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Standing at the gates of Europe: Human behavior and biogeography in the Southern Carpathians during the Late Pleistocene

Julien Riel-Salvatore^{a,*}, Gabriel Popescu^{b,c}, C. Michael Barton^{c,d}

^a Department of Anthropology, McGill University, Stephen Leacock Building, Room 717, 855 Sherbrooke Street, W., Montréal, Que., Canada H3A 2T7

^b Institute of Archaeology “Vasile Parvan”, 11, Henri Coanda Street, Sector 1, Bucharest 010667, Romania

^c School of Human Evolution & Social Change, Arizona State University, P.O. Box 872402, Tempe, AZ 85287-2402, USA

^d Center for Social Dynamics & Complexity, Arizona State University, Tempe, AZ 85287, USA

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Abstract

This study presents a behavioral analysis of Middle and Upper Paleolithic lithic assemblages from 14 sites located in the southern Carpathian Mountains. Using a whole assemblage behavioral indicator, we show that the hominins that manufactured those stone tools do not appear to have differed in terms of the flexibility of the mobility strategies they employed to exploit their landscapes. Rather than biological change, we argue that large-scale climate changes are likely more important drivers of behavioral changes during the Late Pleistocene of the region, including during the Middle–Upper Paleolithic transition. These results agree well with the results of studies having employed this methodology in other regions, suggesting that this is a generalized feature of the transition across Eurasia. Recasting the transition as a mainly ecological rather than purely biocultural process allows us to generate new perspectives from which to approach the question of behavioral change during the Late Pleistocene, and ultimately suggests that the process referred to as the ‘Middle–Upper Paleolithic transition’ is essentially a brief segment of a much more extensive process driven by prehistoric human–environment interactions that would culminate in the highly logistical mobility strategies documented throughout the continent at the Last Glacial Maximum.

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Introduction

Recently, Eastern Europe has received increasing attention for contributing to our understanding of the Middle–Upper Paleolithic transition, largely due to its position astride the “Danube corridor”, long a major pathway between Europe and Asia, especially during the last Glacial when the eastern European plain to the north would have been a much more inhospitable environment than it is today (e.g., Conard et al., 2003; Mellars, 2005). The discovery of the oldest dated remains of anatomically modern humans in Europe at Pesteră cu Oase in Romania (Trinkaus et al., 2003a,b) and of modern human remains display-

ing some Neanderthal features (Soficaru et al., 2006) underscores the importance of Romania for understanding Late Pleistocene human biogeography. However, little else in the way of new Paleolithic archaeological data from that country have yet been published, especially in English, and most prior research has been dominated by a descriptive, culture-historical research agenda. Nevertheless, the results of more than century of Paleolithic archaeology potentially offer a heretofore untapped resource of information about the behavioral dynamics of the Late Pleistocene occupation of Europe by anatomically modern humans.

Recent studies focusing notably on raw material procurement patterns (e.g., Adams, 1998, 2007), recognizing particular constellations of technotypological traits (e.g., Tostevin, 2000, 2003), and the organization of technological systems (Riel-Salvatore and Barton, 2004) have shown

* Corresponding author. Fax: +1 514 398 7476.

E-mail address: julien.rielsalvatore@mail.mcgill.ca (J. Riel-Salvatore).

that there is still much valuable information to be gleaned from old collections, provided that appropriate methods are devised to study them.

The issue of appropriate methodology is inextricably linked to the question of what aspects of prehistoric behavior one wishes to investigate and over what time period. Of the multifaceted dimensions of the Middle–Upper Paleolithic transition (and which are often assumed to document behavioral differences between Neanderthals and modern humans), research on land-use strategies has remained under-developed, largely because of a lack of appropriate methods to directly compare sites across periods. For example, while Neanderthal and modern human land-use strategies are proposed to have differed in the Middle Paleolithic of the Levant (Lieberman and Shea, 1994; Shea, 2003; but cf. Lieberman, 1998), it has proven very difficult to document this over the transition interval. Various researchers have used retouch intensity as a proxy for land-use patterns in the Mousterian (e.g., Barton, 1988; Kuhn, 1995) and in the Aurignacian (e.g., Blades, 2001, 2003). However, differences in ways of measuring retouch intensity that vary by researcher and blank form have so far precluded direct comparisons across regions and the Middle–Upper Paleolithic transition except in the most general terms (Dibble, 1995a).

Furthermore, the spatial dimension of prehistoric human behavior is often underappreciated. Hunter–gatherers in different areas, employing a common set of behavioral rules, may not act in comparable ways or leave comparable archaeological records because contextual factors such as climate, hydrology and resource abundance can lead to variable expression of a single behavioral system. In light of models which postulate that modern humans entered Europe via two ecologically distinct routes, a continental one along the Danube and a coastal one along the northern coast of the Mediterranean, we cannot assume similar suites of behaviors, behavioral changes over time, or archaeological records.

In order to address these issues of human biogeography and their dynamics along one of the main corridors through which people have passed into and out of Europe, we undertake a diachronic study of Late Pleistocene land-use patterns based on a series of 44 assemblages from 14 Middle and Upper Paleolithic sites, extending across central Romania. We employ a methodology that can be applied to collections from previously excavated sites and irrespective of any typological label assigned to assemblages. In a series of publications, we have productively used this approach to analyze numerous Middle, ‘transitional’ and Upper Paleolithic assemblages from the Mediterranean coast of Europe (Barton, 1998; Riel-Salvatore and Barton, 2004, 2007; Villaverde et al., 1998); this paper is its first application to assemblages from the European interior. Particularly critical for this ‘gateway’ to Europe, this approach offers a means of comparing land-use strategies and gaining better insight into ecological behaviors

more generally across the typologically defined transition between the Middle and Upper Paleolithic.

Paleolithic research in the Southern Carpathians

A series of Paleolithic caves in the southern Carpathians were the focus of very early archaeological investigations, beginning in the latter half of the 18th Century, aimed at recovering prehistoric artifacts and faunal remains, sometimes accompanied by limited recording of the geological context of the materials. This work was well underway by the mid-19th Century, with excavations at several of the caves used in the present study, including Hotilor, Mare, Muierilor, Nandru Curata, Spurcata, Bordu Mare, and Gura Cheii Caves (Jungbert, 1978, 1979, 1982, 1987; Paunescu, 1987, 2001).

This interest in the Carpathian prehistoric record continued into the first decades of the 20th Century, with notable work by M. Roska that included three seasons at Cioclovina Cave, one at Craciunesti Cave (with H. Breuil, M. M. Jeannel and P. A. Chappuis), and seven at Bordu Mare Cave, as well as many other sites (Cârciumaru, 1999; Paunescu, 1989, 2001; Roska Marton, 1942).

Beginning in 1954, archaeological projects in the Carpathians were increasingly carried out by a team of archaeologists and physical anthropologists led by C. S. Nicolaescu-Plopsor. Sites excavated by this team include Muierii Cave (Nicolaescu-Plopsor, 1957; Paunescu, 2000), Bordu Mare Cave (Nicolaescu-Plopsor et al., 1955, 1957a), Cioarei Cave (Nicolaescu-Plopsor et al., 1955), Hotilor Cave (Nicolaescu-Plopsor et al., 1957b), Curata and Spurcata Caves at Nandru (Nicolaescu-Plopsor et al., 1957a), Mare and Valea Coacazei Caves at Pestera (Nicolaescu-Plopsor, 1959, 1961), and Gura Cheii Cave (Nicolaescu-Plopsor et al., 1962). At roughly the same time, Florea Mogosanu conducted field projects at open air sites in the Banat area (Mogosanu and Cârciumaru, 1978; Paunescu, 2001).

More recently, in the 1980s and 1990s, several *sondages* were dug by Al. Paunescu in Bordu Mare Cave, Curata and Spurcata Caves, Gura Cheii-Cave, Mare Cave, and Valea Coacazei Cave (Paunescu, 1989, 1991, 2001). Work at Borosteni–Cioarei Cave, continued under the direction of M. Bitiri and M. Carciumaru in the 1980s and of a Romanian–Belgian team led by M. Carciumaru and M. Otte in the 1990s (Cârciumaru, 1980, 1999; Cârciumaru et al., 2002; Otte et al., 1996; Paunescu, 2000).

The lithic assemblages recovered in this nearly two centuries of research have been published in varying degrees of detail, and classified following French Paleolithic systematics (e.g., Cârciumaru, 1999, 2000; Mogosanu and Cârciumaru, 1978; Paunescu, 1980, 1988b, 1989, 1991, 2000, 2001). These studies were largely culture-historical in nature and sought to assign these assemblages to different technocomplexes and/or facies of the Middle and Upper Paleolithic.

A combination of typological characteristics, raw materials, and regional peculiarities have been used to define a variety of Middle Paleolithic industries from southern Carpathians caves. These include the Preszletian Mousterian (Nicolaescu-Plopsor, 1957), the Eastern Charentian of Pontinian technique (Cârciumaru, 1989, 1999; Gábori, 1976; Gábori-Csank, 1968; Mertens, 1996; Paunescu, 1989, 2001), and the Quartzitic Mousterian (Cârciumaru, 1999; Mogosanu and Cârciumaru, 1978; Paunescu, 2001). More recently, Al. Paunescu (2001) has described the Middle Paleolithic of the region as belonging to a Carpathian Mousterian facies, rich in scrapers and made mainly on quartz and quartzite. In a recent synthesis of the Romanian Paleolithic, Cârciumaru (1999) suggests that early Middle Paleolithic assemblages from the Carpathians can be assigned to a Charentian Mousterian of Pontinian technique.

Although Al. Paunescu did not recognize a 'transitional' industry between the Middle and Upper Paleolithic (see also Paunescu, 1980, 1988a,b, 1993), Cârciumaru argues that late Mousterian assemblages (i.e., those found stratigraphically higher up within a given sequence), as well as those from single-occupation Mousterian sites, display technological features that suggest they represent a 'transitional' industry of Szeletian influence that he calls the *Carpathian Facies*. This view is also based on the available radiocarbon age determinations for these assemblages (Table 1). Although many of the finite ^{14}C dates appear reasonable, some have been criticized as not reliably dating Middle Paleolithic occupations of the sites in question, especially the late Mousterian dates (i.e., <40,000 BP) (Allsworth-Jones, 1990; Djindjian, 2000; Mertens, 1996). Thus, although they remain unresolved, the questions of the late persistence of the Mousterian in Romania as a whole, and in the Carpathians in particular, and of the possible existence of a 'transitional' industry in the region have been the focus of considerable recent discussion (e.g., Allsworth-Jones, 1986, 1990, 2000; Cârciumaru, 1980, 1989, 1999; Mertens, 1996; Mogosanu and Cârciumaru, 1978; Nicolaescu-Plopsor, 1956; Paunescu, 1980, 1988a,b, 1993, 2001)).

Recently, a detailed inventory of Paleolithic and Mesolithic assemblages in Transylvania was published by Paunescu (2001), that provides complete counts and of cores, debitage and retouched pieces, and evaluations of assemblage integrity based on curation history since their recovery. With a few notable exceptions comparatively little has been published in the way of technological debitage analysis (Cârciumaru et al., 2000, 2002; Moncel et al., 2002), or of studies on raw material procurement, land use, and/or subsistence strategies (Patou-Mathis, 2000–2001; Terzea, 1987). The study presented here aims to contribute to this latter suite of issues pertaining to human ecology by employing an alternative analytical perspective to the typotechnological studies that have long characterized Romanian Paleolithic research. While rooted in different theoretical perspective, however, it is important to stress that this approach also can shed light on the underlying

causes of observed typological variability across time and space in this region of eastern Europe.

Methods

The methodology used in this paper was originally proposed by Barton (1998; see also Villaverde et al. 1998), and refined in subsequent studies (Riel-Salvatore, 2007; Riel-Salvatore and Barton, 2004, 2007). Since this approach has been described at length elsewhere, we only briefly summarize it here, with reference to previous results to highlight its heuristic potential as a way to document Late Pleistocene land-use patterns in the Carpathians.

This method uses a whole assemblage behavioral indicator (WABI) that employs information about the total number of retouched pieces in an assemblages and the density of lithic accumulation in the original deposit. It is based on middle range theory that integrates the organization of lithic technology and the relationship between retouch and artifact curation, and it postulates a strong negative correlation between the incidence of retouched pieces in a lithic assemblage and the volumetric density of all lithic pieces in that assemblage (including cores and debitage). In other words, for a given depositional environment, assemblages with low lithic volumetric densities are predicted to show relatively higher frequencies of retouched pieces compared to high-density assemblages where the frequency of retouch is expected to be comparatively low. Repeated experimental studies have shown that increasing amounts of lithic reduction produces a curve that increases geometrically from relatively few large pieces (minimal lithic reduction) to a great many smaller pieces (much reduction) (Ahler, 1989; Newcomer, 1971; Patterson, 1990; Patterson and Sollberger, 1978). Also, taphonomic processes such as trampling will increase lithic counts rapidly through breakage in sites that are occupied longer (McBrearty et al., 1998; Hiscock, 2002). The theoretical inverse relationship between retouch frequency and artifact density is best seen, in many cases, by plotting each assemblage on a scatter plot in which the axes are rescaled by a log-log transformation (see Riel-Salvatore and Barton, 2004; Fig. 1).

Ideally and in many real cases, the relationship between retouch frequency and density is a (negative) linear one, the regression line for such a graph visually representing behavioral variation (i.e., WABI). That is, for a group of assemblages that display this theoretically predicted relationship, any given assemblage can fall at any point along the line that expresses the relationship between retouch and volumetric density; its position along that line graphically expresses the WABI and serves as a proxy indicator for curation behaviors that are linked, in turn, to residential mobility and land-use. That is, high frequencies of retouch (and correspondingly low artifact density) are argued to be diagnostic of curated assemblages while low frequencies of retouch (and dense artifact accumulations) tend to represent expedient assemblages. Expedient assemblages are

Table 1
Sites discussed in text

Map key-cluster-locality	Site	Assemblage	¹⁴ C Dates BP	Primary references
1-1-Baia de Fier	Muierii (cave)	Aurignacian Mousterian	42,560 +1310/–1120 (GrN16977)	Nicolaescu-Plopsor et al., 1957a; Paunescu, 2000
2-1-Băile Herculane	Hotilor (cave)	Epigravettian Aurignacian Mousterian		Mogosanu and Cârciumaru, 1978; Paunescu, 2001
3-1-Boroșteni	Cioarei (cave)	Mousterian J Mousterian H Mousterian G Mousterian F Mousterian E	48,000 +1800/–1500 (GrN15054) 49,500 +3200/–1100 (GrN13002) >50,000 (GrN13003); >54,000 (GrN15055); 50,900 +4400/–2800 (GrN15046) 51,900 +5300/–3200 (GrN15048) >45,000 (GrN13004) >47,000 (GrN15047) >49,000 (GrN15056)	Cârciumaru (1999); Cârciumaru et al., 2000, 2002; Moncel et al., 2002; Paunescu, 2000
4-1-Gornea	Dealul Căuniței (open air)	Mousterian		Mogosanu and Cârciumaru, 1978; Paunescu, 2001
5-1-Pescari	Livadița (cave)	Mousterian		Paunescu, 2001
6-2-Coșava	Cuca (open air)	Aurignacian III Aurignacian I		Mogosanu and Cârciumaru, 1978; Paunescu, 2001
7-2-Nandru	Curată (cave)	Mousterian II d Mousterian II c Mousterian II b Mousterian II a Mousterian I c Mousterian I b Mousterian I a	40,800 +1050/–930 (GrA-13948) >47,800 (GrN23406) 44,600 +1900/–1500 (GrN24221) >45,000 (GrN23407) 29,940 +420/–400 (GrA13249) 45,200 +4200/–2700 (GrN24222) >31,700 (GrN24326) >36,300 (GrN24223) 28,250 +350/–530 (GrA-13250) >39,600 (GrN24224)	Nicolaescu-Plopsor et al., 1957d; Paunescu, 2001
8-2-Nandru	Spurcată (cave)	Mousterian	30,000 +1900/–1500 (GrN14622)	Nicolaescu-Plopsor et al., 1957d; Paunescu, 2001
9-2-Ohaba Ponor	Bordu Mare (cave)	Aurignacian Mousterian IV b Mousterian IV a Mousterian III g Mousterian III f Mousterian III e Mousterian III d Mousterian III c Mousterian III b Mousterian III a Mousterian III w/o L.nr. Mousterian II Mousterian I	28,780 ± 290 (GrN14627) 45,500 +3500/–2400 (GrN14626) 43,600 +2800/–2100 (GrN12676) >41,000 (GrN11617) >40,000 (GrA6036) >40,000 (GrA6036)	Nicolaescu-Plopsor et al., 1957c; Paunescu, 2001

Table 1 (continued)

Map key-cluster-locality	Site	Assemblage	¹⁴ C Dates BP	Primary references
10-2-Romanеști	Dumbravița (open air)	Aurignacian III		Mogosanu and Cărciumaru, 1978; Paunescu, 2001
11-2-Tincova	Seliște II (open air) Seliște I (open air)	Aurignacian Mousterian		Mogosanu and Cărciumaru, 1978; Paunescu, 2001
12-3-Peștera	Mare (cave)	Gravettian?! Aurignacian? Mousterian	16,110 ± 90 P (GrN14619) 17,360 ± 80 (GrN13947) 38,700 ± 850 (GrN14618)	Nicolaescu-Plopsor, 1959; Paunescu, 2001
13-3-Peștera	Valea Coacăzei (cave)	Gravettian Mousterian	15,710 ± 310 (GrN14642) 34,400 ± 500 (GrN16141)	Paunescu, 2001
14-3-Rașnov	Gura Cheii (cave)	Gravettian Aurignacian Mousterian	28,900 +2400/–1800 (GrN14620) 29,700 +1700/–1400 (GrN11619) 30,450 ± 300 (GrN13008) 33,300 ± 900 (GrN13009)	Nicolaescu-Plopsor et al., 1962; Paunescu, 2001

See Fig. 1 for site and cluster locations.

argued to indicate prevalently logistical land-use patterns whereby a site is occupied more intensively and/or for a longer duration, and provisioned with raw material and other essential resources by forager groups that travel to satellite resource extraction sites. This, in effect, creates a situation of effective raw material abundance under which overall raw material utility does not need to be maximized. During such an occupation, there is also much less need for artifact portability, meaning that multiple lithic artifacts can be used and discarded, rather than requiring a few artifacts to be maintained for multiple uses.

In contrast, curated assemblages are argued to represent mainly residential mobility, although they can in certain cases also indicate activity-specific resource extraction sites (see Kuhn, 1989). In contexts of residential mobility, lithic raw material is generally effectively scarce since it cannot practically be stockpiled at frequently moving home bases, which must be provisioned in resources mainly from their immediate surroundings due to their short term occupancy. Under such conditions, foragers tend to make more extensive use of more portable packages of raw material that are often prepared ahead of time to maximize the extraction of usable blanks.

As with any kind of lithic analysis, the results of the WABI method can be affected by amount of a site's overall surface that is sampled during excavation, since the lithic assemblage collected in one part of a site may differ dramatically from that from another part. The influence of sampling bias has been discussed by other researchers, and it has been explicitly recognized at a number of Paleolithic sites, including the Mousterian site of Tor Faraj (Henry, 2003; Henry et al., 2004) and the Early Upper Paleolithic site of Tor Fawaz (Kerry and Henry, 2003).

In the specific case of the WABI, the most important issue is whether the analyzed lithic assemblages provide an accurate reflection of lithic curation during a given prehistoric occupation. It could be argued that an assemblage derived from an area of 16 m² excavated over 25 cm is more representative of the range of prehistoric behavior expressed at a site than one recovered from an area of 4 m² over a depth of 1 m. While this may be true, we would argue that this quandary is one faced by *all* lithic analyses, and not the exclusive purview of the WABI. Furthermore, in caves and rock shelters especially, taphonomic processes resulting from repeated reoccupation of physically bounded areas can so disturb any original spatial patterning in lithic refuse that the assemblage from any excavated area can be considered a time-averaged palimpsest (Barton and Clark, 1993). Hence, it is always better to base any reconstruction of prehistoric life, be it typological, technological, or behavioral, on as representative a sample as possible. For instance, important *fossiles directeurs* may not be found in small sondages, and a *chaîne opératoire* may appear truncated because different parts of the lithic reduction sequence were conducted in different parts of a site, only one of which was excavated (e.g., Kerry, 2000; Kerry and Henry, 2003). On the other hand, a detailed analysis of Middle Paleolithic, Upper Paleolithic, and transitional assemblages in Italy shows a strong correlation between the frequency of retouched pieces in an assemblage and the average reduction intensity on individual retouched pieces (Riel-Salvatore, 2007). This suggests that, for assemblages for which we currently lack data pertaining to the degree of reduction of individual stone tools, WABI analysis can serve as a reliable proxy for assemblage curation as a first

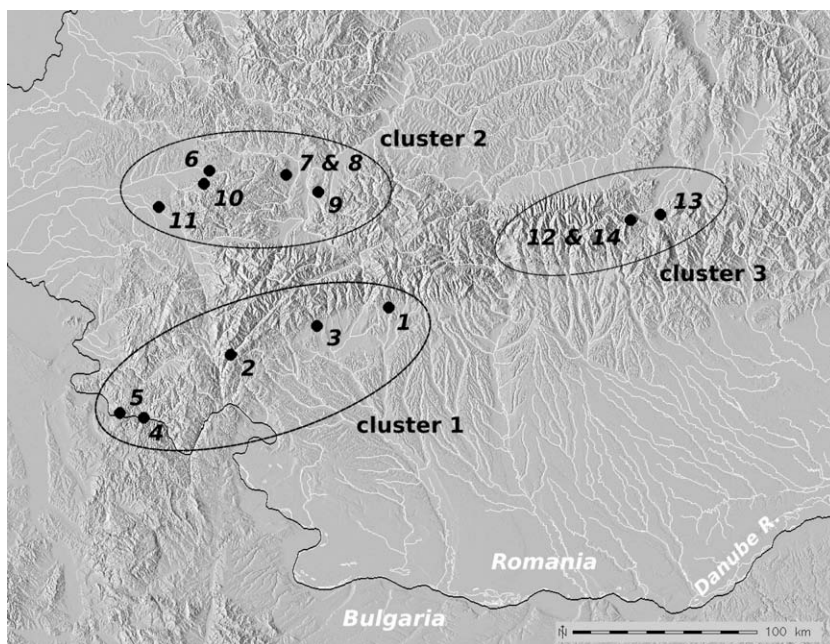


Fig. 1. Map of sites studied and geographic site clusters. See Table 1 for key to sites.

step in understanding pattern of technoeconomic decision-making by prehistoric hominins.

Different methods of core reduction also could theoretically influence an assemblage's lithic volumetric density. Recent reassessments of Levallois technology, for instance, suggest that this highly-structured core management strategy helps maximize the number of blanks extractable from a given unit of raw material (Brantingham and Kuhn, 2001; Sandgathe, 2004, 2005). This would have understandably made this blank production strategy especially profitable in high-mobility contexts (Riel-Salvatore and Barton, 2004, p. 261), although this may appear paradoxical at first glance since such assemblages are expected to be comparatively small and more curated (i.e., contain relatively high frequencies of retouched pieces). That this is not the case, however, is due to the fact that archaeologists deal mainly with artifact discard contexts, and only rarely with primary use and production contexts (i.e., archaeological *versus* systemic contexts; Schiffer, 1972). While a higher incidence of Levallois products should characterize curated as opposed to Mousterian assemblages, the true archaeological expectation should be for a high incidence of heavily reduced Levallois cores in curated assemblages. In more expedient assemblages that may in certain contexts be conceptually closer to systemic contexts, Levallois cores might also be present in high numbers, although they can be expected to reflect a broader swath of core life-histories than in curated assemblages. Thus, different core reduction strategies result in the production of different amounts of lithic debris viewed in the context of assemblages that represent discard decision and that constitute time-averaged palimpsests accumulated over hundreds if not thousands of years. This problem is additionally compounded by the observation that core-reduction strategies often chan-

ged over the course of a core's use-life as its size diminished (e.g., Baumlér, 1988; Dibble, 1995a; Monigal, 2003).

We certainly are not suggesting that these are trivial issues. Rather, we emphasize that it is imperative that all lithic analyses—not just the WABI—consider its potential impact. We see the WABI as a method imminently complementary to technotypological analysis rather than one meant to replace it. In other words, it constitutes one more analytical tool that can be used to generate more robust interpretations of archaeological samples. In this sense, the issue of sample bias remains as important as ever, but weaving WABI and technotypology together permits to extract the greatest amount of information about past life-ways from any and all samples analyzed by archaeologists, and thus to generate interpretations that can serve as departing points for future investigations of given sites and archaeological levels.

One of the main advantages of the analytical method employed here is that it can be applied in the same way to all the lithic assemblages of a site or series of sites irrespective of their typological labels, something which traditional systematics do not permit (e.g., applying Middle Paleolithic systematics to an Upper Paleolithic assemblage would have little meaning). Similarly, this defining characteristic of the WABI also limits its applicability to specific research questions. Because it assumes that the underlying mechanics of lithic technology have been largely constant over time, as have the fundamental energetics of lithic procurement, transport, and use (e.g., costs to carry and flake stone), WABI analysis highlights shifts in behavior across a *potentially* continuous range of variation. It would be a mistake to assume that this sort of analysis can only portray differences between assemblages as continuous. Rather, as we show below, WABI analysis can identify

both continuity and discontinuity in technological behavior in ways that traditional systematics cannot. Moreover, as argued elsewhere (i.e., Riel-Salvatore and Barton, 2004), this approach is well-suited to contextualizing the *behavioral meaning* of changes in lithic technology that descriptive approaches such as typology and *chaîne opératoire* reconstruction serve to highlight.

Technological change in the paleoanthropological record is often interpreted as *ipso facto* evidence for significant behavioral change, although descriptive methods by their very nature yield precious little in the way of relevant evidence to address such complex evolutionary issues. Approaches such as the WABI, in contrast, specifically address questions of behavioral import and help assess quantitatively whether change in lithic technology is behaviorally meaningful. For instance, while there are undeniable differences between Mousterian and Aurignacian lithic technology, technotypology contributes little in explaining how this change was significant in behavioral terms, and whether it conforms to any expectations of what aspects of behavior it can be expected to reflect. By focusing on one dimension that is critically important to all forager lifeways—namely mobility and the organization of technology—WABI offers a means to assess whether technological changes are paralleled by changes in mobility strategies, as they can legitimately be expected to be (see below). While the behavioral patterns highlighted through use of the WABI method will be positioned along a potential continuum, if significant differences in that aspect of prehistoric life exist, they should be manifest by Middle and Upper Paleolithic strategies occupying discretely clustered points along that continuum. This can be seen, for example, in the identification of mobility strategies for Epigravettian foragers in the Salento peninsula that are markedly distinct from those of earlier foragers (Riel-Salvatore and Barton, 2004, 2007).

In essence, the logic that underpins the use of the WABI method in diachronic comparisons of forager behavior is that any and all behavioral differences claimed to be documented archaeologically need to be demonstrated using directly comparable and behaviorally significant data. It is the next logical step to assess the meaning of prehistoric change in lithic technology evidenced by typotechnology to have occurred and *presupposed but not shown* to have evolutionary import.

Studies that have employed the WABI method diachronically have shown that by and large, mobility strategies in both the Middle and Upper Paleolithic seem equally flexible, with the main factor driving the preferential adoption of residential versus logistical mobility being responses to large-scale climatic variations (Barton, 1998; Riel-Salvatore, 2007; Riel-Salvatore and Barton, 2007). Because cave and shelter assemblages are very often time-averaged palimpsests of multiple occupations (Barton and Clark, 1993), and assemblage sequences in these sites span tens of millennia, proxy measures of land-use behavior are likewise time averaged on a multimillennial timescale. It is unsurprising then that past studies have evidenced a strong

correlation between changes in retouch frequency, artifact accumulation density, and broad intervals of climatic change (Barton, 1998; Kuhn, 1995; Riel-Salvatore and Barton, 2007; Rolland and Dibble, 1990).

In a recent paper (Riel-Salvatore and Barton, 2004), the same range of variation in climate and land-use relationships can be seen for all Late Pleistocene assemblages in southeastern Italy until the Last Glacial Maximum. After this point, hunter-gatherer land-use appears to shift decisively to a logistical land-use pattern characterized by the accumulation of very large assemblages of mainly unretouched lithics which are, interestingly, made almost exclusively on non-local, and even potentially exotic, raw material (see also Milliken, 1998). It would appear that demographic packing in southwestern Europe brought about by the LGM, favored technological and/or social adaptations among human foragers that were no longer a direct response to large-scale climatic fluctuations.

Lastly, in a recent paper, Riel-Salvatore and Barton (2007) suggest that this approach can also be used to link together sites prehistoric sites to model Pleistocene socioecological organization at regional scales. Penecontemporaneous Mousterian assemblages from sites in southeastern Spain that are in geographic proximity but in differing ecological contexts show complementary patterns that cluster at opposite ends of the curated-expedient spectrum. Based on these data, sites located on ecotones at relatively high elevation settings (i.e., Cova del Salt and Cova Beneito) likely served as logistical base camps task-sites while the low-elevation site of Cova Negra would have served as a logistical resource procurement site. Thus, it would appear that this method can also usefully be employed to reconstruct Paleolithic socioecological landscapes, provided that chronology and sedimentation rates are given adequate consideration.

While other recent studies have begun to emphasize the importance of the notion of volumetric artifact density and its relationship to retouch frequency (e.g., Kuhn, 2004), we are aware of only one, by Sandgathe (2005), that has employed the method summarized here. Overall, the data from four sites in southern France display patterns that closely match the model's expectations (see Sandgathe, 2005: Figs. 4.2 and 4.3). While Sandgathe's interpretation about the specific nature of the occupations represented by extremely dense assemblages with very few retouched pieces departs somewhat from ours (see discussion in Riel-Salvatore and Barton, 2004), it is important to stress that they are nonetheless perfectly accommodated by our concept of *effective raw material availability*. Under conditions of effective abundance, density will be higher and retouch frequency lower, and vice versa for conditions of effective scarcity. This explains why components of two distinct kinds of land-use patterns (i.e., residential base camps and task-sites *sensu lato*) have comparable WABI signatures and why logistical base camps will differ by orders of magnitude from quarry sites, despite all of them conforming to the same basic relationship between artifact density and frequency of retouched tools.

Table 2
Contextual and compositional information for the assemblages in the sample

Site and layer	Period	Area	Thickness	Volume	Retouched	Debitage	Cores	Total lithics
Mare Mousterian	MP	80	0.38	30.00	28	44	1	73
Valea Coacăzei Mousterian	MP	14	0.20	2.80	6	29	2	37
Gura Cheii Mousterian	MP	10	0.48	4.80	18	46	1	65
Bordu Mare Mousterian I	MP	8	0.20	1.60	10	63	1	74
Bordu Mare Mousterian II	MP	10	0.24	2.35	6	43	3	52
Bordu Mare Mousterian III a + b	MP	16.5	0.32	5.20	51	356	7	414
Bordu Mare Mousterian IIIc	MP	30	0.16	4.65	43	391	5	439
Bordu Mare Mousterian IIId	MP	30	0.12	3.60	25	205	8	238
Bordu Mare Mousterian IIIe	MP	12	0.14	1.68	9	59	1	69
Bordu Mare Mousterian IIIf	MP	16	0.22	3.44	6	61	3	70
Bordu Mare Mousterian IIIg	MP	27	0.23	6.21	24	198	3	225
Bordu Mare Mousterian III w/o nr.	MP	26	0.27	6.89	70	441	10	521
Bordu Mare Mousterian IV a	MP	28	0.28	7.70	19	127	1	147
Bordu Mare Mousterian IV b	MP	25	0.17	4.13	9	49	2	60
Curată I a	MP	47	0.40	18.80	10	34	1	45
Curată I b + c	MP	47	0.88	41.36	28	85	3	116
Curată II a	MP	47	0.18	8.46	10	31	0	41
Curată II b	MP	47	0.32	15.04	8	23	0	31
Curată II c	MP	47	0.34	15.98	16	38	2	56
Curată II d	MP	47	0.36	16.92	30	87	1	118
Spurcată	MP	31.4	0.30	9.42	18	29	1	48
Cioarei E	MP	49	0.35	17.15	22	167	2	191
Cioarei F	MP	49	0.30	14.70	4	59	3	66
Cioarei G	MP	49	0.20	9.80	14	137	4	155
Cioarei H	MP	49	0.20	9.80	12	245	4	261
Cioarei J	MP	49	0.50	24.50	5	129	4	138
Hotilor Mousterian	MP	14	0.20	2.80	25	155	29	209
Muierii Mousterian	MP	65	0.44	28.60	349	4936	269	5554
Livadita	MP	32	0.85	27.20	4	18	1	23
Mare Aurignacian	UP	80	0.15	12.00	67	173	10	250
Rasnov-Gura Cheii	UP	7.5	0.15	1.13	6	49	1	56
Mare Gravettian	UP	80	0.07	5.20	19	39	2	60
Rasnov-Gura Cheii Gravettian	UP	12.5	0.23	2.81	22	56	2	80
Ohaba Ponor Aurignacian	UP	10	0.17	1.65	3	18	0	21
Hotilor Aurignacian	UP	14	0.28	3.92	7	19	0	26
Muierii Aurignacian	UP	8	0.40	3.20	19	61	2	82
Hotilor Epigravettian	UP	60	0.17	10.20	86	1064	25	1175
Valea Coacăzei Gravettian	UP	12	0.23	2.70	1	10	0	11
Dealul Căuniței	MP	28	0.20	5.60	15	147	3	165
Seliste II	MP	12	0.10	1.20	6	15	0	21
Seliste I	UP	280	0.40	112.00	110	2494	65	2669
Cuca Aurignacian I	UP	226	0.10	22.60	111	609	11	731
Cuca Aurignacian III	UP	226	0.10	22.60	24	183	n/d	207
Dumbravita	UP	400	0.16	64.00	115	5086	77	5278

This approach has proven a very effective way to reanalyze assemblages collected over nearly two centuries of Paleolithic research around the western Mediterranean Basin to provide new information about Late Pleistocene human ecology and its dynamics. We extend this approach here to a reevaluation of lithic evidence from the Carpathian Mountains in Romania, both as a test of its further generalized applicability and to derive new behavioral information about the Middle–Upper Paleolithic transition in this important region from the results of a long history of research in this region.

Sites and assemblages analyzed

We focus this study on a series of sites that have yielded Middle and Upper Paleolithic assemblages, that were exca-

vated using reasonably current techniques with systematic recovery of all pieces, and that have been published in sufficient detail to be used for analysis. The 14 sites selected extend from east to west across the southern Carpathians (Fig. 1 and Table 1). Seven of these sites have both Middle and Upper Paleolithic assemblages, five have only Middle Paleolithic and two have only Upper Paleolithic assemblage. Four of the sites are open-air localities (counting the adjacent localities of Seliste I and II as a single site) and the rest are caves/rockshelters. Insufficient information for the type of analysis presented here (e.g., counts of all artifacts or volume of sediment excavated) was available for a few assemblages from the sites of Spurcata and Dumbravita; only assemblages with complete information are used. The details of the resulting sample of assemblages are presented in Table 2.

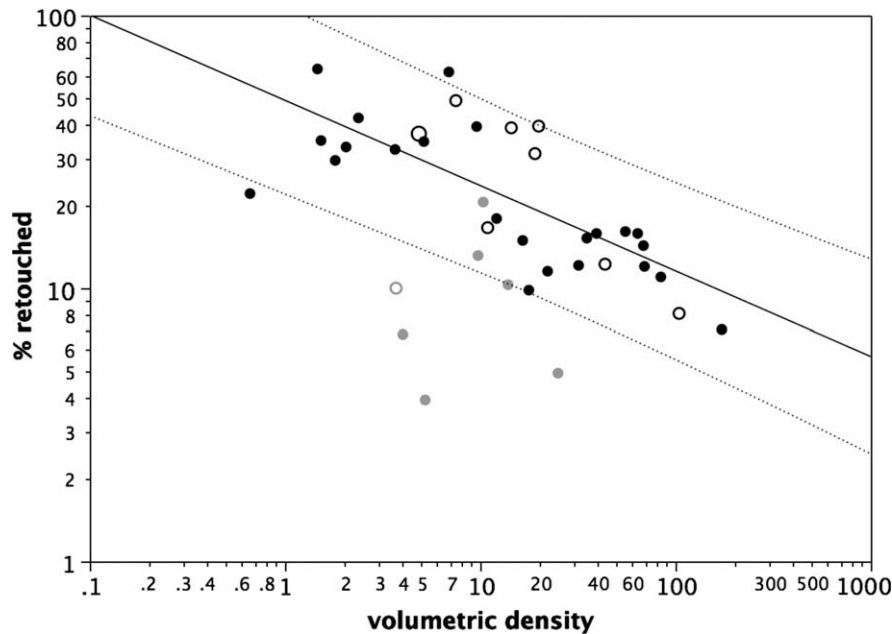


Fig. 2. All assemblages from cave sites. $r = -.74$ without outliers; $r = -.48$ with outliers (Cioarei and Valea Coacazii). Solid circles are Middle Paleolithic; open circles are Upper Paleolithic; grey circles (solid and open) are outliers.

The assemblages used in the analysis here were recently described typologically and technologically (Paunescu, 2001). The Middle Paleolithic assemblages in this area are considered to represent a regional variant of the Oriental Charentian (Cârciumaru, 1999; Gábori, 1976; Mertens, 1996; Paunescu, 1989, 2001), characterized by the dominant use of quartz and quartzite and the rare exploitation of fine-grained rock, such as flint. Typologically, the retouched artifacts of this industry are dominated by scrapers, notches and denticulates, but they also include some points and a limited number of bifacial pieces. Upper Paleolithic types such as endscrapers and burins are also present in small numbers. Technologically, the assemblages are characterized by the Pontinian split-pebble technique, and the debitage is described as non-Levallois and emphasizing the production of flake blanks. An exception is the assemblage from the open-air site of Dealu Căuniței, which has been attributed to a Typical Mousterian of Levallois debitage (Mogosanu and Cârciumaru, 1978; Paunescu, 2001). Cores appear in limited numbers, and include globular, discoid, amorphous, polyhedral, and Levallois forms, as well as some described as “quasiprismatic” and “quasipyramidal” (Cârciumaru, 1999; Moncel et al., 2002; Paunescu, 2001).

Upper Paleolithic assemblages from the sites in our sample have been assigned to the Aurignacian and Eastern Gravettian/Epigravettian technocomplexes. Raw materials differ from those common in the Middle Paleolithic, with a greater reliance on flint, opal and other fine-grained lithotypes. Unsurprisingly, technological differences with the Middle Paleolithic include debitage strategies oriented towards laminar and lamellar production, the higher incidence of prismatic cores, and the greater frequency of small

pieces (e.g., bladelets and microliths) in the Gravettian and Epigravettian assemblages. Several authors (e.g., Cârciumaru, 1999; Paunescu, 2001) have suggested a strong link between changing raw material use and the technological differences documented between the Middle and Upper Paleolithic of the region.

Typologically, the Upper Paleolithic assemblages are characterized by larger frequencies of endscrapers and burins, although they still include significant numbers of notches and denticulates. This is especially true for the Aurignacian. The microlithic component of Gravettian assemblages includes backed, truncated and bitruncated bladelets, as well as some *microgravette* points. The Epigravettian assemblage from Hotilor Cave also includes a number of geometrics, such as triangles, truncated trapezoids and rectangles (Mogosanu and Cârciumaru, 1978; Paunescu, 1989, 2001).

Results

For all assemblages in the sample, there is an overall strongly negative correlation between frequency of retouched pieces and artifact volumetric density ($r = -0.50$, $p = 0.0005$). However, this sample contains both cave and open-air sites, which are very different depositional environments. There are also two sites, Cioarei and Valea Coacazei that appear to be outliers compared to the other twelve, and these warrant further discussion (see also Figs. 6 and 8). The two assemblages from Valea Coacazei do not match the predicted relationship between density and retouch. However, one of the two assemblages is the smallest in the sample, with only one retouched and nine unretouched pieces, suggesting this aberrant pattern may

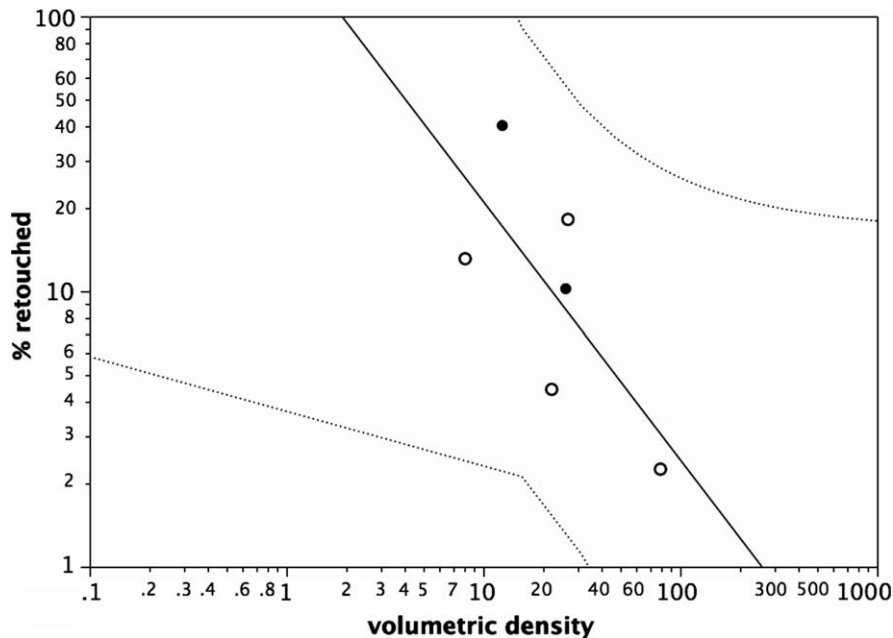


Fig. 3. All assemblages from open air sites $r = -.71$. Solid circles are Middle Paleolithic; open circles are Upper Paleolithic.

be due to a sample size problem. Although the sample size from Cioarei is reasonable, it derives from excavations by three different teams (in the 1950s, 1980s, and 1990s), each of which used different excavations strategies (Cârciumaru, 1980, 1999; Paunescu, 2000).

In Figs. 2 and 3, assemblages are divided into those from cave/rockshelter and open-air sites. For the cave sites, the outlier sites are shown in grey; r values are given with and without these outliers. Especially when cave and open-air sites are considered separately, and when the two outlier sites are excluded, the relationship between retouch frequency and artifact density is as strong as in other studies in which we have employed the method (see Riel-Salvatore and Barton, 2007). This is especially notable given that the sample of sites considered here extends across a very large region—much more extensive, in fact, than those investigated in previous studies using the WABI approach.

In other words, at the level of the Carpathians as a whole, variation in artifact volumetric density account for over half of the variability observed in the frequency of retouched pieces ($r = -.74$ for cave sites and $r = -.71$ for open air sites). Given that the majority of these assemblages were recovered several decades ago, it is likely that the relationship would in actuality even stronger if they had all been recovered using fully modern excavation methods. As noted in prior work (Barton, 1998; Riel-Salvatore and Barton, 2004, 2007; Villaverde et al., 1998), the very strong negative correlation between retouch frequency and artifact density indicates that these data can serve as proxy for prehistoric forager land-use, especially mobility strategies and the nature of site occupancy. We should also reiterate, however, that the assemblages discussed here most likely represent time-averaged palimpsests. In this sense, they serve as good proxies for the predominant

land-use strategy of the occupations that produced an assemblage, but they usually cannot provide information about the behaviors of a specific social group at a particular moment in time.

In applying WABI analysis to assemblages from multiple sites across a geographically extensive region, we differ from most of our previous work that generally focused on patterning within individual sites (Barton, 1998; Riel-Salvatore and Barton, 2004, 2007; but see Villaverde et al., 1998). However, the results remain very robust. Nevertheless, in order to assess whether differences in excavation strategies (spatially extensive excavation vs. *sondages* or differences in stratigraphic resolution) might have biased the results, we also compared retouch frequency with area excavated and excavated unit thickness. In neither case do we find significant correlations. A log log regression of retouch vs. area produced $r = 0.15$ ($p = 0.37$) and log log regression of retouch vs. thickness produced $r = 0.12$ ($p = 0.52$) with outliers Cioarei and Valea Coacazei excluded. A simple linear regression returned equally insignificant values as did dividing the sites into cave and open air contexts. Lastly, a linear regression shows only a weak negative relationship between count of retouched tools and the frequency of retouched pieces ($r = -0.39$, $p = 0.009$) in the assemblages in our sample, indicating that the relationship identified by the WABI is not conditioned by assemblage size or excavation area.

With respect to diachronic behavioral changes across the Middle–Upper Paleolithic transition, it is important to note the high degree of overlap between technological organization strategies and associated land-use patterns displayed by Mousterian and Upper Paleolithic assemblages (including the outlier assemblages) along the curation continuum defined by the regression lines of Figs. 2

and 3. In both periods, we document curated and expedient assemblages, along with some that fall somewhere in-between those two poles. This is even more clearly seen in Figs. 4 and 5, which compare retouch frequency and artifact volumetric density for Middle and Upper Paleolithic assemblages. An analysis of variance shows Middle and Upper Paleolithic assemblages to be identical with

respect to these measures. Overall, this suggests that there is no apparent qualitative difference in the range of land-use strategies employed by the hominin groups responsible for manufacturing and accumulating the assemblages analyzed here. This observation, in turn, suggests a lack of marked changes in the organization in technology or mobility strategies in the southern Carpathians throughout

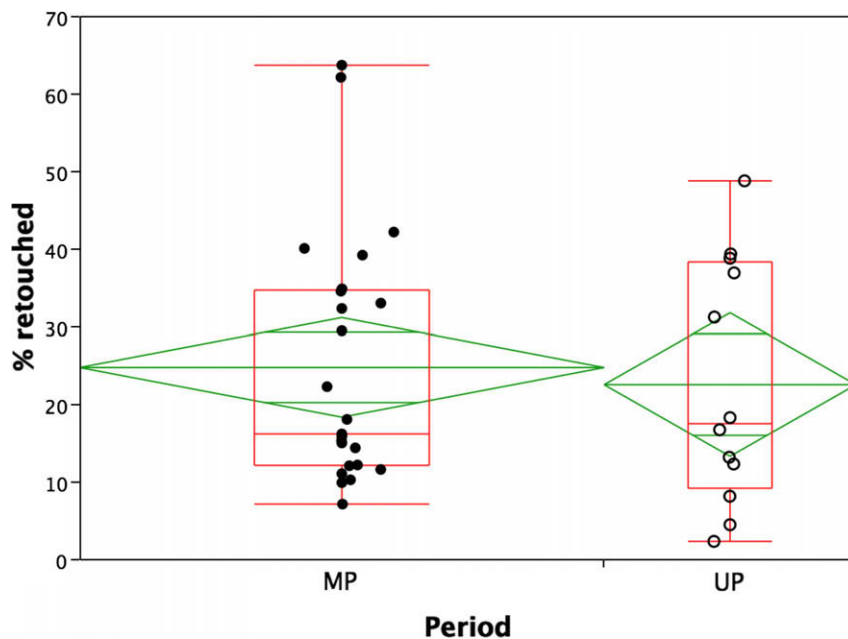


Fig. 4. Comparison of retouch frequency for Middle and Upper Paleolithic assemblages. ANOVA: $p = 0.69$ excluding assemblages from outliers (Cioarei and Valea Coacăzei) in Fig. 2. Boxplots show median, midspread, and range. Mean diamonds show mean (center horizontal line), 95% confidence intervals (upper and lower horizontal lines), and standard deviations (upper and lower points of the diamond). Widths of boxes and diamonds is proportional to sample size.

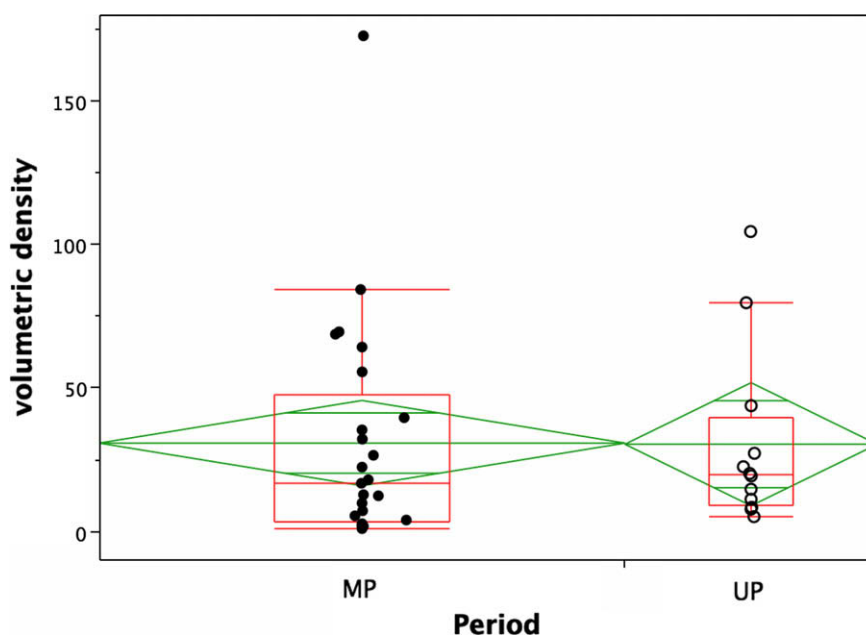


Fig. 5. Comparison of artifact volumetric density for Middle and Upper Paleolithic assemblages. ANOVA: $p = 0.98$ excluding assemblages from outliers (Cioarei and Valea Coacăzei) in Fig. 2.

most of the Late Pleistocene, including over the Transition Interval. While other aspects of the archaeological record of the region may well have changed over that interval, it is noteworthy that one of the most fundamental aspects of hunter–gatherer lifeways (if not *the* most important one, as mobility conditions and responds to the need to acquire the resources crucial for survival) does not appear to have been affected as a result.

It should be clear from the onset that continuity in land-use strategies does not demonstrate a *de facto* continuity—cultural, behavioral, or genetic—between the hominins responsible or manufacturing Middle and Upper Paleolithic industries. However, in light of the history of research on the transition between the two periods, demonstrable similarity in mobility patterns across this typological boundary is a very important observation since at least three lines of evidence suggest that they should be characterized by different mobility strategies.

First, it has been repeatedly argued that Upper Paleolithic lithic technology evidences more lithic curation than that of the Mousterian (e.g., Binford, 1973), whether manifest by more careful shaping of tools following mental templates, or by heavier retouch on these implements (Bar-Yosef, 2002, 2007; Mellars, 1989, 1996, 2005). From the perspective adopted here, an emphasis on curated technology indicates a higher degree of overall mobility. Second, the oft-mentioned claim that long-distance raw material procurement and transport clearly distinguishes the social and natural geographies of the Middle and Upper Paleolithic implies that Upper Paleolithic foragers moved over greater distances than Mousterian ones (e.g., Bar-Yosef, 2002, 2007; Féblot-Augustins, 1993, 1997; Gamble, 1999; Mellars, 1996, 2005). While it has been claimed that this shift represents primarily an expansion of social geography and indirect procurement through trade and/or exchange (Gamble, 1999, 2007), recent modeling shows this not to be a prerequisite to explain such patterns, at least in the Early Upper Paleolithic (e.g., Brantingham, 2003, 2006). Lastly, the higher population densities of Upper Paleolithic hominins, extrapolated from site density, faunal exploitation patterns and the development of organic hunting and decorative technologies (e.g., Conard, 2006), also imply an overall higher degree of mobility than in the Mousterian. This is a correlate of the observation that higher populations deplete given resource patches faster than comparatively less dense ones (Kelly, 1995; Binford, 2001). Indeed, the very fact that the development of new technologies is associated with the exploitation of increasingly lower-ranked prey with the beginning of the Upper Paleolithic suggests that individual resource patches were increasingly stressed and that increased mobility would have been one of the solutions to this dietary quandary (Stiner and Kuhn, 2006).

In sum, prior research presupposes—albeit often implicitly—that Upper Paleolithic populations should be more mobile overall than Mousterian ones. Testing this idea has, however, proven difficult up to now, due largely to

the absence of methods to directly compare the mobility patterns reflected by Middle and Upper Paleolithic assemblages. The method employed in this study permits such a comparison but shows that the expectation that Middle and Upper Paleolithic mobility should differ qualitatively is not borne out.

The sites included in this study span a region of over 38,000 km², extend across the breadth (from east to west) of the southern Carpathians, and are located in different ecological settings. They also span a period of considerable climatic change in the Late Pleistocene, even argued by some to have been the most unstable of the Pleistocene (Finlayson, 2004). Even though retouch–density relationships are surprisingly strong over this large area and environmentally variable time span, it is useful to examine such variation in lithic technology with respect to geography and environment to better understand its significance for human ecology.

Geographical analysis

Contrary to the situation in the Salento (Riel-Salvatore and Barton, 2004), raw material quality does not appear to have a strong impact on the WABI signature of Late Pleistocene assemblages in the southern Carpathians. The geography of the region and diachronic climatic change, in contrast, appear to have been determinant factors. Geographically, the sites in this study fall into three clusters (Fig. 1 and Table 1): a southwestern group (cluster 1), a western group (cluster 2), and an eastern group (cluster 3). Figs. 6–8 display retouch–density patterns for sites within each cluster. Dividing the assemblages in this way slightly improves the strong retouch–density relationships, but more importantly, it reveals other information about land-use patterns that warrant further discussion. In some cases site-use appears to change over time, with some assemblages at a site indicative of short-term occupations by more residentially mobile groups (low artifact density and higher retouch frequency), and others representing longer occupations that generated higher artifact densities and fewer retouched tools. As discussed below, this suggests that as climate and other dependent environmental conditions in the vicinity of a site changed, humans made use of the locality in different ways. This is most apparent for cluster 1 (Fig. 6), where assemblages from Hotilar and Muierii span much of the range of curation/land-use behaviors. Importantly, in certain cases, it is the Middle Paleolithic assemblages that are the most curated while in others, it is the Upper Paleolithic ones. The assemblage from the open-air site of Dealu Caunitei is centrally located along the continuum from more curated to more expedient. The single Livadita assemblage, on the other hand, appears to represent residues of highly mobile occupants—either residentially mobile foragers or a special-purpose site occupied for limited duration.

In other cases, the way in which a particular site was used seems to remain fairly stable through time. Currently, it is not clear whether this means that a site was only occu-

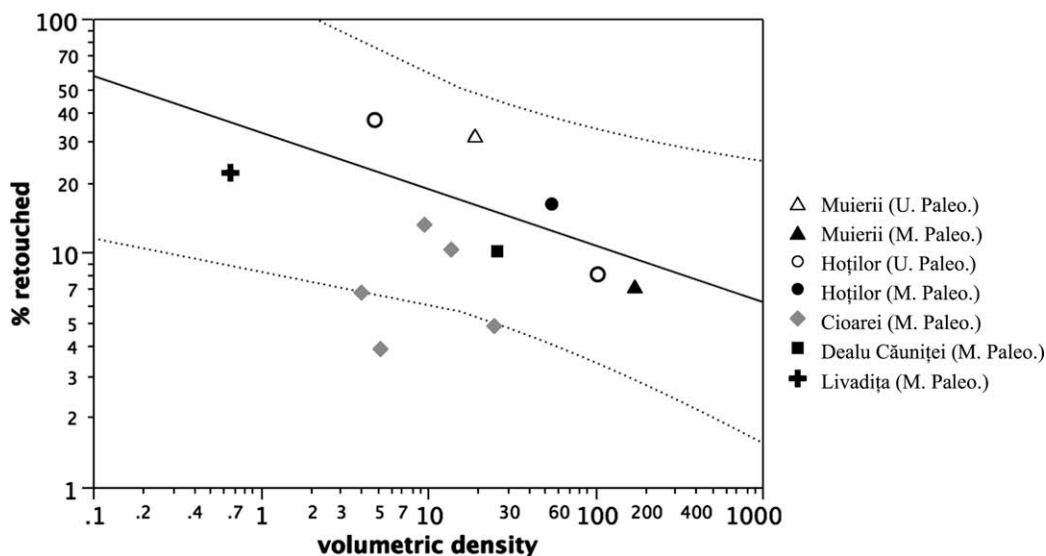


Fig. 6. Assemblages from cluster 1 sites. $r = -.70$ without outliers (Cioarei).

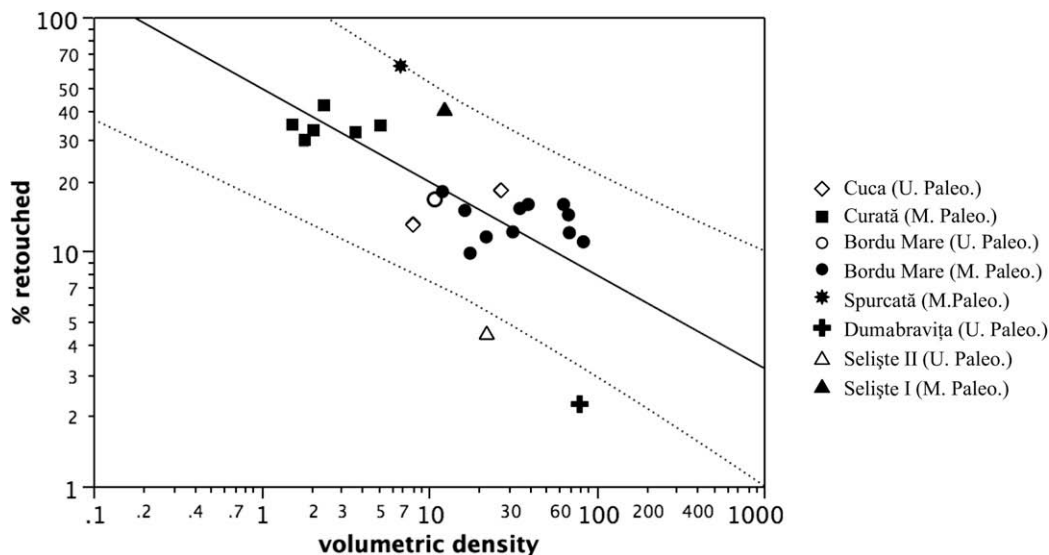


Fig. 7. Assemblages from cluster 2 sites. $r = -.69$ for all sites; $r = -.76$ for cave sites only.

pped under a particular set of climatic conditions or whether it was used in a similar way under different environmental conditions. This is most apparent in cluster 2, which includes Curată, Spurcată and Bordu Mare Caves and the open-air localities of Seliște I and II, Dumabravița, and Cuca. Differential use patterns from these sites allow us to begin to create a model of an articulated Paleolithic socioecosystem, similar to a model proposed for the Mousterian of Mediterranean Spain (Riel-Salvatore and Barton, 2007). We emphasize at the outset that while the sites in cluster 2 exemplify the kind of variation that would have been seen across the Late Pleistocene landscape in the southwestern Carpathians, we lack sufficient chronological controls to unambiguously assert that the particular assemblages studied here are residues from a coherent, contemporaneous settlement system.

The assemblages from the cluster 2 cave sites fall into two groups (Fig. 7), one comprising curated assemblages from the low-altitude sites of Curată and Spurcată Caves and the other comprising largely expedient assemblages from Bordu Mare Cave, located at 650 m asl. With high artifact densities and low retouch frequencies, Bordu Mare may have served mainly as a logistical home base located on a high point overlooking the valley landscape where Curată and Spurcată are found. The later two sites might have thus been used as resource-procurement sites, maybe hunting camps, from which needed resources would be brought back to a home base like Bordu Mare, some 20 km away. The open-air sites of Cuca, Dumabravița, and Seliște I and II are aligned along a much steeper regression line (Fig. 7). Along this continuum, Cuca, and especially Dumabravița and Seliște II lie at the more expe-

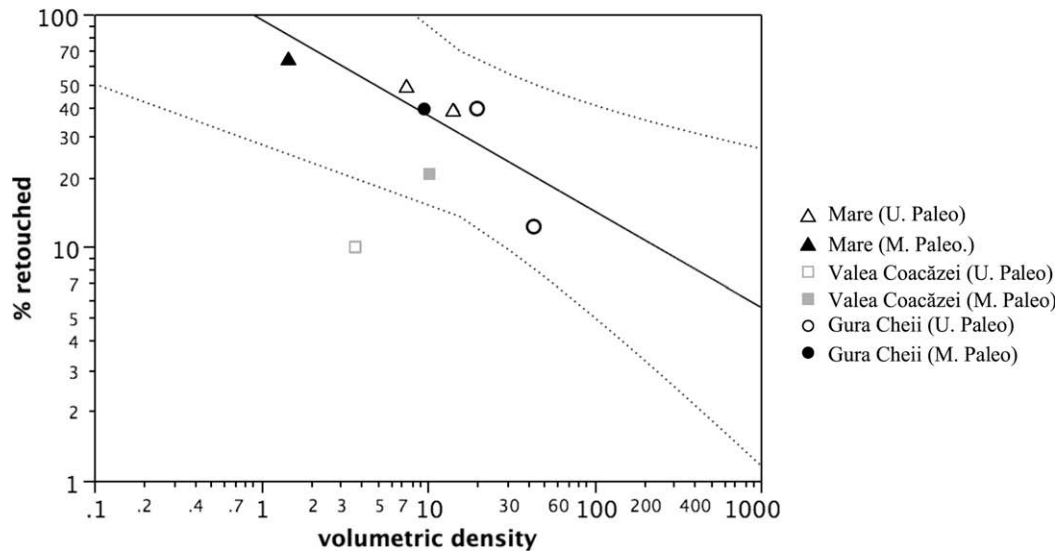


Fig. 8. Assemblages from cluster 3. $r = -.83$ without outliers (Valea Coacăzei).

dient end of the spectrum with lower retouched frequencies than Bordu Mare, while Seliște I groups more with the occupation patterns of Curată and Spurcă.

The sites of cluster 3 pattern in a way intermediate between those of clusters 1 and 2. These three sites are located at the highest elevations of the sample studied here. Assemblages from Gura Cheii cave (altitudinally the lowest of the three sites at 750 m) tend toward the more expedient end of the continuum and are roughly on par with Bordu Mare in cluster 2, while those of much higher Mare cave (950 m) seem to indicate more short-term occupations and higher mobility, like Curată in cluster 2. However, the assemblages of Gura Cheii and Mare overlap slightly with respect to retouch frequency and artifact density. The very small Upper Paleolithic assemblage from Valea Coacăzei is difficult to interpret, but the larger Middle Paleolithic assemblage matches those of the other two sites of the cluster and, at 864 m, lies altitudinally between the other two as well.

Climatic analysis

The variation in site occupation patterns with altitude reinforces the apparent importance of environmental conditions in structuring both local site occupation and broader land-use strategies. Besides varying geographically, environmental parameters varied temporally with global climatic change during the Late Pleistocene. Human foragers respond to environmental change through an integrated suite of organizational land-use strategies, including shifting between logistical and residential mobility, varying the frequency of distance of moves, varying social group size and composition, and diversifying or specializing diet. Such organizational shifts have been noted for Late Pleistocene hominins elsewhere (Barton et al., 1994, 1998; Jochim, 1998; Lieberman, 1998; Lieberman and Shea, 1994; Marks and Freidel, 1977; Riel-Salvatore and Barton,

2004; Shea, 2003; Stiner and Kuhn, 1992; Wallace and Shea, 2006), and the kinds of analyses presented here are allowed us to track such changes in the southern Carpathians.

For the sites studied here, sedimentological analyses are available in a few cases, but are of uneven quality. Similarly, published zooarchaeological data are handicapped by variable quality of the reported information and, especially, by the overwhelming abundance of cave bear remains in most of the assemblages studied here. There are additional problems inherent in deriving accurate climatic reconstruction from samples of large mammal remains, especially given that the available sample is likely impacted by hominin hunting preferences.

Fortunately, there are a number of recent studies of the microfaunal assemblages associated with many of our assemblages (Chaline, 1987; Paunescu, 1996; Paunescu and Abassi, 1996; Radulescu and Samson, 1992; Terzea, 1971, 1987). Because of the sensitivity of microfaunal communities to changes in climatic regime and because they are not accumulated by humans, they offer the most reliable source of paleoenvironmental information for the southern Carpathian sites discussed here. Based on this work, assemblages for which microfaunal information was available were separated into “cold/continental” and “temperate” groups in order to assess the potential influence of climatic conditions on land-use strategies. Because of the strong correlation between artifact density and retouch frequencies, the latter variable alone was used here as a proxy measure of residential mobility, with high frequencies indicating residential land-use patterns and low frequencies indicating a prevalently logistical land-use strategy (see Riel-Salvatore and Barton, 2004 for additional discussion).

Fig. 9 displays retouch frequency under different climatic regimes. Land-use strategies clearly vary under different climatic conditions, with temperate conditions associated predominantly with lower residential mobility (mean retouch frequency = 14.50%) and colder conditions

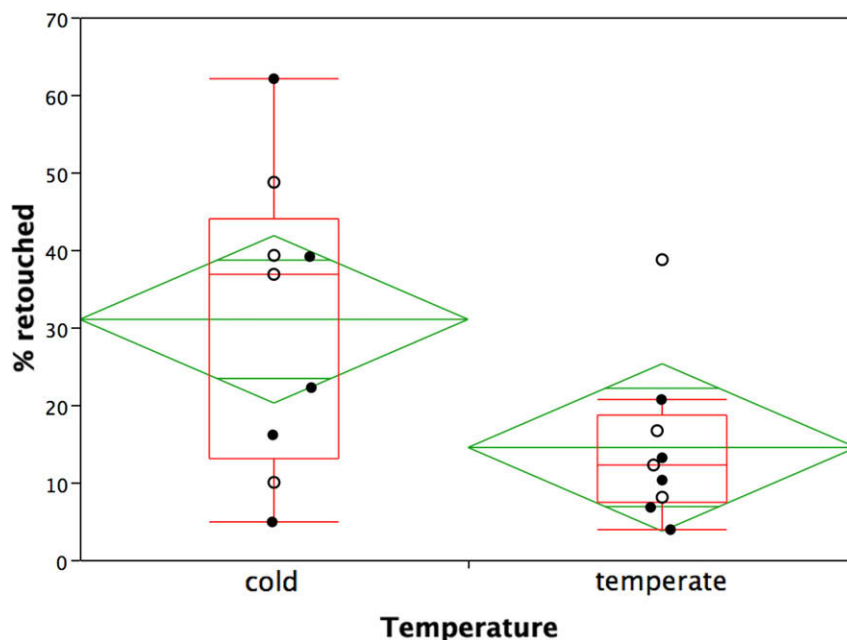


Fig. 9. Comparison of assemblages with microfauna associated with cold and temperate climatic regimes. ANOVA: $p = 0.04$ using assemblages from all sites with microfaunal data, including outliers (Cioarei and Valea Coacazii) in Fig. 2; $p = 0.07$ without outliers.

displaying both evidence of higher mobility and greater variance in mobility (mean retouch frequency = 31.03%). The higher variance in retouch frequency for colder climate suggests that greater mobility is also associated with greater diversity in occupational patterns—a sign of more logistical mobility, with sites that vary in terms of the range of activities and length of occupation. In spite of a relatively modest sample size of 18 assemblages, (or 12, if outliers are excluded), these results conform to the expectations of our model, and agree well with results from previous studies which have employed this method (Barton, 1998; Riel-Salvatore and Barton, 2007). This suggests that, in continental Eastern Europe as in the western Mediterranean, large-scale climatic fluctuations are a much better predictor of land-use strategies adopted by Late Pleistocene hunter-gatherers, than the typotechnological classification of the lithic industry (i.e., Middle or the Upper Paleolithic).

Discussion and conclusions

The results of this analysis of Middle and Upper Paleolithic assemblages from selected sites from the Southern Carpathians show that the two periods appear identical in terms of land-use strategies, organizational flexibility and, consequently, lithic technological organization. The patterns observed suggest that, rather than varying temporally, behaviors such as technoeconomic strategies, artifact curation intensity and land-use strategies seem more closely tied to environmental variation as reflected in a combination of geography, paleoenvironment and topography. This is very much in agreement with the results of studies conducted in other areas using the same method (Barton,

1998; Villaverde et al., 1998; Riel-Salvatore and Barton, 2004, 2007). This is unsurprising since human–environment relationships are mediated by technology, which conditions behavioral responses to ecological conditions as well as to resource abundance and availability. In other words, changing human land-use behavior effectively changes the environment of selection for hominins and their lithic technology, conceptualized as an integral component of the interface between humans and the natural world. As such, it is to be expected that foragers should pattern movement across their landscapes in comparable ways even in very different ecological contexts.

Importantly, this study also demonstrates that the applicability of the WABI method is not dependent on regional conditions, as it has now been used to yield insights about prehistoric behavior over a very large area and in markedly different geographical, cultural and topographical areas (see also Sandgathe, 2005). These include coastal and continental Europe, lowland and highland locations, caves/rockshelters and open-air sites, and—perhaps most significantly—both Middle and Upper Paleolithic deposits. This is not to say that there were no behavioral changes or differences between the two periods. However, as concerns lithic industries, those distinctions seem to have been largely limited to formal aspects of specific lithic elements as opposed to a fundamental reconceptualization of how lithic technology articulated with land-use strategy, a fundamental aspect of hunter-gatherer life.

The results of our study therefore suggest a broad level of behavioral continuity across the boundary usually referred to as the Middle–Upper Paleolithic transition, while not negating the importance of changes in the artifactual record of the period. These behavioral data comple-

ment those from other recent studies on the Early Upper Paleolithic in Eastern Europe and beyond that increasingly suggest a degree of technotypological continuity between regional variants of the Late Middle Paleolithic and the Early Upper Paleolithic in some regions (e.g., Kozłowski, 2004; Svoboda, 2004; Vishnyatsky and Nehoroshev, 2004). One conclusion that derives from this wealth of new, multifaceted information is that the process of the transition appears to have been much more gradual in Eastern Europe than has traditionally been thought, and that it is crucially important to meticulously study this process at various regional scales before proposing grand narratives about abrupt cultural change that invoke biological replacement as a prime mover (e.g., Bar-Yosef, 2002; Mellars, 2004, 2005). Another conclusion of this study is that ecological fluctuations, ultimately linked to prehistoric climatic change, likely were much more important determinants of this process (see also Finlayson, 2004 and papers in van Andel and Davies, 2003).

In sum, this paper has demonstrated the heuristic validity of the WABI method as a means to reconstruct time-averaged land-use patterns over the European landmass and across very different geographical and ecological zones. This underscores its widespread applicability as a powerful tool to inform us about the lifeways of Paleolithic hominins and as an objective method to compare prehistoric behavior across traditional typologically-defined ‘cultures’ and periods. As well, with regards to the Middle–Upper Paleolithic transition, a large and wide-ranging sample of Late Pleistocene lithic assemblages from the southern Carpathians strongly suggests that, in this region as in others (see Riel-Salvatore and Barton, 2007), that interval was not characterized by marked differences in the flexibility of technoeconomic choices and land-use exploitation patterns. Considered in their broader ecological and climatic contexts, these data further allow us to recast the transition as only a segment in a much longer sequence of events leading to the technological developments and demographic pulses associated with the LGM rather than a qualitative “behavioral revolution.” We hope that these results, along with those from other large-scale research projects about the population and climatic dynamics of the Eurasian Late Pleistocene (e.g., van Andel and Davies, 2003), will stimulate other researchers to take a fresh look at the available data in order to examine the Middle–Upper Paleolithic transition as a complex of regional-scale, biobehavioral processes, rather than a simply biologically-driven event.

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