not deprived of the raw material. This is observed, for example, in Levallois cores in the Asinipodian and Aterian.

As much as it might be difficult to accept that some blanks are cores for producing even smaller blanks, it is equally problematic to recognize these blanks in among the flake debris of an assemblage. Microlithic blanks in the Upper Paleolithic are still easily recognizable end-products, either because of their morphological standardization or evidence of use shown by subsequent retouch or edge wear. In contrast, such direct evidence is far from being obvious and straightforward for many Mousterian assemblages (e.g., Faivre, 2012). Unless retouched, the final products from small cores or cores-on-flakes are difficult to identify, as most of their attributes may not differ from flakes produced by other actions, such as core preparation flakes. Moreover, one may wonder what would be the functional difference between large and small unretouched flakes. If the size of the unretouched blanks is continuous, any substantial, functional differentiation between them is difficult to show (Schurmans, 2008: 263). Nevertheless, we know that small flakes were produced in various contexts,
either as nearly predominant blank production or alongside flaking methods aimed at production of other size/form blanks (Bourguignon et al., 2004; Bourguignon and Turq, 2003; Dibble and McPherron, 2006; Mora et al., 2004; Rios-Garaizar et al., 2015; Tixier and Turq, 1999) and even transported (Turq et al., 2013). The use of unretouched elements is not uncommon, not only in the Middle Paleolithic (Dibble et al., 2016; Pargeter and Redondo, 2016) but also in earlier periods (Agam et al., 2014; Burdukiewicz and Ronen, 2003) and in various more recent contexts (Holdaway and Douglass, 2012; Shott and Sillitoe, 2005). Yet for which activities these small blanks were used for is not clear. Experimental studies show that it is possible to use them in butchering activities (Barkai et al., 2010), and according to some their production and use might be related to plant-related activities potentially performed by women and thus indicating a social aspect of tool production (Richter, 2001).

Small implements in Mousterian contexts at times take the form of somewhat elongated products (i.e., bladelets) manufactured through different core reduction processes (Faivre, 2012; Manuel et al., 2004; Slimak, 1999). For some, these products may suggest a cognitive step towards behavioral modernity (McBrearty and Brooks, 2000). If there is a trend in lithic technologies through time (though it should not be considered as teleological and unilinear cultural developments) then it is a trend of an increasing microlithization of stone tools, though not concomitantly and under different local conditions (Elston and Kuhn, 2002). If present, bladelet production in a Middle Paleolithic assemblage is usually a negligible component of the production system, and it remains anecdotal and not widely adopted (Faivre, 2012). Its occurrence in the later phases of the Middle Paleolithic, during or just before the widespread use of blade and bladelet technologies carried by the newcomers in Europe, brings another set of questions. What was the role of the Middle Paleolithic technologies in the microlithization? What is the relationship between the “microlithic” Middle Paleolithic with the “transitional” industries (Chatelperonian, Uluzzian)? Incidental bladelet production might have been grounded in the Middle Paleolithic set of flaking methods providing cultural links between the Middle and the Upper Paleolithic (Manuel et al., 2004). Alternatively their use emerges as an outcome of acculturation (d’Errico et al., 1998). The link between the “transitional” Uluzzian industry, for instance, and the
preceding Mousterian is strengthened by the presence of bladelet production in both (Moroni et al., 2012; Peresani, 2011; Peresani et al., 2016; Peresani and Centi Di Taranto, 2013).

The production of small elements if not ubiquitous is then rather common in the Middle Paleolithic, but the techno-economic background of its appearance is not entirely clear. Regardless of whether small flakes are being generated through a continuous core reduction until they are very exhausted or through a discontinuous process of blank production, where certain blanks are transformed into cores for the production of small blanks, these processes are seen as different ways of coping with difficulties in acquiring material for the production of fresh edges (e.g., Rios-Garaizar et al., 2015). With raw material shortages or other contexts that would necessitate an increased need for blank production, cores can be reduced until the smallest usable blank is made or blanks used as sources for more blanks (e.g., Munday, Frederick, 1976). However, in many cases cores on flakes do not reflect curational behavior; on the contrary, they appear as an expedient form of technology (Hovers, 2007). At Pech de l’Azé IV, there was no other evidence of the exhaustion of the assemblage due to raw material shortages which is expected to be seen in curated technologies (Dibble and McPherron, 2006). At Roca dels Bous, heavily reduced small Levallois cores and cores on flakes are not seen as a form of economizing behavior with optimization of resources, but as a reflection of technological knowledge and standards shared by the group, irrespective of the raw material constraints (Mora et al., 2004). In sum, small flake production appears as a part of the Middle Paleolithic package, as another facet to rather flexible attitudes that characterize the technological behavior of Neandertals (Turq et al., 2013).

1.5. THE STUDIED SITES

Here, the description of the sites along with additional stratigraphic and contextual information on the two main studied sites in this dissertation will be presented. Bioče and Crvena stijena are rock shelters located in Montenegro, on the eastern Adriatic coast. Their location, along with the location of notable Middle Paleolithic sites is shown on Figure 1. The Crvena stijena assemblages serve as a
reference for defining several Mousterian variants within the Micromousterian. The two sites stand out as some of the richest stratified Middle Paleolithic sites in the Balkans offering an invaluable opportunity to study variability within the so-called Micromousterian and assess previous appraisals of Mousterian variability in the region. This chapter covers a brief history of investigations, an overview of research performed until now and a summary of the lithic industries. The state of the collections, Crvena stijena in particular, is evaluated and the sampling strategy outlined.

1.5.1 Crvena stijena

Located in southwestern Montenegro, near the village Petrovići, close to Nikšić (42°46’44.7”N, 18°28’53.6”E), on the left bank of the Trebišnjica river, at an elevation of 700 m, the Crvena stijena rock shelter represents one of the most distinctive sites in southeastern Europe and one of the deepest shelters in Europe. With almost continuous human occupation since MIS 6 until the Bronze Age spread over 30 geological levels in nearly 20 m of deposits, it remains as one of the major sites to study the long-term processes of human habitation. The shelter is 26 m wide, 15 m deep, and 15 m high (Fig. 2). Bearing in mind the morphology of the shelter and the depth of the sediments, one can envision the shelter’s much greater size in terms of depth and height at its lower levels.

The site was discovered in 1954 and the excavations commenced the following year in Holocene deposits. Excavations conducted by M. Brodar from 1955-1959 focused on discovering pre-Holocene occupations and had a test character; several trenches were initially opened and later connected to form a wide systematic excavation area. They reached the depth of 11.7 m and revealed Middle Paleolithic deposits until Level XVIII (Benac and Brodar, 1958; Brodar, 1958, 1962) (Fig. 3). Middle Paleolithic deposits were excavated in the area against the back wall of the shelter and over a smaller surface area (6m², narrowing to 4m² and even less at the lower parts). These excavations offered the division of upper Middle Paleolithic deposits that remained in use in later investigations. An initial characterization of the lithic industries (based on nearly 3500 artifacts) showed its resemblance to other industries with artifacts of small size (San Bernardino, Italy), and it was recognized as a Micromousterian culture (Benac and
Brodar, 1958; Brodar, 1958, 1962). Some preliminary sedimentological and faunal work was done as a part of this project (Benac and Brodar, 1958; Rakovec, 1958). Excavations in 1960-1964 were directed by Đ. Basler who extended the area of investigations, removed the Upper Paleolithic deposits and excavated Middle Paleolithic levels reaching a depth of 20.3 m from the surface level, without arriving at the bedrock (Fig. 4). These last excavations were run in a multidisciplinary manner and resulted in a monograph, published in 1975, that included faunal analysis (Malez, 1975) (Table 1), raw material assessment (Памић, 1975), and sedimentological analysis (Basler, 1975a). A new research project was started at the site in 2004 with a goal of acquiring high resolution data on the Middle Paleolithic occupations (Bakovic et al., 2009).

Figure 2: Crvena stijena, a) view of the site (courtesy of D. Mihailović), b) site plan with areas excavated by Brodar (green) and Basler (gray) after (Basler, 1975a; Mihailović and Whallon, 2017).
Figure 3: Crvena stijena. Schematic plan of the location of Brodar’s excavations and western section of the excavation after (Brodar, 1958). Colored are the Middle Paleolithic levels.
Figure 4: Eastern profile of excavations conducted from 1960-1964 by Đ. Basler. Profile comprising levels XII – XXXI after (Basler et al., 1967) and the section with upper Pleistocene deposits (XII-IV) after (Brunnacker, 1975). Only Middle Paleolithic deposits are colored.

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<td>X</td>
<td><strong>Aurignacian</strong></td>
<td>Cervus sp., Rupicapra rupicapra, Capra ibex, Bison priscus, Bovinae, Marmota marmota, Perdix perdix, Columbia livia, Coloeis monedula, Cervus corax</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XI</td>
<td><strong>Late Mousterian</strong></td>
<td>Cervus sp., Rupicapra rupicapra, Capra ibex, Bison priscus, Bovinae, Marmota marmota, Perdix perdix, Columbia livia, Coloeis monedula, Cervus corax</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XII</td>
<td><strong>Denticulate Mousterian</strong></td>
<td>Cervus elaphus, Rupicapra rupicapra, Rupicapra sp., Capra ibex, Bison priscus, Bovinae, Ursus speleaus</td>
<td>C14: 44065-40953; &gt;45289; &gt;45535; OSL: 37.6±2.9; 43.2±3.4</td>
<td></td>
</tr>
<tr>
<td>XIII</td>
<td><strong>Denticulate Mousterian</strong></td>
<td>Cervus sp., Capra ibex, Alces alces, Bovinae, Marmota marmota, Sus sp., Canis lupus, Ursus arctos priscus, Falco tinnunculus, Coloeis monedula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XIV</td>
<td><strong>Mousterian</strong></td>
<td>Cervus elaphus, Sus sp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XV</td>
<td><strong>Mousterian</strong></td>
<td>Cervus elaphus, Cervus sp., Capra ibex, Marmota marmota</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XVI</td>
<td><strong>Mousterian</strong></td>
<td>Coelodonta antiquitatis</td>
<td></td>
<td></td>
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<tr>
<td>XVII</td>
<td><strong>Pontinian</strong></td>
<td>Rupicapra sp., Capra ibex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XVIII</td>
<td><strong>Pontinian</strong></td>
<td>Equus sp., Cervus elaphus, Cervus sp., Rupicapra sp., Capra ibex, Bovinae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XIX-XX</td>
<td><strong>Mousterian with triangular points</strong></td>
<td>Equus caballus germanicus, Equus sp., Cervus elaphus, Cervus sp., Capra ibex, Bos primigenius, Bovinae, Coelodonta antiquitatis, Megaceros giganteus, Sus sp.</td>
<td>ESR (XX): 48.3±2.4 (LU); TL: 65.5±14</td>
<td></td>
</tr>
<tr>
<td>XXI</td>
<td><strong>Pontinian</strong></td>
<td>Equus caballus germanicus, Cervus sp., Bos primigenius, Bovinae, Crocuta spelea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXII</td>
<td><strong>Pontinian</strong></td>
<td>Equus caballus germanicus, Equus mosbachensis-abeli, Cervus elaphus, Cervus sp., Rupicapra sp., Capra ibex, Bos primigenius, Bovinae, Leopardus pardus, Coelodonta antiquitatis, Marmota marmota, Ursus speleaus</td>
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<td></td>
</tr>
<tr>
<td>XXIII</td>
<td><strong>Mousterian with triangular points</strong></td>
<td>Equus caballus germanicus, Equus mosbachensis-abeli, Cervus elaphus, Cervus sp., Rupicapra sp., Capra ibex, Bos primigenius, Bovinae, Leopardus pardus, Coelodonta antiquitatis, Marmota marmota, Ursus speleaus</td>
<td></td>
<td></td>
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<tr>
<td>MIS 3</td>
<td></td>
<td>Y5 tephra</td>
<td></td>
<td></td>
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<tr>
<td>MIS 4</td>
<td></td>
<td>C14: 44065-40953; &gt;45289; &gt;45535; OSL: 37.6±2.9; 43.2±3.4</td>
<td></td>
<td></td>
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<tr>
<td>MIS 5a</td>
<td></td>
<td>Rupicapra sp., Capra ibex</td>
<td></td>
<td></td>
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<tr>
<td>MIS 5b</td>
<td></td>
<td>Equus sp., Cervus elaphus, Cervus sp., Rupicapra sp., Capra ibex, Bovinae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIS 5c</td>
<td></td>
<td>Equus caballus germanicus, Equus sp., Cervus elaphus, Cervus sp., Capra ibex, Bos primigenius, Bovinae, Coelodonta antiquitatis, Megaceros giganteus, Sus sp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIS 5d</td>
<td></td>
<td>ESR (XX): 48.3±2.4 (LU); TL: 65.5±14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1. Pleistocene strata at Crvena stijena with cultural horizons as defined by Basler (after Basler 1975), faunal species representation for the Pleistocene deposits (after Malez, 1975), geological and climatic contexts (MIS stage) based on sedimentological analyses (after Brunnacker, 1975; Morley, 2007), and absolute ages (Mercier et al., 2017). Radiocarbon ages indicated as calibrated and with 95.4% confidence interval.

Sedimentological analysis was undertaken in the 1970s by K. Brunnacker (Brunnacker, 1975) who correlated the deposits with an Alpine glaciation scheme and in 2007 by M. Morley (Morley, 2007). The geochronological attribution by both researchers is to a large extent in correspondence but in slight disagreement with the recent dating by optically stimulated luminescence (OSL), thermoluminescence (TL), and electron spin resonance (ESR) for the Levels XXIV-XII (Mercier et al., 2017). A correlation of the Middle Paleolithic layers at Crvena stijena with marine isotope stages, however, is not yet established, since different disciplines give different chronological
estimates (Fig. 5).

Fig. 5. Chronology of Middle Paleolithic deposits of Crvena stijena, according to radiometric ages (Mercier et al., 2017), geological models (Brunnacker, 1975, Morley, 2007), faunal composition (Morin and Soulier 2017), pollen representation (Shaw, 2017), with lithofacies (LF) (Morley et al., 2017) (redrawn after Whallon and Morin, 2017).

The geological data (Brunnacker 1975, Morley et al. 2017) and fauna (Morin and Soulier, 2017) are not in agreement with the chronology of the Crvena stijena levels. Brunnacker estimated the age of the Levels XXXI-XXV to MIS 6 according to geological characteristics, while faunal representation (tortoise in XXXI, XXIV-XXVII, roe deer in XXXI, XXIX, XXVIII, size of the horses in XXVIII, XXVII more comparable to Late Pleistocene forms) are more consistent with warmer climatic conditions, likely MIS 5 (unless they are related to warm phases within MIS 6). Similarly, the disagreement is present for layers XXVII-XXV where, according to the faunal analysis, the presence of
horses that prefer cooler environments suggests MIS 4 (Morley and Soulier 2017).

Morley’s analysis of Levels XXV-XI showed 3 lithofacies (LF): LF 3 consisting of the coarse gravel bed of Level XXV; LF 2 levels XIV – XXIV are more variable in grain size but finer grained than LF 1 and abound in anthropogenic material (ash, charcoal, bone fragments, some burnt flint), deposited during the MIS 5; and LF 1, comprises Levels XI, XII, and XIII, with homogeneous gravel bed in sandy matrix, with almost no charcoal and bone inclusions, deposited during the MIS 3.

Both sedimentological analyses place Level XXIV in MIS 5e, while resent dosimetric dating give a MIS 5a age (Mercier et al., 2017). This level is rather thick, over 1 m, and three sublayers were initially separated, though material was collected from the bulk of the layer without paying attention to dividing it by finer sedimentological units (Basler, 1975a). Of all LF 2 layers, this is the most distinctive one since it is composed of bedded sediments rich in ash and charcoal with frequent burnt bone and fired clay inclusions; these layers are almost black in color with sublayers of light gray ash and contain up to 50% of anthropogenic material which testifies to the repeated hominin use of the site and intensive use of fire during a warm and wet climate. A similar signature is noticed in XXII - XVII (Morley, 2007). In the faunal assemblage of level XXIV there is a high proportion of burnt bones and an absence of obligate carnivores (Morin and Soulier, 2017).

The low anthropogenic index (charcoal and bone abundance) of Level XII suggested for Morley an infrequent habitation of the site in MIS 3. Comparably, the faunal assemblage shows minor evidence of nonhuman predator activities in the upper levels (XIV-X)(Morin and Soulier 2017). The lithic material, however, is at its highest density in this level (Basler et al., 1967; Đorđević and Đuričić, 2017; Mihailović and Whallon, 2017); additionally, dark layers rich in charcoal and burnt bones were initially noted in this level (Benac and Brodar, 1958). These archeological observations suggest increased human activity during this time with potential spatial differences across the site responsible for the lack of charcoal and bone in the samples studied by Morley.

Several mammal species are represented throughout the sequence (Cervus elaphus, Capra ibex, Bos primigenius), but the notable change is the higher presence of
Equus sp. (*Equus caballus germanicus*, *Equus mosbachensis-abeli*) in levels attributed to MIS 6 – MIS 5, while cervids, caprids, and bovids with some suids continue to exists in the upper deposits too. Cold adapted species (*Coelodonta antiquitatis*, *Marmota marmota*) are encountered in levels attributed to MIS 5a-e (XIX-XX, XXII, XXIV) along with species indicating warmer conditions. Woolly rhino was found in XVI as well, which potentially correlates this level to MIS 4; on the other hand, elk (*Alces alces*) in level XIII, along with other indicators, inclined Morley to associate this level with MIS 4. Radiocarbon and OSL ages place Level XIII in MIS 3 (Mercier et al., 2017). Except this species, no other species typical of colder conditions have been found in the upper deposits. Level XII almost certainly represents the MIS 3 occupation at the site according to radiocarbon and OSL ages (Mercier et al., 2017). This is in line with the occurrence of an *in situ* Campanian Ignimbrite tephra in Level XI (Morley and Woodward, 2011), extending at least 30 m² with a thickness of 5-10 cm up to 20 cm in the rear areas of the shelter.

A new faunal analysis of the newly excavated material (Morin and Soulier, 2017) from levels X to XV and including XXIV, shows the three main taxa to be red deer, *Cervus sp.*, and fallow deer, suggesting rather stable ecological conditions during this time period; alternatively, these deposits could accumulated during a short period of time (Morin and Sourlier 2017). Likewise, the pollen composition is rather stable throughout the sequence (Shaw 2017).

The division of the Middle Paleolithic cultural horizons was established based on lithic material recovered in the 1960s; however, only a relatively small number of artifacts was reported in the monograph. Regardless of the fact that nearly 6000 artifacts have been discovered according to the initial publication (Basler et al., 1967), the assemblage described in the monograph and material stored in the Museum in Podgorica indicate a much smaller assemblage (around 800 overall) (Mihailović, 2009b; Mihailović and Whallon, 2017). Based on the material, consisting of cores, tools, and selected amounts of unretouched pieces, Basler named several Mousterian types (Table 1).

Basler, as Brodar did some years before, paid attention to the fact that the
artifacts are particularly small and discussed the context, causes, and comparisons for the Micromousterian at Crvena stijena. Noting that this is a constant feature of lithic industries at this site, he eventually concluded that this is nothing more than a response to the immediately available raw material, as is also argued for Tata (Hungary). He additionally observed that the remaining cortex resulted from difficulties in performing the initial stages of reduction, similar to what is seen at Kulna and Krapina (Basler, 1983), and consented to the idea of Blanc and Bourgon (Blanc and Bourgon, 1950) that the frozen river bed during the colder climatic phases reduced the availability of raw materials.

Brodar related the earliest deposits, Levels XXX-XXIX, to the Micoquian regardless of the absence of bifacial elements in Crvena stijena, but rather for the presence of Levallois technology and the steeply retouched edges of the scrapers. He noticed the Levallois component (particularly in the presence of chapeau de gendarme platforms) in these and XXVII-XXV deposits and, for a lack of a better comparison, related these industries to the Tayacian. Tayacian, however, is poorly defined industry as shown by the results of the excavations at Fontéchevade (Dibble et al., 2006).

The collection from Basler’s excavations, selective as it is, was studied by other authors in the 1970s, namely S. Ivanova, who applied Bordes’ method (though it is not entirely clear which levels she included), and J. K. Kozłowski, who focused on the lower levels (XXVII-XXIV). Except in one location in Greece, S. Ivanova found no exact parallels for this industry, which she described as rich in sidescrapers and Mousterian points, with low frequencies of Levallois products and low frequencies of Charentian elements. This led her to define a distinct Mousterian facies: Pinios - Crvena stijena-a, a facies equivalent to Typical Mousterian rich in side-scrapers (Ivanova, 1979).

Kozłowski, on the other hand, examined this same material and found similarities between Crvena stijena levels XXIV-XXII and Asprochalikiko, the northern Bosnian Middle Paleolithic, and the lower levels at Bacho Kiro. He grouped these together under the name Balkan Mousterian (Kozłowski, 1975). Later he accentuated the Charentian elements in the early Crvena stijena industries, and he labeled these and eventually all Balkan Mousterian industries “Charentoid” (Kozlowski, 1992). At Crvena
stijena, he noted the use of Levallois technology of recurrent type, some discoidal technology, the rich presence of side-scrapers of various types, including double forms resembling blades, and scrapers with evidence of ventral retouch. These technotypological features, along with Mousterian points and truncated-facetted pieces, are shared with other Middle Paleolithic industries further to the east, in Karain E and in the Zagros Mousterian. Kozłowski was of the opinion that the Charentoid traits among these distant industries reveal a cultural link across the continents that demonstrates the movements of Neandertals at the limit between MIS 6 and MIS 5 (Kozlowski, 1992; Kozłowski, 2002). Recent re-evaluation of these industries downplayed the importance of the recurrent Levallois method and scrapers; the recurrent method is associated with blade production and scrapers are common only in XXIV (Mihailović et al., 2017).

Basler assigned a Pontinian facies to Levels XXII, XXI, and XVIII based on the use of small pebbles as a primary source for stone tool manufacture, as is widespread in the Middle Paleolithic of central Italy. Although he regarded the issue of Pontinian inextricable to the Micromousterian, he was still confined within the culture-historical perspective and thus more prone to recognize the Pontinian as a cultural phenomenon that links the Adriatic coast and the Apenine peninsula. The abundance of scrapers, additionally, prompted him to relate these groups of industries to the Charentian of southwest France. This association of Pontinian at Crvena stijena and the Charantian and Quina elements has been recently stressed (Dogandžić and Đuričić, 2017; Mihailović, 2017; Mihailović et al., 2017).

Mousterian with thicker points that have triangular sections is noted in Levels XIX and XX, and a relative increase in denticulate tools in Level XIII Basler saw as compatible with the tendencies in other late Mousterian developments in Europe and southwest Asia. He termed this industry Denticulate Mousterian. Basler recognized no salient features in Level XII other than a prevalence of scrapers and archaic tool forms, and hence he labeled the industry Late Mousterian. Brodar noticed an increased microlithization in the upper sequence of Crvena stijena. It has recently been noted that Uluzzian elements (bipolar cored and steeply retouched tools) are already present in the late Middle Paleolithic at Crvena stijena (Mihailović et al., 2017; Mihailović and
The lithic assemblages studied in this project are from the collection gathered in 1958 by Brodar. These assemblages were recovered from a 3 m² area in the back part of the shelter, that in the lowermost excavated depth (Level XVIII, at 11.7 m) covered only 1.5 m². This material was made available with the generous help of D. Mihailović. Even though excavation procedures during the 1950s in this region were far from providing a necessary resolution, Brodar kept some stratigraphic control over the small scale excavations he conducted in the rear. Judging by the notes on the bags that contained the lithic material, finds were collected within geological levels and in several excavation levels (spits); 9 spits in Level XVIII, 4 in XII and 1-2 in other levels. There is a possibility, however, that the Level XVIII in Brodar’s excavation included the underlying Level XIX given that Level XVIII is less thick in other areas than in the location of Brodar’s excavation (which may not be surprising). This issue cannot be resolved for the moment (Mihailović and Whallon, 2017).

The condition of the Basler’s collections suggested that a closer look at the state of the assemblage coming from Brodar’s project was necessary to see in particular if some selection of material had occurred. We can assume that Basler was influenced by Bordes’ (1961b) type list when collecting artifacts in his rather fast excavations. These assemblages are, however, valuable for correlating their typological character with Brodar’s material (Mihailović and Whallon, 2017), but other technological and economy parameters will be less available for examination.

The study of Brodar’s assemblage enabled the examination, in a rather qualitative way, of whether the assemblage was subjected to selection and whether it contains the “expected” amounts and proportions of different data classes. Based on the current state and structure of Brodar’s collection, it may be feasible to evaluate whether his collection suffered from the same bias as Basler’s. The material from all levels contained a significant amount of small chips, sometimes even ~ .5 cm size, and a considerable amount of shatter. These artifacts could have been easily overlooked or intentionally discarded by early researchers. In this study, it was assumed that if any selection of material on technological or typological grounds, similar to Basler’s, or selection based
on size or other artifact properties (fragmentation, raw material, etc.), took place, then there would not have been any shatter, flaking debris, and chips in the collection. Therefore, we approached this collection as if a complete assemblage has been preserved. This is of crucial importance for this study since our methodology and approach heavily relies on the entire assemblage. Namely, the assessment of economy, tendencies in blank production methods, platform management and blank morphology, reduction intensity, would greatly change with the exclusion of unretouched elements or an otherwise incomplete assemblage.

The same assemblage was studied recently by (Mihailović and Whallon, 2017) in an attempt to re-evaluate the late Middle Paleolithic at Crvena stijena and to compare the collections from the two different excavations (Basler’s and Brodar’s). The overall sample, assemblage structure, number of particular core and tool types may differ between that study and the one presented here. This may be due to several reasons: size cut-off used for the analysis (here we did not include pieces <15 mm and fragmented pieces <20 mm), different typological considerations, different classification of particular artifact forms such as those that exhibit features of both tools and cores (e.g. truncated-facetted pieces, scrapers with ventral thinning, etc.), or cases where cores are transform into tools and vice versa. This may illustrate a lack of standardization in Middle Paleolithic lithic studies. However, the overall trends in the techno-typological character seem to be largely in agreement.

1.5.2 Bioče

Bioče (42°31'00.7"N, 19°20'44.1"E) is a small rockshelter in the village Bioče (Montenegro), close to the river Morača, at 30 m above the current riverbed and at 90 m asl, at the foot of a high limestone section. The depth of the shelter is 9 m from the dripline, and it is 11 m wide (Fig. 6). A plateau in front of the dripline covers an area of 50 x 30 m. The rockshelter was used during World War II as a shelter and later as a livestock enclosure. This intensive use resulted in the erosion of the sedimentary deposits (potentially of later Pleistocene and early Holocene age) and revealed Mousterian artifacts on its surface.
Initial investigations commenced with a test trench in 1986. The project was led by the Archeological Collection in Podgorica (Montenegro) and the Center for Archaeological Research of the Faculty of Philosophy, University of Belgrade (Srejović and Žižić, 1986). The investigations continued, though not regularly, until 1997 (1986, 1988, 1995, 1997) (Đuričić, 2006; Ђуричић, 1997). The section of the four initial test trenches collapsed during the initial excavation, and a larger excavation area was delimited – 2 x 14.5 m stretching from the plateau to the back wall of the shelter (Fig. 6). Another small trench (2 x 4 m) was opened but not well investigated because recently disturbed deposits were encountered. Excavations at the rear of the shelter reached a depth of 3.6 m (though the last 90 cm did not contain archeological finds) (Fig. 7). In the front part of the shelter, the depth of excavated sediments is 4 m. The bedrock was not reached at the shelter. The mid-part of the trench most likely is disturbed, while the front part seemed to contain sediments with little to no disturbance (Đuričić, 2006; Ђуричић, 1997).
The sample in this study comes from the following levels, with Level numbers assigned: 2 – 5YR3/4, 3 – 10YR3/2, 5 – 7.5YR4/4, 7 – 7.5YR6/6. Two vertical lines bracket the limit of the squared where the sample studied here comes from.

The three major stratigraphic series, each containing several units, have been defined by the excavations undertaken in the 1980s and 1990s. These are best preserved and documented at the rear of the shelter (section E15E16) (Fig. 8a). They are, from the bottom to the top:

III – This series incorporates archeologically sterile levels of clay and clay with sand mixtures.

II – Series II includes levels of shades of light-brown and yellow color, with clay or sand, lower concentrations of detritus and a greater abundance of limestone blocks. Compared to the levels of the series I, remains are less numerous, decreasing in density in the lower sublevels in the series.

I – Stratigraphic series I contains levels of reddish-brown, light-brown and dark-grey color, with the presence of humus, and a high detritus concentration. These levels contain charcoal and ashes which extend across the rock shelter, even in front of the drip line. A high density of lithic artifacts was encountered (e.g., a 5 cm spit on 1 m², yielded on average about 200 artifacts). In the front part of the excavation area, E-F/3-4, at the contact between the first and second stratigraphic series, a high density of artifacts, bones, pebbles, and mineral pigments were encountered (Đuričić, 2006).
The disturbed middle part of the shelter prevented a stratigraphic correlation of the two parts of the site. In the front part of the shelter, the first stratigraphic series and the upper part of the second series were excavated.

Renewed excavations at Bioče begun in 2010 by the Institute of Archaeology and Ethnography (Russian Academy of Sciences) and the Museum in Podgorica (Montenegro) (Derevianko et al., 2014, 2015, 2016, 2017; Derevjanko et al., 2012). These excavations focused on the back part of the shelter. 7 stratigraphic units (their numbering does not correspond to previous level designations in (Dogandžić and Đuričić, 2017; Đuričić, 2006) have been identified over 5 m of deposits. The upper two units, 1 and 2, contain several sublevels, and the greatest amount of material discovered

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1 These levels at the back area of the shelter have been labeled as Levels 1, 2, and 3 by Derevianko et al., but as they contain several sublevels, we will term them ‘Units’, also to differentiate them from the level names used in this study that refer to different
comes from Level 1, as confirmed by the previous researchers. Over 30,000 artifacts have been discovered over 6.5 m² and 1 m depth (Derevjanko et al., 2012). Radiocarbon ages on the bones from Levels 1.1.2 and 1.2 reported recently do not provide enough information (list of samples and their ages) that would help evaluate their soundness; the available information indicated a range between 40 and 31 ka BP falling within an MIS 3 chronology (Derevianko et al., 2014). The researchers suggested a MIS 5c-b age for Levels 3 and 4 based on techno-typological characteristics similar to Crvena stijena Levels XXII-XVIII (Derevianko et al., 2017). In addition, a tephra deposit apparently corresponding to the Campanian Ignimbrite eruption, was discovered within layer 1.3 in the back side of the shelter, with Middle Paleolithic deposits over it (Vishnevskiy et al. 2019). This finding contrasts with data in the region where the Middle Paleolithic ends before the CI eruption; potentially, more detailed analyses on this deposit and re-evaluation of site’s stratigraphy would help resolve this inconsistency.

The main raw material source for stone tool production was chert pebbles from the near-by river (Đuričić, 2006; Ђуричић, 1997). Previous studies of the lithic industries at Bioče emphasized the heterogeneous nature of these assemblages. Given the small artifact size and the proximity to Crvena stijena and Asprochaliko, where the term Micromousterian was already introduced to designate the industries with artifacts of smaller on average size, the industry from Bioče is often labeled as Micromousterian, even though detailed comparisons in techno-typological terms with these sites remain unclear. Moreover, it has been asserted that pebbles of various sizes, including bigger ones, are available in the Morača river banks and so the use of smaller ones may have been for the purposeful production of small artifacts (Đuričić, 2006).

Previous studies of the lithic assemblages from Bioče showed that the techno-typogical character of the industries does not vary much within and between stratigraphic series (Derevjanko et al., 2012; Đuričić, 2006). Differences between the stratigraphic series are negligible, e.g. in the use of raw material, namely, limestone, not chert, is used as the primary source of raw material in the levels of the second stratigraphic series. Within the upper series, it has been noted that the uppermost levels sublevels in the stratigraphic series 1 after (Đuričić, 2006; Ђуричић, 1997).
contain artifacts of somewhat larger sizes (Đuričić, 2006). The prevalence of radial flaking methods, including Levallois, is the major technological attribute in the assemblages, as evidenced by many cores of Levallois, discoidal, and globular forms, and many small radially flaked cores are encountered (Derevianko et al., 2016; Đuričić, 2006, Pavlenok et al., 2017), particularly in the upper levels in the back area of the site (Derevianko et al., 2016). Cores with one and two platforms, similar to prismatic cores, are rare but present in the upper series in both areas of the shelter (Pavlenok et al., 2017). Crest and tablets have been encountered as well, so are truncated-facetted pieces that most likely functioned like cores (Derevianko et al., 2012; Đuričić, 2006).

Most blanks are transformed into scrapers. Various scraper types are present, but lateral and transversal are the most common. Some have ventral modifications. Given the frequency of scrapers and level of rejuvenating their edges, it has been suggested that the upper assemblages resemble Charentian (also because of lack of Levallois) (Pavlenok et al. 2017). The toolkit has abundant raclettes (Đuričić, 2006). Marginally retouched thin blanks, endscrapers and Mousterian points are present as well. There are variable proportions of denticulated tools (Derevianko et al., 2016, 2017; Đuričić, 2006, ), and occasionally bifacial elements are found (Derevianko et al., 2017, 2016).

Unit 2 in the back area of the site is rich in radial techniques, but the production of blades and elongated points is present as well (Derevianko et al., 2017, 2016). Units 3 and 4, identified in the new excavations and suggested to correlated with the previously sterile stratigraphic series III, contained a smaller number of finds (300 and 30 respectively), with rare Levallois elements and evidence of more simple flaking through orthogonal and parallel cores, and also some centripetal (Derevianko et al., 2016, 2017). According to researchers, these flaking methods approximate the industry of Crvena stijena Levels XXII-XVIII and may indicate a MIS 5c-b age for these deposits (Derevianko et al., 2017).

The fauna has not been studied in detail yet, though a preliminary assessment of 3550 specimens excavated in the anterior area of the site shows high fragmentation. This said, the small number of bones that could be identified taxonomically point to the presence of the following species: cave bear (Ursus spelaeus), red deer (Cervus elaphus
Linnaeus), taur-auruch or bison (*Bos primigenius seu Bison*), Alpine ibex (*Capra ibex Linnaeus*), and sheep/goat (*Ovis seu Capra*). A higher density of bison bones is concentrated in the “zone with bones” (lower levels of the upper stratigraphic series). Most numerous are teeth and vertebrae while some other skeletal parts are missing (Đuričić, 2006). A number of bones show evidence of purposeful flaking - modifications similar to flaking/retouching of stone tools.

One interesting find from the upper deposits is a limestone pebble (5 x 1 x 6 cm) with potentially anthropogenic incisions. The pebble’s base is flat, and incisions, in the form of lines, extend around the pebble, in a parallel or radial manner (Đuričić, 2006). The anthropogenic character of this find, however, needs to be further corroborated. During excavations in the same levels as the “zone with bones”, several fragments of light-brown and brown mineral pigments were found (Đuričić, 2006).

The sample of lithic artifacts used in this study comes from the front part of the shelter (4 m²) (Fig. 5). The decision to take this sample was made with a consideration for the levels disturbance in the middle part of the excavated area. Given the distribution of the levels, some levels that are part of this upper stratigraphic series (e.g. Level 4 – 10YR4/4) are missing from our sample because they do not extend over the entire area excavated in this part of the shelter; they are hardly present in the G4-G5, but only observable in the adjacent G5-G8 squares. The excavation procedure followed the collection of material per sub-square (50 cm x 50 cm) within one archaeological level (spit) of an approximate thickness of 5 cm. Đuričić, unlike researchers before her, divided Level 2 into two sublevels; however, in this work we did not maintain this distinction as the material studied here encompassed collections from the previous excavations that did collected the material from the entirety of the level. The material coming from the spits that contain mixed levels (from the contact of the two geological levels) were not analyzed. The uppermost excavated spits were excluded from this study as they have been removed as “leveling out” of the shelter’s surface by the first investigators in order to clean any mixed sediments created by the recent erosional episodes at the site (field notes, Lj. Đuričić, *pers.comm.*). These uppermost remains (depending on the square, those were the spits #1-5 or 1-6) even contained contemporary material. Even though investigators registered only Middle Paleolithic occupations at
this location, the mixing of material with any subsequent Pleistocene/Holocene material should be avoided, thus the decision to exclude the uppermost spits.

1.6 OUTLINE OF THESIS CHAPTERS

Chapter 2. The variability of blank morphology

The toolkits of Balkan Mousterian assemblages primarily feature flake tools, scrapers in particular. Thus, as in many Middle Paleolithic industries, it is expected that much of the industrial variability is rooted in the variability of retouched elements, which are highly susceptible to the amount of resharpening. Variability of flaking methods is, likewise, associated with a resharpening potential since one blank production method might be more suitable to produce blanks that can be repeatedly resharpened, if needed. Consequently, estimating the retouch modification of a tool provides a valuable window into the variation of Middle Paleolithic industries. One way to estimate the amount of resharpening is by reconstructing the original size of a blank and compare it to the discarded size.

Regardless of the approach or a theoretical standing in lithic studies, the shape and size of blanks are principal sources of variation in lithic assemblages. Lithic analysts, however, still disagree about and strive to enhance our ways to measure and interpret this variability. At several analytical levels there still remains room for improvements in the methodology used to investigate blank size/morphology. Namely, the reliability of the researcher’s measures of blank properties – size, shape, edge length - needs to be evaluated. For unretouched elements, are the metric measures we use correct? As for the retouched elements where initial size is reduced and the original size now difficult to estimate, platform variables are highly informative for size/shape reconstruction, though the power of these predictions still remains unsatisfactory. Lastly, the relationships between platform variables and the resulting flake size/shape are important for understanding how knappers control the blank size/shape and eventually their technological strategies. In Chapter 2, these methodological aspects are examined on an experimental assemblage. Using digital images, reliable measures are obtained and compared to the caliper measurements typically employed by lithic analysts in
order to assess their reliability. Models are used to predict blank size/shape based on the following independent variables: metric measurements of platform thickness, platform width, exterior platform angle (variables having the greatest ability to determine size/shape as evidenced by the controlled experiments), and thickness. Blank size and shape are predicted rather well, but the predictive power of these models is insufficient to provide a reliable size estimate on a piece by piece basis. This poses a difficulty in applying equations from these models to archaeological assemblages for evaluating levels of resharpening. A closer look at these models, however, and the effects of independent variables on blank size and form, brings additional and valuable contribution to our understanding of the ways the knappers might have modified the platform to obtain a blank of certain size/shape.


**Chapter 3.** Disentangling the Micromousterian in the southern Balkans

Many sites from the southern Balkans are lumped into the Micromousterian group. Beyond the small artifact size, the features of these industries are not well understood, nor are its diachronic or regional variations. Chapter 4 addresses variability within the Micromousterian using the collections from the stratified and relatively rich rockshelters in the Adriatic region of the Balkan peninsula, Crvena stijena and Bioče. In addition to being grouped into the Micromousterian based on average artifact size, other Mousterian variants, e.g., Pontinian, Denticulate, Typical Mousterian, are recognized at Crvena stijena, which points to a certain variability within these industries that merits further investigation. This work aims to depart from a tight attachment to Mousterian facies and instead considers the technological and typological character and chronological trends in technological behavior, the variability within this group, and eventually tackles the issue of the Micromousterian by elucidating the causes of “microlithism”. Here, core reduction patterns, tendencies of blank morphology and tool production and use are integrated so as to reveal patterns in technological characters.
and changes. Raw material differences and the effects of their properties are recognized as factors affecting the stone implement size. Variations in on-site reduction intensity also affect artifact size at intra-site level. The production of blanks to a large extent relies on various centripetal flaking methods, and cores on flakes are almost regularly exploited. The production of small blanks is therefore testified to both through extensive use of cores and cores on flakes, including cores with varied arrangements of removals that resulted in small blanks sometimes of elongated form. Important trends are observed in the association of blank production strategies and the levels of investment in tools – their production and extensiveness of their reuse – reflecting different strategies in how fresh edges are secured.

The results of this study are published in the Quaternary International: Dogandžić, T., Đuričić, Lj. (2017) Lithic production strategies in the Middle Paleolithic of the southern Balkans, Quaternary International, 450: 68-102

**Chapter 4. The reality of Denticulate Mousterian**

Across the Balkans, several assemblages have been classified as Denticulate Mousterian. This is particularly the case with sites in the Adriatic region. Younger MP levels at both Crvena stijena and Bioče show an increase in denticulate tools; moreover, Level XIII at Crvena stijena, labeled as Denticulate Mousterian, served as a reference for this type of Mousterian for other Balkan assemblages. Postdepositional processes are known to affect the occurrence denticulate and notched pieces in assemblages. Chapter 5 addressed the issue of an increase of denticulates and notches at Crvena stijena and Bioče from a taphonomic perspective. Using data on the edge damage occurrence in assemblages and, in case of Crvena stijena, relating it to the gravel size which known to produce damage, it was possible to show a link between the denticulate/notch increase and the edge damage frequencies. This link was the strongest for the Level XIII at Crvena stijena, which questioned its use as a reference for the Denticulate Mousterian. Taphonomic approach should be encouraged for other Balkan assemblages containing elevated numbers of notched and denticulate tools.

**Chapter 5. The Middle Paleolithic in the Balkans. Reviewing the broader temporal and spatial variability**
The collections from the sites studied in this thesis are valuable as they offer a relatively rich record and a diachronic perspective for variation to be examined; however, the wider context of the observed variation remains unclear. The Balkans has long been a relatively empty spot on the map of the Middle Paleolithic occupation of Europe, and it is timely to provide a review with a critical evaluation of the record. Chapter 4 provides a much needed presentation of the Middle Paleolithic industries in the Balkan peninsula and envisions several objectives. Firstly, a consideration of the industries without strong ties to the previously defined and rather unclear facies is presented, combining technological and typological features and assessing the appearance and the “history” of the techno-typological elements and trends. This work is primarily based on a literature review of the available record and the derived inferences are as good as the data they are based on are, resulting often in somewhat tentative conclusions.

This project integrated the previously observed variability and trends in technological behavior at Crvena stijena and Bioče and the described industrial variability in the wider region of the Balkans in hope that the new data will contribute to our understanding of variation at temporal and regional scales. The perceived patterns of industrial variation in the Balkans are further brought into the context of the currently known variation of the Middle Paleolithic industries in Europe.

Finally, as much as the fragmentary record of the Middle Paleolithic of the Balkans allows, a provisional model of the Neandertal occupation of the region is put forward. What does the current record say about the dis/continuities of their presence, is there any geographical patchiness in their occupation of the region, and how is it expressed at a temporal scale? Particular attention is dedicated to the last stages of their presence in the region when incoming populations of modern humans penetrated the European continent. Hampered by the research gaps in several regions and geomorphological gaps, these occupation scenarios are still provisional, but the current record provides material for building hypothesis and directions for further research. Directions for future research should incorporate detection of new sites, the inclusion of new lithic collections, and more work on older collections.
The results presented in this chapter are under review at the *Journal of World Prehistory*: Dogandžić, T. “The Middle Paleolithic of the Balkans. Industrial Variability, Human Biogeography, and Neandertal Demise”. *Journal of World Prehistory*.

**Chapter 6.** Filling in the gaps: moving forward with field research

Needless to say, furthering our knowledge of Neandertal occupations and adaptations in the Balkans requires discovering new Pleistocene locations. Excluding research bias as a major determinant of the human occupation scarcity is achievable solely with encouraging further prospections and site detection. New research programs should draw from the patterns manifested in the current record, namely, follow the geographical and topographical features of areas where sites, particularly stratified sites, are located in greater numbers, and use these patterns as models for targeting areas for future surveys. A similar strategy was used in the survey for Middle and Upper Paleolithic deposits in the karstic areas in eastern Serbia.


**Chapter 7.** Conclusion: The final chapter of the thesis integrates the conclusions of the different projects and discusses the questions raised in Chapter 1 and discusses directions for future research.
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